सार्वजनिक खरिद ऐन २०६३ को दफा ६५ को उपदफा (१) को खण्ड (ग) ले दिएको अधिकार बमोजिम
सार्वजनिक खरिद अनुगमन कार्यालयबाट जारी गरिएको

(Issued by the Public Procurement Monitoring Office in accordance with the authority given by clause (c) of Subsection (1) of Section 65 of the Public Procurement Act, 2063)

STANDARD BIDDING DOCUMENT (SBD)

Procurement of Works

National Competitive Bidding (NCB)

Single-Stage: Two-Envelope Bidding Procedure

[Procurement of value above NRs. 20 Million]

Government of Nepal

Office of The Prime Minister and Council of Ministers

Public Procurement Monitoring Office (PPMO)

~~**(Revised on July 2026)**~~
~~**(Revised on 12 August 2026)**~~
(Revised on September 2026)

Guidance Notes on the Use of The Standard Bidding Document (SBD)

This Standard Bidding Document for Procurement of Works, has been prepared by the Government of Nepal (GoN), Public Procurement Monitoring Office (PPMO) to facilitate Single-Stage: Two-Envelope Bidding Procedures used for the procurement of Works through National competitive bidding (NCB) procedure (Procurement of value above NRs. 20 million) and is applicable to all the Public Entities as defined in the Public Procurement Act, 2063.

Guidance notes in the Standard Bidding Document within the left square bracket and right square bracket and guidance footnotes are intended as information for preparing the bidding documents and hence should be deleted in the final document.

This document has 10 Sections, of which Section I (Instructions to Bidders) and Section VIII (General Conditions of Contract) must not be altered or modified under any circumstances. The Invitation for Bid (IFB) is a copy for advertisement that provides relevant and essential information to help the Bidders to decide whether or not to participate in the particular bidding process; this is provided in the Biding Document for information only.

The Procuring Entity should provide its specific needs in the Bid Data Sheet (BDS), the Special Conditions of Contract (SCC) and the detailed requirements of the procurement in the Works Requirements.

This Standard Bidding Document, when properly completed should provide all the information that a Bidder needs in order to prepare and submit a bid. This should also provide a sound basis on which a Procuring Entity can fairly, transparently and accurately carry out evaluation of the Bids received from the bidders.

The Procuring Entity, before publishing the Invitation for Bids, should identify and approve from the competent authority the procurement requirements, its technical features, and cost estimate. Furthermore, the Procuring Entity should keep in mind the availability of the budget and possible slicing and packaging of the procurement requirements.

If any amendments on Public Procurement Act, 2063 or Public Procurement Regulation, 2064 are made, the Procuring Entity shall incorporate such amendments when preparing a particular Bidding Document.

Brief description of different sections of the Standard Bidding Document and how a Procuring Entity should use these when preparing a particular Bidding Document is detailed below:

SECTION I
Instructions to Bidders (ITB)

This Section provides relevant information to help the Bidders to prepare their Bids. Information is also provided on the submission, opening, and evaluation of Bids and on the award of Contract.

The Instructions to Bidders (ITB) specify the procedures that regulate the bidding process. The ITB contain standard provisions that have been designed to remain unchanged and to be used without modifying their text. The ITB clearly identify the provisions that may need to be specified for a particular bidding process and require that such specification be introduced through the BDS.

The Instructions to Bidders are not a Contract document and, therefore, are not a part of the Contract.

SECTION II
Bid Data Sheet (BDS)

The Bid Data Sheet (BDS) contains information and provisions that are specific to each bidding process. The Employer must specify in the BDS provisions that supplement the information and requirements specified in Section I, Instructions to Bidders. All information shall be provided; no clause shall be left blank.

To facilitate the preparation of the BDS, the clauses in the BDS format are numbered with the same numbers as the corresponding ITB clauses. The instructions included in the BDS are to guide the Employer on how to enter all required information.

SECTION III
Evaluation and Qualification Criteria (EQC)

The purpose of the Evaluation and Qualification Criteria (EQC) is to specify the criteria that determine the substantially responsive bid closest to the Average Bid Price and the qualifications of the Bidder to perform the contract. The Procuring Entity shall prepare the EQC by taking into account the nature, quantity and or amount of the procurement and include it as a part of the Bidding Document. In determining the Evaluation and Qualification Criteria, the Procuring Entity shall follow the guidance incorporated on this section and shall not limit the competition or make onerous criteria.

The EQC is not a part of the Contract document.

SECTION IV
Bidding Forms

This Section contains the forms which are to be completed by the Bidder and submitted as part of his Bid.

This Section provides the standard format for the Letter of Technical and Price Bid, table of price adjustment data, Bid Security Form, Technical proposal form, Bidder's information and qualification forms to be submitted by the Bidder.

SECTION V
Eligible Countries

This section contains the list of eligible countries. The procuring entity shall mention the list of eligible countries as per the instructions provided in this section.

SECTION VI
Works Requirements

This section contains the volumes of information that describe the Works to be constructed and includes Specification, the Drawings, and supplementary information that describe the Works to be procured Personnel Requirements and Equipment Requirements.

SECTION VII
Bill of Quantities (BOQ)

This Section provides estimated information on the itemized quantities in sufficient detail to distinguish between the different classes of Works to be performed by the bidder and enable to the Bidder to prepare priced bill of quantities efficiently and accurately.

SECTION VIII
General Conditions of Contract (GCC)

The GCC contain standard provisions that have been designed to remain unchanged and to be used without modifying their text. This Section provides the General Conditions of Contract that will apply

to the Contract for which the Biding document is issued. The GCC clearly identify the provisions that may normally need to be specified for a particular bidding process and require that such information be introduced through the SCC

SECTION IX
Special Conditions of Contract (SCC)

The contents of this Section supplement Section VIII: General Conditions of Contract. The Special Conditions of Contract shall be prepared by the Procuring Entity.

The Special Conditions of Contract (SCC) contain provisions that the GCC require be specified for a particular bidding process. The Employer should include at the time of issuing the Bidding Document, all information that the GCC indicate shall be provided in the SCC. No SCC Clause should be left blank.

To facilitate the preparation of the SCC, the Clauses in the SCC format are numbered with same numbers as the corresponding GCC Clauses. The instructions included in the SCC are to guide the Employer to provide the required information.

The SCC is a part of the Contract Document; therefore, the Procuring Entity shall provide the information in appropriate manner as indicated in the SCC.

SECTION X
Contract Forms

This Section contains the Sample format for Letter of Intent, Letter of Acceptance, Contract Agreement Form, the forms for Performance Security, Advance Payment Security and Retention Money Security.

BIDDING DOCUMENT

for

THE PROCUREMENT OF Construction of Belchautara Co-Financing Water Supply Project, Shuklagandaki Municipality, Tanahun (Package-II)

WSSMOLMG/NCB/Works/083/84-05

National Competitive Bidding (NCB)

Single-Stage: Two-Envelope Bidding Procedure

Water Supply and Sewerage Management Office, Lamjung

Issued on: 23-09-2026 00:00

Invitation for Bids No.: WSSMOLMG/NCB/Works/083/84-05

NCB No.: 5

Contract Identification No.: WSSMOLMG/NCB/Works/083/84-05

Abbreviations

BD ..... Bidding Document

BDF ..... Bidding Forms

BDS ..... Bid Data Sheet

BOQ ..... Bill of Quantities

COF ..... Contract Forms

DP ..... Development Partners

DoLI ..... Department of Local Infrastructure

e-GP ..... Electronic Government Procurement

ELI ..... Eligibility

EQC ..... Evaluation and Qualification Criteria

EXP ..... Experience

FIN ..... Financial

GCC ..... General Conditions of Contract

GoN[1] ..... Government of Nepal

ICC ..... International Chamber of Commerce

IFB ..... Invitation for Bids

ITB ..... Instructions to Bidders

JV ..... Joint Venture

LIT ..... Litigation

NCB ..... National Competitive Bidding

NRs. ..... Nepalese Rupees

PAN ..... Permanent Account Number

PPA ..... Public Procurement Act

PPMO ..... Public Procurement Monitoring Office

PPR ..... Public Procurement Regulations

PL ..... Profit & Loss

PS..... .....Provisional Sum

SBD ..... Standard Bidding Document

SCC ..... Special Conditions of Contract

TS ..... Technical Specifications

VAT ..... Value Added Tax

WRQ ..... Works Requirements

[1] "GoN" word indicates all public entities according to Public Procurement Act, 2063

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Invitation for Bids

Government of Nepal (GoN)

Ministry of Infrastructure Development

Department of Water Supply and Sewerage Management

Water Supply and Sewerage Management Office, Lamjung

Invitation for Bids No: WSSMOLMG/NCB/Works/083/84-05

Date of publication: 23-09-2026 00:00

1. ***The Government of Nepal [GoN] has allocated funds or received a loan/credit/grant*** from ***[GoN/or other public entity if applicable or Development Partner]*** towards the cost of ***Belchautara Co-Financing Water Supply Project, Shuklagandaki Municipality, Tanahun*** and intends to apply part of the funds to cover eligible payments under the Contract ***for Construction of Belchautara Co-Financing Water Supply Project, Shuklagandaki Municipality, Tanahun (Package-II) (*****WSSMOLMG/NCB/Works/083/84-05*****)*** Bidding is open to all eligible as per Section V of bidding document.

2. ***Water Supply and Sewerage Management Office, Lamjung*** invites sealed bids from eligible bidders for the construction of ***Construction of Belchautara Co-Financing Water Supply Project, Shuklagandaki Municipality, Tanahun (Package-II)*** under National Competitive Bidding – Single Stage Two Envelope Bidding procedures.

   Only eligible bidders with the following key qualifications should participate in this bidding:

   - Minimum Average Annual Construction Turnover of the best 3 years within the last 10 years: ***NRs. 5,35,00,000.00***
   - Minimum Work experience of similar size and nature: ***NRs. 2,14,00,000.00***

3. Under the Single Stage, Two Envelope Procedure, Bidders are required to submit simultaneously two separate sealed envelopes, one containing (i) the Technical Bid and the other (ii) the Price Bid, both in turn enclosed in one sealed envelope as per the provision of ITB 21 of the Bidding Document.

4. Eligible Bidders may obtain further information and inspect the Bidding Documents at the office of ***Water Supply and Sewerage Management Office, Besishahar-8, Lamjung, Gandaki Province, Nepal, Telephone Number: 066-520110.***

5. A complete set of Bidding Documents may be purchased from the office ***Water Supply and Sewerage Management Office, Besishahar-8, Lamjung, Gandaki Province, Nepal*** by eligible Bidders on the submission of a written application, along with the *copy of company/firm registration certificate*, and upon payment of a non-refundable fee of ***NRs. 5000*** till ***13-10-2026 during office hours*** in the account as specified below.

   Information to deposit the cost of bidding document in Bank:

   Name of the Bank: Rastriya Banijya Bank Ltd.
   Name of Office: Revenue FCGO TSA
   Office Code no.: 337053701
   Account no.: 1000100200010000
   Rajaswa (revenue) Shirshak no.: 14229

6. Pre-bid meeting shall be held at ***Water Supply and Sewerage Management Office, Besishahar-***

8, Lamjung, Gandaki Province, Nepal, *at 05-10-2026 13:00*

7. Sealed bids must be submitted to the office ***Water Supply and Sewerage Management Office, Besishahar-8, Lamjung, Gandaki Province, Nepal*** by hand/courier before ***12:00*** on ***14-10-2026.*** Bids received after this deadline will be rejected.
8. The bids will be opened in the presence of Bidders' representatives who choose to attend at ***14-10-2026 14:00*** at the office of ***Water Supply and Sewerage Management Office, Besishahar-8, Lamjung, Gandaki Province, Nepal.*** Bids must be valid for a period of ***90*** *from* the bid submission deadline and must be accompanied by a bid security amounting to a minimum of **NRs. 14,00,000.00,** which shall be valid for 30 days beyond the validity period of the bid ***(i.e. 11-02-2027)***
9. If the last date of purchasing and /or submission falls on a government holiday, then the next working day shall be considered as the last date. In such case the validity period of the bid and bid security shall remain the same as specified for the original last date of bid submission.

Part I: BIDDING PROCEDURES

Section I: Instructions to Bidders (ITB)

This section specifies the procedures to be followed by Bidders in the preparation and submission of their Bids. Information is also provided on the submission, opening, and evaluation of bids and on the award of contract.

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Section I. Instructions to Bidders

A. General	
1. Scope of Bid	1.1 In connection with the Invitation for Bids **indicated in the Bid Data Sheet (BDS)**, the Employer, **as indicated in the BDS**, issues this Bidding Document for the procurement of Works as specified in Section VI (Works Requirements). The name, identification, and number of lots (contracts) / multiple contracts of the National Competitive Bidding (NCB) are **provided in the BDS.**
	1.2 Throughout this Bidding Document: (a) the term "in writing" means communicated in written form and delivered against receipt through e-GP system or email or fax or courier; (b) except where the context requires otherwise, words indicating the singular also include the plural and words indicating the plural also include the singular; and (c) "day" means calendar day.
2. Source of Funds	2.1 GoN Funded: In accordance with its annual program and budget, approved by the GoN, the implementing agency **indicated in the BDS** plans to apply a portion of the allocated budget to eligible payments under the contract(s) for which this Bidding Document is issued. Or Public Entities' own Resource Funded: In accordance with its annual program and budget, approved by the public entity, the implementing agency **indicated in the BDS** plans to apply a portion of the allocated budget to eligible payments under the contract(s) for which this Bidding Document is issued. Or DP Funded: The GoN has applied for or received financing (hereinafter called "funds") from the Development Partner (hereinafter called "the DP") **indicated in the BDS** toward the cost of the project named in the BDS. The GoN intends to apply a portion of the funds to eligible payments under the contract(s) for which this Bidding Document is issued.
	2.2 DP Funded: Payment by the DP will be made only at the request of the GoN and upon approval by the DP in accordance with the terms and conditions of the financing agreement between the GoN and the DP (hereinafter called the "Loan/Grant Agreement"), and will be subject in all respects to the terms and conditions of that Loan/Grant Agreement. No party other than the GoN shall derive any rights from the Loan Agreement or have any claim to the funds.
3. Fraud and Corruption	3.1 Procuring Entities as well as Bidders, suppliers and contractors and their sub-contractors shall adhere to the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this; (a) the Employer adopts, for the purposes of this provision, the terms as defined below: (i) "corrupt practice" means the offering, giving, receiving, or soliciting, directly

	or indirectly, anything of value to influence improperly the actions of another party; (ii) "fraudulent practice" means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation; (iii) "coercive practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party; (iv) "collusive practice" means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party. v) "obstructive practice" means (a) deliberately destroying, falsifying, altering, or concealing of evidence material to an investigation; (b) making false statements to investigators in order to materially impede an investigation; (c) failing to comply with requests to provide information, documents, or records in connection with an investigation; (d) threatening, harassing, or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; or (e) materially impeding GoN/DP's contractual rights of audit or access to information; and vi) "integrity violation" is any act which violates Anticorruption Policy, including (i) to (v) above and the following: abuse, conflict of interest, violations of GoN/DP sanctions, retaliation against whistleblowers or witnesses, and other violations of Anticorruption Policy, including failure to adhere to the highest ethical standard. (b) the Employer will reject a proposal for award if it determines that the Bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations in competing for the contract; (c) DP will cancel the portion of the financing allocated to a contract if it determines at any time that representative(s) of the GoN/or of a beneficiary of DP-financing engaged in corrupt, fraudulent, collusive, or coercive practices or other integrity violations during the procurement or the execution of that contract, without the GoN having taken timely and appropriate action satisfactory to DP to remedy the situation. d) DP will impose remedial actions on a firm or an individual, at any time, in accordance with DP's Anticorruption Policy and related Guidelines (as amended from time to time), including declaring ineligible, either indefinitely or for a stated period of time, to participate in DP-financed, -administered, or -supported activities or to benefit from an DP-financed, -administered, or -supported contract, financially or otherwise, if it at any time determines that the firm or individual has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations; and (e) The Contractor shall permit the GoN/DP to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by the GoN /DP, if so, required by the GoN/DP.
	3.2 The Bidder shall not carry out or cause to carry out the following acts with an intention to influence the implementation of the procurement process or the procurement agreement: (a) give or propose improper inducement directly or indirectly, (b) distortion or misrepresentation of facts,

	(c) engaging in corrupt or fraudulent practice or involving in such act, (d) interference in participation of other competing bidders, (e) coercion or threatening directly or indirectly to cause harm to the person or the property of any person to be involved in the procurement proceedings, (f) collusive practice among bidders before or after submission of bids for distribution of works among bidders or fixing artificial/uncompetitive bid price with an intention to deprive the Employer the benefit of open competitive bid price, (g) Contacting the Employer with an intention to influence the Employer with regards to the bids or interference of any kind in examination and evaluation of the bids during the period from the time of opening of the bids until the notification of award of contract.
	3.3 PPMO, on the recommendation of the Procuring Entity may blacklist a Bidder for a period of one (1) to three (3) years for its conduct including on the following grounds and seriousness of the act committed by the bidder: (a) if convicted by a court of law in a criminal offence which disqualifies the Bidder from participating in the contract, (b) if it is established that the contract agreement signed by the Bidder was based on false or misrepresentation of Bidder's qualification information, (c) if it at any time determines that the firm has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices in competing for, or in executing, a GoN/DP-financed contract. (d) if the Successful Bidder fails to sign the Contract. (e) if the bidder fails to inform or informs after the specified time about the saturation of the maximum number of contracts as per ITB 4.10. (f) a Bidder requests for withdrawal or modification of its bid: (i) after the Bid Submission deadline and during the period of validity specified by the Bidder on the Letter of Technical Bid and Price Bid, in case of electronic submission; (ii) from the period twenty-four hours prior to bid submission deadline up to the period of bid validity specified by the Bidder on the Letter of Technical Bid and Price Bid, in case of hard copy submission. (g) if the bidder does not provide clarifications of its Bid by the date and time set in the Employer's request for clarification as per ITB 27.1. (h) a Bidder changes the prices or substance of the bid while providing information pursuant to ITB 27.1.
	3.4 A bidder declared blacklisted and ineligible by the GoN, Public Procurement Monitoring Office (PPMO), by a competent authority under the prevailing law for failure to repay a loan disbursed by a bank or financial institution, and/or the DP in case of DP funded project, shall be ineligible to bid for a contract during the period of time determined by the GoN, PPMO, the competent authority, and/or the DP.
	3.5 In case of a natural person or firm/institution/company which is already declared blacklisted and ineligible by the GoN, any other new or existing firm/institution/company owned partially or fully by such Natural person or Owner or Board of director of blacklisted firm/institution/company; shall not be eligible bidder.
	3.6 Furthermore, Bidders shall be aware of the provisions of GCC 28.3 and GCC 72.3(j).
4. Eligible	4.1 A Bidder may be a natural person, private entity, or government owned entity subject to

Bidders	ITB 4.5 or any combination of them in the form of a Joint Venture (JV) under an existing agreement, or with the intent to constitute a legally-enforceable joint venture. In the case of a JV: (a) all partners shall be jointly and severally liable for the execution of the Contract in accordance with the Contract terms. Maximum number of JV shall be as **specified in the BDS** and (b) the JV shall nominate a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the JV during the bidding process and, in the event the JV is awarded the Contract, during Contract execution.
	4.2 A Bidder, and all parties constituting the Bidder, shall have the nationality of an eligible country, in accordance with Section V (Eligible Countries). A Bidder shall be deemed to have the nationality of a country if the Bidder is a citizen or is constituted, or incorporated, and operates in conformity with the provisions of the laws of that country. This criterion shall also apply to the determination of the nationality of proposed sub-contractors or suppliers for any part of the Contract including related services.
	4.3 A Bidder shall not have a conflict of interest. A Bidder found to have a conflict of interest shall be disqualified. A Bidder may be considered to be in a conflict of interest with one or more parties in this bidding process, if any of, including but not limited to, the following apply: (a) they have controlling shareholders in common; or (b) they receive or have received any direct or indirect subsidy from any of them; or (c) they have the same legal representative for purposes of this bid; or (d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to material information about or improperly influence the Bid of another Bidder, or influence the decisions of the Employer regarding this bidding process; or (e) a Bidder participates in more than one bid in this bidding process either individually or as a partner in a joint venture. This will result in the disqualification of all Bids in which it is involved. However, subject to any finding of a conflict of interest in terms of ITB 4.3 (a)-(d) above, this does not limit the participation of the same subcontractor in more than one bid; or (f) a Bidder or any of its affiliated entity, participated as a consultant in the preparation of the design or technical specifications of the works that are the subject of the Bid; or (g) a Bidder was affiliated with a firm or entity that has been hired (or is proposed to be hired) by the Employer as Engineer for the Contract. (h) a Bidder that has a close business or family relationship with a professional staff of the Procuring Entity.
	4.4 A firm that is under a declaration of ineligibility by the GoN in accordance with ITB 3, at the date of the deadline for bid submission or thereafter, shall be disqualified. A firm shall not be eligible to participate in any procurement activities under an DP-financed, -administered, or -supported project while under temporary suspension or debarment by DP pursuant to the DP's Anticorruption Policy (see ITB 3), whether such debarment was directly imposed by the DP, or enforced by other DPs pursuant to

	the Agreement for Mutual Enforcement of Debarment Decisions. A bid from a temporary suspended or debarred firm will be rejected.
	4.5 Enterprises owned by Government shall be eligible only if they can establish that they are legally and financially autonomous and operate under commercial law, and that they are not a dependent agency of the GoN.
	4.6 Bidders shall provide such evidence of their continued eligibility satisfactory to the Employer, as the Employer shall reasonably request.
	4.7 Firms shall be excluded in any of the cases, if (a) by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, Nepal prohibits any import of goods or contracting of works or services from that country or any payments to persons or entities in that country. Where Nepal prohibits payments to a particular firm or for particular goods by such an act of compliance, that firm may be excluded; (b) DP Funded: as a matter of law or official regulation, Nepal prohibits commercial relations with that country, provided that the DP is satisfied that such exclusion does not preclude effective competition for the supply of goods or related services required; (c) DP Funded: a firm sanctioned or temporarily suspended by the DP in relation to their guidelines or appropriate provisions on preventing and combating fraud and corruption in projects financed by them.
	4.8 In case a prequalification process has been conducted prior to the bidding process, this bidding is open only to prequalified Bidders.
	4.9 The Bidder, including all parties constituting the Bidder, shall be ineligible to participate in the open competitive bidding process if it has already secured maximum number of construction contracts (in open competitive bidding) **as specified in BDS** and has not yet completed the work as stipulated in the respective contracts
	4.10 For the purpose of ITB 4.9 above, the bidder shall declare that the bidder, and all parties constituting the Bidder have not already secured maximum number of construction contract (in open competitive bidding) **as specified in BDS**. If the bidder, and all parties constituting the Bidder has participated in bidding processes of many public entities and during that period the maximum number of contracts have been attained as specified saturates due to issuance of letters of acceptance by a particular public entity, the bidder shall inform in writing to all other concerned public entities, where the bidder have participated in bidding process, within three days of issuance of last letter of acceptance that saturates the maximum number of contracts as specified.
5. Eligible Materials, Equipment and Services	5.1 The materials, equipment and services to be supplied under the Contract shall have their origin in any source countries as defined in accordance with Section V (Eligible Countries) and all expenditures under the Contract will be limited to such materials, equipment, and services. At the Employer's request, Bidders may be required to provide evidence of the origin of materials, equipment and services.
	5.2 For purposes of ITB 5.1 above, "origin" means the place where the materials and equipment are mined, grown, produced or manufactured, and from which the

	services are provided. Materials and equipment are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that differs substantially in its basic characteristics or in purpose or utility from its components.
B. Contents of Bidding Documents	
6. Sections of Bidding Document	6.1 The Bidding Document consist of Parts I, II, and III, which include all the Sections indicated below, and should be read in conjunction with any Addenda issued in accordance with ITB 8. PART I Bidding Procedures Section I Instructions to Bidders (ITB) Section II Bid Data Sheet (BDS) Section III Evaluation and Qualification Criteria (EQC) Section IV Bidding Forms (BDF) Section V Eligible Countries PART II Requirements Section VI Works Requirements (WRQ) Section VII Bill of Quantities (BOQ) PART III Conditions of Contract and Contract Forms Section VIII General Conditions of Contract (GCC) Section IX Special Conditions of Contract (SCC) Section X Contract Forms (COF)
	6.2 The Invitation for Bids (IFB) issued by the Employer is not part of the Bidding Document.
	6.3 The Employer is not responsible for the completeness of the Bidding Document and their Addenda, if they were not obtained directly from the source stated by the Employer in the Invitation for Bids.
	6.4 The Bidder is expected to examine all instructions, forms, terms, and specifications in the Bidding Document and to furnish with its bid all information and documentation as is required by the Bidding Documents. Failure to furnish all information or documentation required by the Bidding Document may result in the rejection of the bid.
7. Clarification of Bidding Document, Site Visit, Pre-Bid Meeting	7.1 A prospective Bidder requiring any clarification of the Bidding Document shall contact the Employer in writing at the Employer's address **indicated in BDS** or raise any question or curiosity during the pre-bid meeting if provided for in accordance with ITB 7.4. The Employer will respond in writing to any request for clarification, provided that such request is received within the period as mentioned in ITB 7.5. The Employer shall forward copies of its response to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3, including a description of the inquiry but without identifying its source. Should the Employer deem it necessary to amend the Bidding Document as a result of a request for clarification, it shall do so following the procedure under ITB 8 and ITB 22.2.
	7.2 The Bidder is advised to visit and examine the Site of Works and its surroundings and obtain for itself, on its own risk and responsibility, all information that may be necessary for preparing the bid and entering into a Contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.
	7.3 The Bidder and any of its personnel or agents will be granted permission by the

	Employer to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the Bidder, its personnel, and agents will release and indemnify the Employer and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.
	7.4 The Bidder's designated representative is invited to attend a pre-bid meeting, if **provided for in the BDS**. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.
	7.5 The Bidder is requested, to submit any questions in writing, to reach the Employer as **mentioned in BDS.**
	7.6 Minutes of the pre-bid meeting, including the text of the questions raised, without identifying the source, and the responses given, together with any responses prepared after the meeting, will be transmitted promptly to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3. Any modification to the Bidding Document that may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an addendum pursuant to ITB 8 and not through the minutes of the pre-bid meeting.
	7.7 Nonattendance at the pre-bid meeting will not be a cause for disqualification of a Bidder.
8. Amendment of Bidding Document	8.1 At any time prior to the deadline for submission of bids, the Employer may amend the Bidding Document by issuing addendum or several addenda.
	8.2 Any addendum issued shall be part of the Bidding Document and shall be communicated in writing to all who have obtained the Bidding Document from the Employer in accordance with ITB 6.3.
	8.3 To give prospective Bidders reasonable time in which to take an addendum into account in preparing their Bids, the Employer may, at its discretion, extend the deadline for the submission of Bids, pursuant to ITB 22.2. However, the time available to submit bids shall not be less than five (5) days since amendment in bidding document.
C. Preparation of Bids	
9. Cost of Bidding	9.1 The Bidder shall bear all costs associated with the preparation and submission of its Bid, and the Employer shall in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.
10. Language of Bid	10.1 The Bid, as well as all correspondence and documents relating to the bid exchanged by the Bidder and the Employer, shall be written in the language **specified in the BDS**. Supporting documents and printed literature that are part of the Bid may be in another language provided they are accompanied by an accurate translation of the relevant passages in the language **specified in the BDS**, in which case, for purposes of interpretation of the Bid, such translation shall govern.
11. Documents	11.1 The Bid shall comprise two envelopes submitted simultaneously, one called the Technical Bid containing the documents listed in ITB 11.2 and the other the Price Bid

Comprising the Bid	containing the documents listed in ITB 11.3, both envelopes enclosed together in an outer single envelope. 11.2 The Technical Bid shall comprise the following: (a) Letter of Technical Bid; (b) Bid Security in accordance with ITB 19; (c) alternative Technical Bid, at Bidder's option and if permissible, in accordance with ITB 13; (d) written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with ITB 20.2; (e) documentary evidence in accordance with ITB 17, establishing the Bidder's qualifications to perform the contract; (f) Technical Proposal in accordance with ITB 16; (g) Bids submitted by a Joint Venture shall include a copy of the Joint Venture Agreement entered into by all partners. Alternatively, a Letter of Intent to execute a Joint Venture Agreement in the event of a successful Bid shall be signed by all partners and submitted with the Bid, together with a copy of the proposed agreement. The Joint Venture agreement, or letter of intent to enter into a Joint Venture including a draft agreement shall indicate at least the parts of the Works to be executed by the respective partners; (h) list of subcontractors, in accordance with ITB 34 (If any); and (i) Any other documents required in the **BDS.** 11.3 The Price Bid shall comprise the following: (a) Letter of Price Bid; (b) completed Bill of Quantities (BoQ), in accordance with ITB 12 and ITB 14, or as stipulated in the BDS; (c) alternative price Bids, at Bidder's option and if permissible, in accordance with ITB 13; (d) Table of Price adjustment (if applicable) ; and (e) Any other document required in the **BDS**.
	11.4 The Bidder is solely responsible for the authenticity of the submitted documents. 11.5 The Technical Bid shall not include any financial information related to the Price Bid. A Technical Bid containing such material financial information shall be declared non-responsive.
12. Letter of Bid and Schedules	12.1 The Letters of Technical Bid and Price Bid, Schedules, and all documents listed under ITB 11, shall be prepared using the relevant forms in Section IV (Bidding Forms) and in Section VII (Bill of Quantities). The forms must be completed without any alterations to the text, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested.
13. Alternative Bids	13.1 Unless otherwise **specified in the BDS**, alternative bids shall not be considered.
	13.2 When alternative times for completion are explicitly invited, a statement to that effect will be **included in the BDS**, as will the method of evaluating different times for completion.
	13.3 When specified in the BDS pursuant to ITB 13.1, and subject to ITB 13.4 below,

	Bidders wishing to offer technical alternatives to the requirements of the Bidding Document must first price the Employer's design as described in the Bidding Document and shall further provide all information necessary for a complete evaluation of the alternative by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, and proposed construction methodology and other relevant details. Only the technical alternatives, if any, of the evaluated Bidder whose Bid Price is closest to the Average Bid Price conforming to the basic technical requirements shall be considered by the Employer.
	13.4 When **specified in the BDS**, Bidders are permitted to submit alternative technical solutions for specified parts of the Works. Such parts will be **identified in the BDS** and described in Section VI (Works Requirements). The method for their evaluation will be stipulated in Section III (Evaluation and Qualification Criteria).
14. Bid Prices and Discounts	14.1 The prices and discounts quoted by the Bidder in the Letter of Price Bid and in the Schedules shall conform to the requirements specified below.
	14.2 The Bidder shall submit a bid for the whole of the works described in ITB 1.1 by filling in prices for all items of the Works, as identified in Section VII (Bill of Quantities). In case of Unit Rate Contracts, the Bidder shall fill in rates and prices for all items of the Works described in the Bill of Quantities. Items against which no rate or price is entered by the Bidder will not be paid for by the Employer when executed and shall be deemed covered by the rates for other items and prices in the Bill of Quantities.
	14.3 The price to be quoted in the Letter of Price Bid shall be the total price of the Bid, excluding any discounts offered. Absence of the total price in the Letter of Price Bid may result in rejection of the Bid.
	14.4 The Bidder shall quote any discounts and the methodology for their application in the Letter of Price Bid, in accordance with ITB 12.1.
	14.5 If so indicated in ITB 1.1and ITB 35.4, bids are invited for individual Contracts or for any combination of Contracts (packages). Bidders wishing to offer any price reduction for the award of more than one Contract shall specify in their bid the price reductions applicable to each package, or alternatively, to individual Contracts within the package. Price reductions or discounts shall be submitted in accordance with ITB 14.4, provided the Bids for all Contracts are submitted and opened at the same time.
	14.6 Unless otherwise **provided in the BDS** and the Conditions of Contract, the prices quoted by the Bidder shall be fixed. If the prices quoted by the Bidder are subject to adjustment during the performance of the Contract in accordance with the provisions of the Conditions of Contract, the Bidder shall furnish the indices and weightings for the price adjustment formulae in the Table of Adjustment Data in Section IV (Bidding Forms) and the Employer may require the Bidder to justify its proposed indices and weightings.
	14.7 All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, as of the date 30 days prior to the deadline for submission of bids, shall be included in the rates and prices and the total bid price submitted by the Bidder.

15. Currency of Bid and Payment	15.1 The currency of the bid and payment shall be in Nepalese Rupees.
16. Documents Comprising the Technical Proposal	16.1 The Bidder shall furnish a Technical Proposal including a statement of work methods, equipment, personnel, schedule and any other information as stipulated in Section IV (Bidding Forms), in sufficient detail to demonstrate the adequacy of the Bidders' proposal to meet the work requirements and the completion time.
17. Documents Establishing the Qualifications of the Bidder	17.1 To establish its qualifications to perform the Contract in accordance with Section III (Evaluation and Qualification Criteria) the Bidder shall provide the information requested in the corresponding information sheets included in Section IV (Bidding Forms).
18. Period of Validity of Bids	18.1 Bids shall remain valid for the period **specified in the BDS.** The bid validity period shall start from the bid submission deadline as prescribed by the Employer in accordance with ITB 22.1. If the prescribed bid submission deadline date falls on a government holiday, then the next working day shall be considered as the bid submission deadline date. In such case the validity period of the bids shall be considered from the original bid submission deadline date. In the case of electronic bid submission, if any technical issue arises in the handling of the e-GP system, the PPMO may extend the deadline for bid submission. However, the validity period of the bids shall still be counted from the original bid submission deadline. A bid valid for a shorter period shall be rejected by the Employer as nonresponsive.
	18.2 In exceptional circumstances, prior to the expiration of the bid validity period, the Employer may request Bidders to extend the period of validity of their Bids. The request and the responses shall be made in writing. If a bid security is requested in accordance with ITB 19, it shall also be extended 30 days beyond the deadline of the extended validity period. A Bidder may refuse the request without forfeiting its bid security. A Bidder granting the request shall not be required or permitted to modify its Bid and to include any additional conditions against the provisions specified in Bid Documents.
19. Bid Security	19.1 The Bidder shall furnish as part of its bid, in original form, a bid security as **specified in the BDS**. In case of e-submission of bid, the Bidder shall upload scanned copy of Bid security letter at the time of electronic submission of the bid. The Bidder accepts that the scanned copy of the Bid security shall, for all purposes, be equal to the original. The details of original Bid Security and the scanned copy submitted with e-bid should be the same otherwise the bid shall be non-responsive.
	19.2 The bid security shall be, at the Bidder's option, in any of the following forms: (a) an unconditional bank guarantee from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law or; (b) a cash deposit voucher in the Employer's Account as **specified in BDS**. In the case of a bank guarantee, the bid security shall be submitted either using the Bid Security Form included in Section IV (Bidding

	Forms) or in another Form acceptable to the employer. The form must include the complete name of the Bidder. The bid security shall be valid for minimum thirty (30) days beyond the original validity period of the bid, or beyond any period of extension if requested under ITB 18.2. A bid security valid for a shorter period shall be rejected by the Employer as nonresponsive.
	19.3 The bid security issued by any foreign Bank outside Nepal must be counter guaranteed by Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal.
	19.4 Any bid not accompanied by an enforceable and substantially compliant bid security shall be rejected by the Employer as nonresponsive. In case of e- Submission, if the scanned copy of an acceptable Bid Security letter is not uploaded with the electronic Bid then Bid shall be rejected.
	19.5 The public entity shall return the bid securities except those that are to be forfeited as per ITB 19.6 to the respective bidders within three (3) days after the successful bidder has furnished the required performance security and signed the Contract Agreement pursuant, to ITB 40.1 and ITB 41.1.
	19.6 The bid security shall be forfeited if: **GoN funded:** (a) a Bidder requests for withdrawal or modification of its bid, except as provided in ITB 18.2: (i) during the period of bid validity specified by the Bidder on the Letter of Technical Bid and Price Bid, in case of electronic submission; (ii) from the period twenty-four hours prior to bid submission deadline up to the period of bid validity specified by the Bidder on the Letter of Technical Bid and Price Bid, in case of hard copy submission. (b)a Bidder changes the prices or substance of the bid while providing information pursuant to clause 27.1; (c) a Bidder involves in fraud and corruption pursuant to clause 3.1; (d) the successful Bidder fails to: (i) furnish a performance security in accordance with ITB 35.5, ITB 35.8 and ITB 40.1; or (ii) sign the Contract in accordance with ITB 41.1; or (iii) accept the correction of arithmetical errors pursuant to clause 33.1; (e) if the bidder fails to inform about the saturation of the maximum number of contracts as per ITB 4.10. **DP funded:** The bid security shall be forfeited (a) if a Bidder withdraws its bid during the period of bid validity specified by the Bidder on the Letters of Technical Bid and Price Bid, except as provided in ITB 18.2; or (b) if the successful Bidder fails to (i) furnish a performance security in accordance with ITB 35.5 and ITB 40.1; or (ii) sign the Contract in accordance with ITB 41.1; or (iii) accept arithmetical corrections in accordance with ITB 33.1.

	19.7 The Bid Security of a Joint Venture shall be in the name of the Joint Venture that submits the bid. If the Joint Venture has not been legally constituted at the time of bidding, the Bid Security shall be in the names of all future partners as named in the letter of intent mentioned in ITB 4.1.
20. Format and Signing of Bid	20.1 The Bidder shall prepare one original set of the Technical Bid and one original of the Price Bid comprising the Bid as described in ITB 11 and clearly mark it **"ORIGINAL – TECHNICAL BID"** and **"ORIGINAL – PRICE BID."** Alternative bids, if permitted in accordance with ITB 13, shall be clearly marked **"ALTERNATIVE".** In addition, the Bidder shall submit copies of the bid in the number specified in the BDS, and clearly mark each of them **"COPY."** In the event of any discrepancy between the original and the copies, the original shall prevail. In case of e-submission of bid, the Bidder shall submit his bid electronically in PDF or web forms files as specified in ITB Clause 21.1(b).
	20.2 The original and all copies of the bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder. This authorization shall consist of a written confirmation as **specified in the BDS** and shall be attached to the bid. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the bid, except for un amended printed literature, shall be signed or initialed by the person signing the bid.
	20.3 Any amendments such as interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the bid.
D. Submission and Opening of Bids	
21. Sealing and Marking of Bids	21.1 Unless otherwise **specified in BDS**, Bidders shall submit their bids by electronic or by mail/by hand/by courier. Procedures for submission, sealing and marking are as follows: (a) Bidders submitting bids by mail, by hand or by courier shall enclose the original of the Technical Bid, and the original of the Price Bid and each copy of the Technical Bid and Price Bid, including alternative bids, if permitted in accordance with ITB 13, in separate sealed envelopes, duly marking the envelopes as **"ORIGINAL TECHNICAL BID", "ORIGINAL – PRICE BID", "ALTERNATIVE" and "COPY No. – TECHNICAL BID" and "COPY NO. PRICE BID"** These envelopes containing the original and the copies shall then be enclosed in one single envelope. (b) Bidders submitting Bids electronically shall follow the electronic bid submission procedure specified in this clause. i. The bidder is required to register in the e-GP system https://www.bolpatra.gov.np/egp following the procedure specified in e-GP guideline. ii. Interested bidders may either purchase the bidding document from the Employer's office as specified in the Invitation for Bid (IFB) or bidders may download the IFB and bidding document from e-GP system. iii. The registered bidders need to maintain their profile data required during

preparation of bids.

iv. The bidder can prepare their technical and price bids using data and documents maintained in bidder's profile and forms/format provided in bidding document by Employer. The bidder may submit bids as a single entity or as a joint venture. The bidder submitting bid in joint venture shall have to upload joint venture agreement along with partner(s) Bolpatra ID provided during bidder's registration.

v. Bidders (all partners in case of JV) should update their profile data and documents required during preparation and submission of their technical bids.

vi. In case of bid submission in JV, the consent of the partners shall be obtained through the confirmation link sent to the registered email address and the partners shall have to acknowledge their confirmation.

The required forms and documents shall be part of technical bids.

No.	Document	Requirement	Remarks
1.	Letter of Technical Bid	Mandatory	PDF
2.	Bid Security / Bank Guarantee	Mandatory	PDF
3.	Firm or Company registration Certificate	Mandatory	PDF
4.	VAT and PAN registration Certificate	Mandatory (for domestic bidders only)	PDF
5.	Business Registration Licence	Mandatory	PDF
6.	Tax Clearance Certificate/Tax return submission evidence/evidence of time extension	Mandatory (for domestic bidders only)	PDF
7.	Power of Attorney of Bid signatory	Mandatory	PDF
8.	Joint venture agreement	Mandatory in case of JV Bids Only	PDF
9.	Qualification Documents	Mandatory	Using profile data(financial details, contract details etc.) and Technical Proposal
10.	Additional documents] specified in ITB 11.2 (i)	Mandatory (If any)	PDF

The required forms and documents shall be part of price bids.

No.	Document	Requirement	Remarks
1.	Letter of Price Bid	Mandatory	PDF
2.	Completed Bill of Quantities (BoQ)	Mandatory	Online Forms
3.	Price Adjustment Table	Mandatory (If applicable)	Online Forms
4.	Additional Documents specified in ITB 11.3 (e)	Mandatory (If any)	PDF

	<u>Note:</u> *a) The documents specified as "Mandatory" should be included in e-submission and non-submission of the documents shall be considered as non-responsive bid.* *b) Bidders (all partners in case of JV) should verify/update their profile documents as appropriate for the specific bid before submitting their bid electronically.* vii. After providing all the details and documents, two separate bid response documents i.e technical bids and price bids will be generated from the system. Bidders are advised to download and verify the response documents prior to bid submission. viii. For verifying the authentic user, the system will send one time password (OTP) in the registered e-mail address of the bidder. System will validate the OTP and allow bidder to submit their bid. ix. Electronically submitted bids can be modified and/or withdrawn through system. The bidder may modify their bids multiple times online within bid submission date and time specified in e-GP system. Once a Bid is withdrawn, bidder won't be able to submit another bid response for the same bid. x. The Bidder / Bid shall meet the following requirements and conditions for e-submission of bids; aa) The e-submitted bids must be readable through PDF reader. bb) The facility for submission of bid electronically through e-submission is to promote transparency, non-discrimination, equality of access, and open competition in the bidding process. The Bidders are fully responsible to use the e- submission facility properly in e-GP system as per specified procedures and in no case the Employer shall be held liable for Bidder's inability to use this facility. cc) When a bidder submits electronic bid through the PPMO e-GP portal, it is assumed that the bidder has prepared the bid by studying and examining the complete set of the Bidding documents including specifications, drawings and conditions of contract. 21.2. The inner and outer envelopes shall: (aa) bear the name and address of the Bidder; (bb) be addressed to the Employer as provided in BDS 22.1; (cc) bear the specific identification of this bidding process indicated in BDS 1.1; and 21.3 The outer envelope and the inner envelope containing Technical Proposal shall bear a warning not to open before the time and date for the opening of Technical Bid in accordance with ITB 25.1. 21.4 The inner envelope containing the Price Bid shall bear a warning not to open until advised by the Employer in accordance with ITB 25.7 21.5 If all envelopes are not sealed and marked as required, the Employer will assume no responsibility for the misplacement or premature opening of the bid.
22. Deadline for Submission	22.1 Bids must be received by the Employer at the address and no later than the date and time indicated **in the BDS**. In case of e-submission, the standard time for e-submission is Nepal Standard Time as

of Bids	set out in the server. The e-procurement system will accept the e-submission of bid from the date of publishing of notice and will automatically not allow the e-submission of bid after the deadline for submission of bid.
	22.2 The Employer may, at its discretion, extend the deadline for the submission of bids by amending the Bidding Document in accordance with ITB 8, in which case all rights and obligations of the Employer and Bidders previously subject to the deadline shall thereafter be subject to the deadline as extended.
23. Late Bids	23.1 The Employer shall not consider any bid that arrives after the deadline for submission of bids, in accordance with ITB 22. Any bid received by the Employer after the deadline for submission of bids shall be declared late, rejected, and returned unopened to the Bidder.
24. Withdrawal, and Modification of Bids	24.1 A Bidder may withdraw, or modify its bid- Technical or Price - after it has been submitted either in hard copy or by e-submission. Once a Bid is withdrawn, bidder shall not be able to submit another bid for this bidding process. Procedures for withdrawal or modification of submitted bids are as follows: (i) **Bids submitted in Hard Copy** **GoN Funded:** a) Bidders may withdraw or modify its bids by sending a written notice in a sealed envelope, duly signed by an authorized representative, and shall include a copy of the authorization in accordance with ITB 20.2. The corresponding modification of the bid must accompany the respective written notice. All notices must be: (aa) prepared and submitted in accordance with ITB 20 and ITB 21, and in addition, the respective envelopes shall be clearly marked "**WITHDRAWAL", "MODIFICATION;"** and (bb) received by the Employer twenty; four hours prior to the deadline prescribed for submission of bids, in accordance with ITB 22. **DP Funded:** A Bidder may withdraw or modify its Bid – Technical or Price – after it has been submitted by sending a written notice, duly signed by an authorized representative, and shall include a copy of the authorization in accordance with ITB 20.2, (except that withdrawal notices do not require copies). The corresponding modification of the Bid must accompany the respective written notice. All notices must be (a) prepared and submitted in accordance with ITB 20 and ITB 21 (except that withdrawal notices do not require copies), and in addition, the respective envelopes shall be clearly marked "WITHDRAWAL," and "MODIFICATION;" and (b) received by the Employer prior to the deadline prescribed for submission of Bids, in accordance with ITB 22. ii) **E-submitted bids**. a) Bidder may submit modification or withdrawal prior to the deadline prescribed for submission of bids through e-GP system by using the forms and instructions provided by the system.
	24.2 Bids requested to be withdrawn in accordance with ITB 24.1 shall not be opened. In case of hard copy submission, the Bid will be returned unopened to the Bidders.
	24.3 The following provisions apply for withdrawal or modification of the Bids:

	GoN Funded: (i) In case of bids submitted in hard copy no bid shall be withdrawn or modified in the interval between 24 hours prior to the deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder on the Letter of Bid or any extension thereof. (ii) In case of e-submitted bids no bids shall be withdrawn or modified in the interval between deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder on the Letter of Technical Bid and Price Bid or any extension thereof. **DP Funded:** No Bid may be withdrawn or modified in the interval between the deadline for submission of Bids and the expiration of the period of bid validity specified by the Bidder on the Letters of Technical Bid and Price Bid or any extension thereof.
	24.4 Except in case of any modification or correction in bid document made by procuring entity, Bidder may submit request for withdrawal or modification only one time.
	24.5 In case of hard copy bid, no bid may be withdrawn if the bid has already been modified; except in case of any modification or correction in bid document by procuring entity.
	24.6 Request for withdrawal or modification must be made through the same medium of submission. Request for withdrawal or modifications through different medium shall not be considered.
25. Bid Opening	25.1 The Employer shall open the Technical Bids in public at the address, on the date and time **specified in the BDS** in the presence of Bidders` designated representatives who choose to attend. The Price Bids will remain unopened and will be held in custody of the Employer until the specified time of their opening. If the Technical Bid and Price Bid are submitted together in one envelope, the Employer shall reject the Bid as nonresponsive.
	25.2 The Employer shall download the e-submitted Technical Bid. The e-GP system allows the Employer to download the e-submitted technical bid only after bid opening date and time after login simultaneously by at least two members of the Bid Opening Committee.
	25.3 Electronically submitted Technical Bid shall be opened at first in the same time and date as specified above. Electronic Bids shall be opened one by one and read out. The e-submitted technical bids must be readable through open standards interfaces. Unreadable and or partially submitted bid files shall be considered incomplete.
	25.4 Thereafter, envelopes marked "WITHDRAWAL" shall be opened and read out and the envelope with the corresponding Bid shall not be opened, but returned to the Bidder. No bid withdrawal shall be Permitted unless the corresponding withdrawal notice contains a valid authorization to request the withdrawal and is read out at bid opening. Next, envelopes marked "MODIFICATION" shall be opened and read out with the corresponding bid. No Technical Bid and/or Price Bid modification shall be permitted unless the corresponding modification notice contains a valid authorization to request the modification and is read out and recorded at bid opening. Only the Technical Bid, both Original as well as Modification, are to be opened, read

	out, and recorded at the opening. Price Bids, both Original and Modification, will remain unopened in accordance with ITB 25.1.
	25.5 All other envelopes holding the Technical Bid shall be opened one at a time, reading out the name of the Bidder; whether there is a modification; the presence of a bid security and any other details as the Employer may consider appropriate. Only Technical Bids read out and recorded at bid opening shall be considered for evaluation. No bid shall be rejected at opening of Technical Bids except for late bids, in accordance with ITB 23.1.
	25.6 The Employer shall prepare a record of the opening of Technical Bids that shall include, as a minimum: the name of the Bidder and whether there is a withdrawal, or modification; and the presence or absence of a bid security. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record.
	25.7 At the end of the evaluation of the Technical Bids, the Employer will invite bidders who have submitted substantially responsive Technical Bids and who have been determined as being qualified for award to attend the opening of the Price Bids. The date, time, and location of the opening of Price Bids will be advised in writing by the Employer. Bidders shall be given at least 7 days' notice for the opening of Price Bids.
	25.8 The Employer will notify Bidders in writing who have been rejected on the grounds of their Technical Bids being substantially nonresponsive to the requirements of the Bidding Document and return their Price Bids unopened.
	25.9 The Employer shall conduct the opening of Price Bids of all Bidders who submitted substantially responsive Technical Bids, in the presence of Bidders` representatives who choose to attend at the address, on the date, and time specified by the Employer. The Bidder's representatives who are present shall be requested to sign a register evidencing their attendance.
	25.10 All envelopes containing Price Bids shall be opened one at a time and the following read out and recorded: (a) the name of the Bidder; (b) whether there is a modification; (c) the Bid Prices, including any discounts and alternative offers; and (d) any other details as the Employer may consider appropriate. Only Price Bids, discounts, modifications, and alternative offers read out and recorded during the opening of Price Bids shall be considered for evaluation. No Bid shall be rejected at the opening of Price Bids.
	25.11 The Employer shall prepare a record of the opening of Price Bids that shall include, as a minimum, the name of the Bidder, the Bid Price (per lot if applicable), any discounts, modifications and alternative offers. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record.
E. Evaluation and Comparison of Bids	
26.	26.1 Information relating to the examination, evaluation, comparison, and post-qualification

Confidentiality	of bids and recommendation of Contract award, shall not be disclosed to Bidders or any other persons not officially concerned with such process until information on Contract award is communicated to all Bidders.
	26.2 Any attempt by a Bidder to influence the Employer in the evaluation of the bids or Contract award decisions may result in the rejection of its bid.
	26.3 Notwithstanding ITB 26.2, from the time of bid opening to the time of Contract award, if any Bidder wishes to contact the Employer on any matter related to the bidding process, it may do so in writing.
27. Clarification of Bids	27.1 To assist in the examination, evaluation, and comparison of the Technical and Price Bids, the Employer may, at its discretion, ask any Bidder for a clarification of its Bid. Any clarification submitted by a Bidder that is not in response to a request by the Employer shall not be considered. The Employer's request for clarification and the response shall be in writing. No change in the substance of the Technical Bid or prices in the Price Bid shall be sought, offered, or permitted, except to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Price Bids, in accordance with ITB 33. In case of e-submission of bid, upon notification from the employer, the bidder shall also submit the original of documents comprising the Technical and Price Bid as per ITB 11.2 and ITB 11.3 for verification of submitted documents for acceptance of the e-submitted bid.
	27.2 If a Bidder does not provide clarifications of its Bid by the date and time set in the Employer's request for clarification, its Bid shall be rejected.
28. Deviations, Reservations, and Omissions	28.1 During the evaluation of bids, the following definitions apply: (a) "Deviation" is a departure from the requirements specified in the Bidding Document; (b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Document; and (c) "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Document.
29. Examination of Technical Bid	29.1 The Employer shall examine the Technical Bid to confirm that all documents and technical documentation requested in ITB 11.2 have been submitted. If any of these documents or information (except alternative Technical Bid which is optional) is missing, the bid shall be rejected.
	29.2 In case of e-submission bids, the Employer shall confirm that all the documents and information requested in ITB 21.1 have been submitted. If any of these documents or information is missing, the bid shall be rejected.
30. Determination of Responsiveness of Technical Bid	30.1 The Employer's determination of a Bid's responsiveness is to be based on the contents of the bid itself, as defined in ITB 11.2.
	30.2 A substantially responsive Technical Bid is one that meets the requirements of the Bidding Document without material deviation, reservation, or omission. A material deviation, reservation, or omission is one that, (a) if accepted, would: (i) affect in any substantial way the scope, quality, or performance of the

	Works specified in the Contract; or (ii) limit in any substantial way, inconsistent with the Bidding Document, the Employer's rights or the Bidder's obligations under the proposed Contract; or (b) if rectified, would unfairly affect the competitive position of other Bidders presenting substantially responsive bids.
	30.3 The Employer shall examine the technical aspects of the Bid submitted in accordance with ITB 16, Technical Proposal, in particular, to confirm that all requirements of Section VI (Works Requirements) have been met without any material deviation, reservation or omission.
	30.4 If a bid is not substantially responsive to the requirements of the Bidding Document, it shall be rejected by the Employer and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.
	30.5 In case of e-submission bids, the Employer evaluates the bid on the basis of the information in the electronically submitted bid files. If the Bidder cannot substantiate or provide evidence to establish the information provided in e-submitted bid through documents/ clarifications as per ITB Clause 27.1, the bid shall not be considered for further evaluation.
	30.6 Except in case of e-submission, the Price Bid of the bidder, which is evaluated as substantially non-responsive in technical bid, shall be returned to the respective bidders.
31. Non-conformities Errors, and Omissions	31.1 Provided that a bid is substantially responsive, the Employer may waive any non-conformities in the bid that do not constitute a material deviation, reservation, or omission.
	31.2 Provided that a Technical Bid is substantially responsive, the Employer may request that the Bidder submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities in the Technical Bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any aspect of the Price Bid. Failure of the Bidder to comply with the request may result in the rejection of its bid.
	31.3 Provided that a Technical Bid is substantially responsive, the Employer shall rectify quantifiable nonmaterial nonconformities related to the Bid Price. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of a missing or non-conforming item or component. The adjustment shall be made using the methods indicated in Section III (Evaluation and Qualification Criteria).
	31.4 If the monetary value of such non-conformities is found to be more than fifteen percent of the Bid Price of the bidder pursuant to ITB **31.3**, such bid shall be considered nonresponsive and shall not be involved in evaluation.
32 Eligibility and Qualification of the Bidder	32.1 The Employer shall determine to its satisfaction during the evaluation of Technical Bids whether Bidders meet the eligibility and qualifying criteria specified in Section III (Evaluation and Qualification Criteria).
	32.2 The determination shall be based upon an examination of the documentary evidence

	of the Bidder's qualifications submitted by the Bidder, pursuant to ITB 17.1. If two or more companies or firms have been merged prior to the submission of the bid, the qualifications of the companies or firms existing prior to such merger shall be deemed to form part of the qualifications of the resulting merged firm or company.
	32.3 An affirmative determination shall be a prerequisite for the opening and evaluation of a Bidder's Price Bid. A negative determination shall result into the disqualification of the Bid, in which event the Employer shall return the unopened Price Bid to the Bidder.
33. Correction of Arithmetical Errors	33.1 During the evaluation of Price Bids, the Employer shall correct arithmetical errors on the following basis: (a) only for unit price Contracts, if there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected, unless in the opinion of the Employer there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price shall be corrected; (b) if there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected; (c) If there is a discrepancy between the bid price in the Summary of Bill of Quantities and the bid amount in item (c) of the Letter of Price Bid, the bid price in the Summary of Bill of Quantities will prevail and the bid amount in item (c) of the Letter of Price Bid will be corrected. (d) If there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a), (b) and (c) above.
	33.2 If a Bidder does not accept the correction of arithmetical errors, its bid shall be disqualified and its bid security shall be forfeited.
34 Subcontractors	34.1 In case of Prequalification, the Bidder's Bid shall name the same subcontractor as submitted in the prequalification application and approved by the Employer. In case of Post-qualification, the Employer may permit subcontracting for certain specialized works as indicated in Section III When subcontracting is permitted by the Employer, the sub-contractor shall meet the qualifications criteria as indicated in section III. Sub-contractors' qualification and experience will not be considered for evaluation of the Bidder. The Bidder on its own (without taking into account the qualification and experience of the sub-contractor) should meet the qualification criteria. Bidders may propose subcontracting up to the percentage of total value of contracts or the volume of works as **specified in the BDS.**
35. Evaluation of Price Bids	35.1 The Employer shall use the criteria and methodologies listed in this Clause. No other evaluation criteria or methodologies shall be permitted.
	35.2 To evaluate a Price Bid, the Employer shall consider the following: (a) the bid price, excluding Value Added Tax, and Provisional Sums, in the Summary Bill of Quantities, for Unit Rate Contracts, or Schedule of Prices for lump sum Contracts, but including Day work items, where priced competitively;

	(b) adjustment for correction of arithmetic errors in accordance with ITB 33.1; (c) adjustment due to discounts offered in accordance with ITB 14.4; (d) adjustment for nonconformities in accordance with ITB 31.3; (e) application of all the evaluation factors indicated in Section III (Evaluation and Qualification Criteria) If the evaluated Bid Price of the Bidder is more than 30 (thirty) percent below or substantially higher than the cost estimate, the Employer shall reject the Bid as non-responsive.
	35.3 The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in bid evaluation.
	35.4 If this Bidding Document allows Bidders to quote separate prices for different lots (Contracts), and to award multiple Contracts to a single Bidder **as specified in BDS**, the methodology to determine the lowest evaluated price of the Contract combinations, including any discounts offered in the Letter of Price Bid, is specified in Section III (Evaluation and Qualification Criteria).
	35.5 If the bid for a Unit Rate Contract, evaluated as per ITB 36.1, is front-loaded or has quoted abnormally high rate for any item believing that the item was underestimated, the Employer **shall** require the Bidder to provide clarification along with detailed rate analysis, for any or all items of the Bill of Quantities as per ITB 27.1. The rate analysis submitted shall be analyzed and compared against prevailing norms and rates, on the basis of the work execution methodology, technology, and management methods specified by the bidder. If the clarification is deemed unsatisfactory, the Employer shall require that the amount of the performance security be increased at the expense of the Bidder as **specified in BDS**.
	35.6 In case of e-submission bids, the Employer evaluates the bid on the basis of the information in the electronically submitted bid files. If the Bidder cannot substantiate or provide evidence to establish the information provided in e-submitted bid through documents/ clarifications as per ITB Clause 27.1, the bid shall not be considered for further evaluation.
	35.7 If all the Bids evaluated are substantially higher than the cost estimate, the employer may negotiate with the bidder who submitted the lowest evaluated substantially responsive Bid to propose a lump sum discount rate in order to bring the bid price within the approved cost estimate. However, no change in the substance of the bid is permitted during the negotiations.
	35.8 If no agreement can be reached as per ITB 35.7, the employer shall cancel the procurement proceedings.

36. Comparison of Bids	36.1 The Employer shall evaluate all the bid prices of the substantially responsive bids in accordance with ITB 35.2. The Employer shall determine the Average Bid Price of all the substantially responsive Bids. The Bid Price which is closest to the Average Bid Price **AND is not substantially higher than the cost estimate** shall be selected for awarding the contract. In case two or more Bid Prices are determined to be equally closest to the Average Bid Price, the Bid Price which is below the Average Bid Price shall be selected for awarding the contract.
	36.2 While evaluating the Bid Price as per ITB 36.1, if the Bid Price of two or more Bidders is found to be equal, the Employer shall select the bid for awarding the contract by drawing of lots in presence of Bidders' designated representatives who choose to attend in date, time and place as notified by the Employer in writing to the concerned bidders. The Bidders' representatives who are present shall be requested to sign a record evidencing their attendance. The omission of a Bidder's signature on the record or the absence of a Bidder during the drawing of lots shall not invalidate the contents and the effect of the record. The method of drawing of lots shall be determined by the Employer.
37. Employer's Right to Accept Any Bid, and to Reject Any or All Bids	37.1 The Employer reserves the right to accept or reject any bid, and to annul the bidding process and reject all Bids at any time prior to contract award, without thereby incurring any liability to Bidders. In case of annulment, all Bids submitted and specifically, bid securities, shall be promptly returned to the Bidders.
	37.2 The public entity shall give notice of the rejection of bids or the cancellation of the procurement proceedings pursuant to ITB 37.1, along with the reasons for such rejection or cancellation, to all bidders**.**
	37.3 Where any bidder requests, within thirty (30) days of the communication of the notice pursuant to ITB 37.2, the grounds for the rejection of all bids or the cancellation of the procurement proceedings, the public entity shall provide such information to that bidder**.**
F. Award of Contract	
38. Award Criteria	38.1 The Employer shall award the Contract to the Bidder whose Bid Price is selected as per ITB 35.7, ITB 36.1 or ITB 36.2 and is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily.
39. Letter of Intent to Award the Contract/Notification of Award	39.1 The Employer shall notify the concerned Bidder whose bid has been selected in accordance with ITB 38.1 within seven days of the selection of the bid, in writing that the Employer has intention to accept its bid and the information regarding the name, address and amount of selected bidder shall be given to all other bidders who submitted the bid.
	39.2 After issuance of the notice under ITB 39.1 if the concerned bidder provides information pursuant to ITB 4.10 regarding saturation of maximum number of contracts, the employer shall disqualify the bidder and shall select the next Bidder whose Bid Price is closest to the previously determined Average Bid Price in accordance with ITB 38.1 and notify accordingly as per ITB 39.1.
	39.3 If no bidder submits an application pursuant to ITB 42 within a period of seven days

	of the notice provided under ITB 39.1, the Employer shall, accept the bid selected in accordance with ITB 38.1 and Letter of Acceptance shall be communicated to the selected bidder prior to the expiration of period of Bid validity, to furnish the performance security and sign the contract within fifteen days.
	39.4 After communicating letter of acceptance under ITB 39.3, if the concerned bidder provides information pursuant to ITB 4.10 regarding saturation of maximum number of contracts, the employer shall reject the bid of that bidder and shall select the next Bidder whose Bid Price is closest to the previously determined Average Bid Price in accordance with ITB 38.1 and shall issue the notice accordingly as per ITB 39.1. In such case bid security of the rejected bidder shall not be forfeited.
40. Performance Security	40.1 Within Fifteen (15) days of the receipt of Letter of Acceptance from the Employer, the successful Bidder shall furnish the performance security in an amount equal to 5 (five) percent of the Bid Price in accordance with the Conditions of Contract and subject to ITB 35.5, from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal using Sample Form for the Performance Security included in Section X (Contract Forms), or another form acceptable to the Employer. The performance security issued by any foreign Bank outside Nepal must be counter guaranteed by Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal. The Bid Price shall be without VAT but including Provisional Sum.
	40.2 Failure of the successful Bidder to submit the above-mentioned Performance Security or to sign the Contract Agreement shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security. In that event the Employer may award the Contract to the next Bidder whose Bid Price is closest to the previously determined Average Bid Price in accordance with ITB 38.1 whose offer is substantially responsive and is determined by the Employer to be qualified to perform the Contract satisfactorily. The process shall be repeated according to ITB 39.
41 Signing of Contract	41.1 The Employer and the successful Bidder shall sign the Contract Agreement within the period as stated ITB 40.1.
	41.2 At the same time, the Employer shall affix a public notice on the result of the award on its notice board and make arrangement for causing such notice to be affixed on the notice board also of the ***District Coordination Committee, District Administration Office, Provincial Treasury and Controller Office and District Treasury and Controller Office.*** The Employer may make arrangements to post the notice into its website, if it has; and if it does not have, into the website of the Public Procurement Monitoring Office, identifying the bid and lot numbers and the following information: (i) the result of evaluation of bid; (ii) date of publication of notice inviting bids; (iii) name of newspaper; (iv) reference number of notice; (v) item of procurement; (vi) name and address of bidder making contract and (viii) contract price
	41.3 Within thirty (30) days from the date of issuance of notification pursuant to ITB 39.1 unsuccessful bidders may request in writing to the Employer for a debriefing seeking explanations on the grounds on which their bids were not selected. The Employer shall promptly respond in writing to any unsuccessful Bidder who, requests for debriefing.
	41.4 If the bidder whose bid has been accepted fails to sign the contract as stated ITB 40.1, the Public Procurement Monitoring Office shall blacklist the bidder on recommendation of

	the Public Entity.
42. Complaint and Review	42.1 If a Bidder is dissatisfied with the Procurement proceedings or the decision made by the Employer in opening of the price bid or the intention to award the Contract, it may file an application to the Chief of the Public Entity within Seven (7) days of providing the notice under ITB 25.8 and ITB 39.1 by the Public Entity, for review of the proceedings stating the factual and legal grounds.
	42.2 Late application filed after the deadline pursuant to ITB 42.1 shall not be processed.
	42.3 The chief of Public Entity shall, within five (5) days after receiving the application, give its decision with reasons, in writing pursuant to ITB 42.1: (a) whether to suspend the procurement proceeding and indicate the procedure to be adopted for further proceedings; or (b) to reject the application. The decision of the chief of Public Entity shall be final for the Bid amount up to the value as stated in 42.4.
	42.4 If the Bidder is not satisfied with the decision of the Public Entity in accordance with ITB 42.3, or the decision is not given within five (5) days of receipt of application pursuant to ITB 42.1, it can, within seven (7) days of receipt of such decision, file an application to the Public Procurement Review Committee of the GoN, stating the reason of its disagreement on the decision of the chief of Public Entity and furnishing the relevant documents, provided that its Bid amount ,equal or more than Rupees Twenty Million (NRs. 20,000,000). The application may be sent by hand, by post, by courier, or by electronic media at the risk of the Bidder itself.
	42.5 Late application filed after the deadline pursuant to ITB 42.4 shall not be processed.
	42.6 Within three (3) days of the receipt of application from the Bidder, pursuant to ITB 42.4, the Public Procurement Review Committee shall notify the concerning Public Entity to furnish its procurement proceedings, pursuant to ITB 42.3.
	42.7 Within three (3) days of receipt of the notification pursuant to ITB 42.6, the Public Entity shall furnish the copy of the related documents to the Public Procurement Review Committee.
	42.8 The Public Procurement Review Committee, after inquiring from the Bidder and the Public Entity, if needed, shall give its decision within thirty (30) days of the receipt of the application filed by the Bidder, pursuant to ITB 42.4.
	42.9 The Bidder, filing application pursuant to ITB 42.4, shall have to furnish a cash amount or Bank guarantee from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law equivalent to ten percent (10 %) of amount of bid security in case of complaint against decision pursuant to ITB 25.8 and one percent (1%) of its quoted Bid amount in case of complaint against decision pursuant to ITB 39.1 with the validity period of at least ninety (90) days from the date of the filing of application pursuant to ITB 42.4.
	42.10 If the claim made by the Bidder pursuant to ITB 42.4 is justified, the Public Procurement Review Committee shall have to return the security deposit to the applicant, pursuant to ITB 42.9, within seven (7) days of such decision made.
	42.11 If the application submitted by the Bidder pursuant to ITB 42.4 is dismissed by the

	Public Procurement Review Committee, the security deposit (Cash or Bank Guarantee) submitted by the Bidder pursuant to ITB 42.9 shall be forfeited.
	42.12 If the Employer does not implement the decision of the Public Procurement Review Committee, the Bidder may file an application to the Public Procurement Review Committee.

Section II: Bid Data Sheet

This section consists of provisions that are specific to each procurement and supplement the information or requirements included in Section I. Instructions to Bidders.

A. General	
ITB 1.1	The number of the Invitation for Bids is: WSSMOLMG/NCB/Works/083/84-05
ITB 1.1	The Employer is***: Water Supply and Sewerage Management Office, Lamjung, Gandaki Province, Nepal***
ITB 1.1	**Multiple Contract or lots (contracts) is *not applicable.***
ITB 2.1	The name of the Project is ***Belchautara Co-Financing Water Supply Project, Shuklagandaki Municipality, Tanahun*** The DP is N/A The implementing agency is N/A GoN Funded or DP Funded: ***GoN Funded***
ITB 3.3 (d)	For DP Funded: Not Applicable
ITB 4.1 (a)	**For GoN Funded:** Maximum number of partners in a joint venture shall be: **3 (three)**
ITB 4.4	*For GoN:* *For DP: **N/A***
ITB 4.9 & ITB 4.10	**For GoN Funded:** The Bidder, including all parties constituting the Bidder, shall be ineligible to participate in the open competitive bidding process if it has already secured **five (5)** number of construction contracts (in open competitive bidding) and has not yet completed the work as stipulated in the respective contracts. Following Procurement of Works contracts shall not be counted for this purpose: a) The works for which tender were invited or contracts accepted before 2078-12-03 B.S (March 17, 2022 A.D). b) The works for which tender were invited and contracts accepted after 2078-12-03 B.S (March 17, 2022 A.D) but the work acceptance report has been approved according to Rule 117 of PPR. c) The works for which tenders were invited or contracts accepted under all types of foreign assistance. **For DP Funded: N/A**

B. Bidding Document	
ITB 7.1	For clarification purposes only, the Employer's address is: Attention: Mohan Pokharel Address: Besishahar, Lamjung, Nepal Telephone: 9856067110 Facsimile number: _____ Electronic mail address: fwssmplamjung@gmail.com
ITB 7.4	A Pre-Bid meeting ***shall be*** held. Pre-Bid Meeting will **Take place at the following date, time and place:** Date: 05-10-2026 Time: 13:00 Place: Water Supply and Sewerage Management Office, Lamjung A site visit "**shall not be**" organized by the Employer.
ITB 7.5	Time for request: Requests for clarification should be received by the Employer no later than **10 days** prior to the deadline for submission of bids.
C. Preparation of Bids	
ITB 10.1	The language of the bid is: **English / Nepali**
ITB 11.2 (i)	The Bidder shall submit with its Technical Bid the following additional documents: ***None***
ITB 11.3 (b)	In accordance with ITB 12 and ITB 14, the following schedules shall be submitted with the bid, including the priced Bill of Quantities for Unit Rate Contracts and Schedule of Prices for lump sum contracts: ***None***
ITB 11.3 (e)	The Bidder shall submit with its Price Bid the following additional documents: ***None***
ITB 13.1	Alternative bids ***shall not be*** permitted.
ITB 13.2	Alternative times for completion ***shall not be*** permitted. *If alternative times for completion are permitted, the evaluation method will be as specified in Section III (Evaluation and Qualification Criteria).*
ITB 13.4	Alternative technical solutions shall be permitted for the following parts of the Works: ***None*** *If alternative technical solutions are permitted, the evaluation method will be as specified in Section III (Evaluation and Qualification Criteria).*
ITB 14.6	The prices quoted by the Bidder ***shall be*** subject to adjustment during the performance of the Contract. *"Bidder shall submit the Table of Price Adjustment Data as a part of price bid."*
ITB 18.1	The bid validity period shall be: ***Ninety (90) days.***
ITB 19.1	The Bidder shall furnish a bid security, from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal with a minimum of **NRs *14,00,000.00*** which shall be valid for 30 days beyond the validity period of the bid.

ITB 19.2 (b)	Office Name: DHARAUTI A/C KO.LE.NI.KA Bank Name: Rastriya Banijya Bank Ltd. Bank Address: Lamjung, Gandaki Province,Nepal Account Number: [illegible]100102030000 Office Code: 33[illegible]
ITB 20.1	In addition to the original of the bid, the number of copy is: ***N/A***
ITB 20.2	The written confirmation of authorization to sign on behalf of the Bidder shall indicate: (a) The name and description of the documentation required to demonstrate the authority of the signatory to sign the Bid such as a Power of Attorney; and (b) In the case of Bids submitted by an existing or intended JV, an undertaking signed by all parties (i) stating that all parties shall be jointly and severally liable, and (ii) nominating a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the JV during the bidding process and, in the event the JV is awarded the Contract, during contract execution.
D. Submission and Opening of Bids	
ITB 21.1	Bidders shall have the option of submitting their bids: ***by mail / by hand / by courier***.
ITB 22.1	For bid submission purposes only, the Employer's address is: Attention: The Office Chief Address: Water Supply and Sewerage Management Office, Besishahar-8, Lamjung The deadline for bid submission is: Date: 14-10-2026 Time: 12:00
ITB 25.1	The Technical Bid opening shall take place at: Address: Water Supply and Sewerage Management Office, Besishahar-8, Lamjung Date: 14-10-2026 Time: 14:00
E. Evaluation and Comparison of Bids	
ITB 34.1	Contractor's proposed subcontracting: Maximum percentage of subcontracting permitted is: **25% (Twenty Five)**
ITB 35.4	Bidders are ***permitted*** to quote separate prices for lots (Contracts), and a single Bidder will be awarded multiple lots (Contracts) based on provision of ***Paragraph 1.2, Multiple Contracts Section III (Evaluation and Qualification Criteria):***
ITB 35.5	The amount of the performance security be increased by **Eight (8)** percent of the quoted bid price without VAT but Including PS.
ITB 41.4	For DP Funded: Not Applicable

Section III: Evaluation and Qualification Criteria

This Section contains all the criteria that the Employer shall use to evaluate bids and qualify Bidders by post-qualification exercise. GoN/DP requires bidders to be qualified by meeting predefined, precise minimum requirements. The method sets pass-fail criteria, which, if not met by the bidder, results in disqualification. In accordance with ITB 32 and ITB 35, no other methods, criteria and factors shall be used. The Bidder shall provide all the information requested in the forms included in Section IV (Bidding Forms).

1. Evaluation

In addition to the criteria listed in ITB 35.2 (a) - (e) the following criteria shall apply:

Note:
Use the evaluation criteria listed below as appropriate and required for the project.

1.1 Adequacy of Technical Proposal

Evaluation of the Bidder's Technical Proposal will include an assessment of the Bidder's technical capacity, to mobilize key equipment and personnel for the contract consistent with its proposal regarding work methods, scheduling, and material sourcing in sufficient detail and fully in accordance with the requirements stipulated in Section VI (Works Requirements).

Non-compliance with equipment and personnel requirements described in Section VI (Works Requirements) shall not be grounds for bid rejection and such non-compliance will be subject to clarification and rectification prior to contract award.

1.2 Multiple Contracts

Multiple Contracts, if permitted under ITB 35.4, will be evaluated as follows:

Award Criteria for Multiple Contracts [ITB 35.4]:

Bidders have the option to Bid for any one or more Contracts. Bids will be evaluated taking into account discounts offered, if any, for combined contracts. The contract(s) will be awarded to the Bidder or Bidders offering the lowest evaluated cost to the Employer for combined contracts, subject to the selected Bidder(s) meeting the required qualification criteria for combination of multiple contracts as the case may be.

Qualification Criteria for Multiple Contracts:

The criteria for qualification shall be the sum of the minimum requirements for respective individual contracts as specified under items 2.3.2, 2.3.3, 2.3.4 and 2.4.2 b.

With respect to the **Contracts of Similar Size and Nature** under item 2.4.2(a) of Section III, the evaluation shall be done as below:

N is the minimum number of contracts required as per Specific Construction Experience (2.4.2(a)).

V is the minimum value of a single contract as per Note (2~~),~~ **~~or~~** (3) of 2.4.2 Specific Construction Experience.

i. Minimum requirements for combined contract(s) shall be the aggregate requirements for each contract for which the bidder has submitted bids as follows, and N1,N2,N3, etc. shall be different contracts:

Contract 1: N1 contracts, each of minimum value V1;

Contract 2: N2 contracts, each of minimum value V2;

Contract 3: N3 contracts, each of minimum value V3;

----etc.

Or

ii. Total number of contracts is equal or less than N1 + N2 + N3 +--but the total value of all such contracts is equal or more than N1 x V1 + N2 x V2 + N3 x V3 +---.

1.3 In Case, other than Multiple Contracts

Bidders have the option to Bid for any one or more Contracts. The contracts will be awarded to the Bidder or Bidders offering the **substantially responsive Bid closest to the Average Bid Price** to the Employer, subject to the selected Bidder(s) meeting the required qualification which shall be the sum of the minimum requirements for respective individual contracts. Under this case, the Contract shall be awarded based on Least Cost Combination to the Employer.

1.4 Completion Time

An alternative Completion Time, if permitted under ITB 13.2, will be evaluated as follows:

[insert project specific requirements]

1.5 Alternative Technical Solutions

Alternative technical solutions, if permitted under ITB 13.4, will be evaluated as follows:

[insert project specific requirements]

1.6 Quantifiable Nonconformities and Omissions

Subject to ITB 14.2 and ITB 35.2, the evaluated cost of quantifiable nonconformities including omissions, is determined as follows:

[***Insert in bidding document:*** **"**Pursuant to ITB 31.3, the cost of all quantifiable nonmaterial nonconformities shall be evaluated but excluding omission of prices in the BoQ.The Employer will make its own assessment of the cost of any nonmaterial nonconformities and omissions for the purpose of ensuring fair comparison of bids."]

2. Qualification

2.1 Eligibility

Criteria	Compliance Requirements				Documents
Requirement	**Single Entity**	**Joint Venture**			**Submission Requirements**
		All Partners Combined	**Each Partner**	**One Partner**	
2.1.1 Nationality					
Nationality in accordance with ITB sub-clause 4.2	must meet requirement	must meet requirement	must meet requirement	not applicable	Letter of Technical Bid, Forms ELI –1; ELI – 2 with attachments
2.1.2 Conflict of Interest					
No conflicts of interest in accordance with ITB Sub-Clause 4.3.	must meet requirement	existing or intended JV must meet requirement	must meet requirement	not applicable	Letter of Technical Bid
2.1.3 Government/ DP Eligibility					
Not having been declared ineligible by government /DP, as described in ITB Sub-Clause 4.4.	must meet requirement	must meet requirement	must meet requirement	not applicable	Letter of Technical Bid
2.1.4 Government-owned Entity					
Bidder required to meet conditions of ITB Sub-Clause 4.5.	must meet requirement	existing or intended JV must meet requirement	must meet requirement	not applicable	Letter of Technical Bid, Forms ELI - 1, ELI - 2, with attachments
2.1.5 UN Eligibility					

Not having been declared ineligible based on a United Nations resolution or Employer's country law, as described in ITB Sub-Clause 4.7.	must meet requirement	existing or intended JV must meet requirement	must meet requirement	not applicable	Letter of Technical Bid
2.1.6 Bidder's Running Contracts					
Bidders have not yet secured five (5) number of construction Contracts[2] (in open competitive bidding) as described in ITB Sub-Clause 4.9.	must meet requirement	existing or intended JV must meet requirement	must meet requirement	not applicable	Letter of Technical Bid, Form ELI-3
2.1.7 Other Eligibility					
Firm or Company Registration Certificate	must meet requirement	not applicable	must meet requirement	not applicable	Document attachment
Business Registration License	must meet requirement	not applicable	must meet requirement	not applicable	Document attachment
VAT and PAN Registration certificate ***(only for domestic bidders)***	must meet requirement	not applicable	must meet requirement	not applicable	Document attachment
Tax Clearance Certificate or Tax return submission evidence or evidence of time extension for the **F/Y 2082/83** ***(Only for domestic bidders)***	must meet requirement	not applicable	must meet requirement	not applicable	Document attachment
Additional requirements ***N/A***	……..	……	……	……	……

[2] Following Procurement of Works contracts shall not be counted for this purpose:

a) The works for which tender were invited or contracts accepted before 2078-12-03 B.S (March 17, 2022 A.D)

b) The works for which tender have been invited and contracts accepted after 2078-12-03 B.S (March 17, 2022 A.D) but the work acceptance report has been approved according to Rule 117 of PPR.

c) The works for which tenders were invited or contracts accepted under all types of foreign assistance.

2.2 Pending Litigation

Criteria	Compliance Requirements				Documents
Requirement	**Single Entity**	**Joint Venture**			**Submission Requirements**
		All Partners Combined	**Each Partner**	**One Partner**	
2.2.1 Pending Litigation					
All pending litigation shall be treated as resolved against the Bidder and so shall in total not represent more than ***50 (Fifty)*** percent of the Bidder's net worth.	must meet requirement by itself or as partner to past or existing JV	not applicable	must meet requirement by itself or as partner to past or existing JV	not applicable	Form LIT - 1

Note:

(1) The percentage should normally be within the range of 50% to 100% of the Bidder's net worth.

2.3 Financial Situation

2.3.1 Historical Financial Performance					
Submission of audited balance sheets and income statements, for the last **3** ***(Three)*** years to demonstrate the current soundness of the Bidder's financial position. As a minimum, a Bidder's net worth for the last year calculated as the difference between total assets and total liabilities should be positive.	must meet requirement	not applicable	must meet requirement	not applicable	Form FIN - 1 with attachments

Note:

(2)The financial information provided by a Bidder should be reviewed in its entirety to allow a truly informed judgment, and the pass-fail decision on the financial position of the Bidder should be given on this basis. Balance sheet of the past three to five year's period which shall be decided according to the nature of the work.

2.3.2 Average Annual Construction Turnover					
Minimum average annual construction turnover of NRs ***5,35,00,000.00*** calculated as total certified payments received for construction contracts in progress or completed, within best three years out of last ten fiscal years.	must meet requirement	must meet requirement	must meet ***25%*** of the requirement	must meet ***40%*** of the requirement	Form FIN -2

Only the net amount shall be calculated after deducting the amount for VAT and such amount shall be adjusted to present value by applying wholesale price index of Nepal Rastra Bank.

Note:

(3) The amount stated should normally not be less than 1.5 x V/T, the estimated annual turnover in the subject contract based on a straight-line projection of the Engineer's estimated cost (V), over the contract duration (T) in year. The Engineer's estimated cost (V) is taken without VAT and contingencies but including provisional sum. Contract duration less than one year shall be considered one year. The multiplier of 1.5 m ay be reduced up to1 (one) in accordance with the size, nature and complexity of contracts.

(4) Usually not less than 25 %

(5) Usually not less than 40 %

2.3.3 Financial Resources					
Using Forms FIN - 3 and FIN - 4 in Section IV (Bidding Forms) the Bidder must demonstrate access to, or availability of, financial resources such as liquid assets[3], unencumbered real assets, and other financial resources, (other than any contractual advance payments) to meet the cash-flow requirement of NRs. ***1,49,00,000.00***	must meet requirement	must meet requirement	must meet ***25%*** of the requirement	must meet ***40%*** of the requirement	Form FIN - 3

Note:

[3] Liquid Assets mean cash and cash equivalents, short-term financial instruments, short term available-for-sale-securities, marketable securities, trade receivables, short-term financing receivables and other assets that can be converted into cash within ONE YEAR.

(6) Construction cash flow requirement for a number of months (to the nearest half-month), determined as the total time needed by the Employer to pay a contractor's invoice, allowing for (a) the actual time consumed for construction, from the beginning of the month invoiced, (b) the time needed by the Project Manager to issue the monthly payment certificate, (c) the time needed by the Employer to pay the amount certified, and (d) a contingency period of one month (30 days) for unforeseen delays. The total period should not exceed three months for estimated cost (without VAT and contingencies but including PS) more than NRs. 250 Millions and for estimated cost (without VAT and contingencies but including PS) less than NRs. 250 Millions, the total period should not exceed 5 months. The assessment of the monthly amount should be based on a straight-line projection of the estimated cash flow requirement over the particular contract period, neglecting the effect of any advance payment and retention monies, but including contingency allowances in the estimated contract cost.]

(7) Usually not less than 25 %

(0) Usually not less than 40 %

2.3.4 Required Bid Capacity					
The bidding capacity of the bidder should be equal to or more than the NRs **5,34,00,000.000**	must meet requirement	must meet requirement	must meet ***25%*** of the requirement	must meet ***40%*** of the requirement	Form FIN - 4 and Form FIN - 5

Note:

(9) The amount stated should be 80 % to 100 % of Engineer's Estimate (without VAT and Contingencies but including Provision Sum) in round figure

(10) Usually not less than 25 %

(11) Usually not less than 40 %

2.4 Experience

Criteria	**Compliance Requirements**				**Documents**
Requirement	**Single Entity**	**Joint Venture**			**Submission Requirement**
		All Partners Combined	**Each Partner**	**One Partner**	
2.4.1 General Construction Experience					
Experience under construction contracts in the role of contractor, subcontractor, or management contractor for at least the last ***3 (Three)*** years prior to the applications submission deadline.	must meet requirement	not applicable	must meet requirement	not applicable	Form EXP - 1

Note:

(12) Insert number of years in words and figures. The time period is normally 5 years, but may be reduced to not less than 3 years, according to the nature of works.

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirement
		All Partners Combined	Each Partner	One Partner	
2.4.2 Specific Construction Experience					
(a) Contracts of Similar Size and Nature					
(i) For Works with Estimated value (without VAT & Contingency but including PS) up to NRs. 100 million					
Participation as Prime contractor, management contractor, or subcontractor, within the last ten (10) years, that have been successfully or are substantially[a] completed and that are similar to the proposed works. The similarity shall be based on the physical size, complexity, methods, technology or other characteristics as described; 1. Water supply and/or Sanitation Project.	must meet requirement, in at least One (1) Contract with a value of at least NRs **2,14,00,000.00**	not applicable	not applicable	must meet requirement, in at least One (1) Contract with a value of at least NRs **2,14,00,000.00**	Form EXP – 2(a)

(ii) For Works with Estimated value (without VAT & Contingency but including PS) above NRs. 100 million

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirement
		All Partners Combined	Each Partner	One Partner	
Participation as Prime contractor, management contractor, or subcontractor, within the last ten (10) years, that have been successfully or are substantially[a] completed and that are similar to the proposed works. The similarity shall be based on the physical size, complexity, methods,	Must meet requirement in at least One (1) Contract with a value of at least NRs …..(14)….	not applicable	not applicable	Must meet requirement in at least One (1) Contract with a value of at least NRs …..(14)….	Form EXP – 2(a)

technology or other characteristics as described; 1…. 2…. 3…..					
(iii) For complex works with Estimated value (without VAT & Contingency but including PS) up to NRs. 100 million**					
Participation as Prime contractor, management contractor, or subcontractor, within the last ten (10) years, that have been successfully or are substantially[a] completed and that are similar to the proposed works. The similarity shall be based on the physical size, complexity, methods, technology or other characteristics as described; 1…. 2…. 3…..	must meet requirement, in at least One (1) Contract with a value of at least NRs …..(13) ….	not applicable	must meet requirement in at least one Contract with a value of at least NRs ….. ***(15)***….	must meet requirement, in at least One (1) Contract with a value of at least NRs …..(13) ….	Form EXP – 2(a)
(iv) For complex works with Estimated value (without VAT & Contingency but including PS) above NRs. 100 million**					
Participation as Prime contractor, management contractor, or subcontractor, within the last **ten (10)**) years, that have been successfully or are substantially[a] completed and that are similar to the proposed works. The similarity shall be based on the physical size, complexity, methods, technology or other characteristics as described; 1…. 2…. 3…..	must meet requirement, in at least One (1) Contract with a value of at least NRs …..(14) ….	not applicable	must meet requirement in at least one Contract with a value of at least NRs …..***(15)***….	must meet requirement, in at least One (1) Contract with a value of at least NRs …..(14) ….	Form EXP – 2(a)

Only the net amount shall be calculated after deducting the amount for VAT and such amount shall be adjusted to present value by applying wholesale price index of Nepal Rastra Bank.

***Complex works means those works involving complex technology such as tunnel roads, roads (asphalt concrete, Rigid pavement with high strength concrete etc.), major bridges, special bridges (pre stress bridge, arch bridge, cable stayed bridge, suspension bridge etc.), airport, large water supply and wastewater projects, large irrigation projects and their components like Headworks, weir, Barrage, Tunnel works, hydropower projects and similar works. However, in case of complex works like tunnel roads, airports, railway lines, hydropower projects, flyover, viaduct etc. for which experienced domestic bidders may not be available in market, in order to enhance capability of domestic bidders, the qualification criteria may be specified in a similar manner for non-complex works i.e. each partner's requirement may be specified as "not applicable".*

[a] A contract for which a Taking-Over Certificate has been issued shall be considered as substantially completed.

Note:

(13) Insert amount in Nepalese rupees, which is 40% (in above round figure in thousand) of the estimated value (without VAT and contingencies but including provisional sum) of the subject contract.

(14) Insert amount in Nepalese rupees, which is 60% (in above round figure in thousand) of the estimated value (without VAT and contingencies but including provisional sum) of the subject contract.

(15) Only in case of complex works, insert amount which is 10% (in above round figure in thousand) of the estimated value (without VAT and contingencies but including provisional sum) of the subject contract.

Criteria	**Compliance Requirements**				**Documents**
Requirement	**Single Entity**	**Joint Venture**			**Submission Requirement**
		All Partners Combined	**Each Partner**	**One Partner**	
(b) Construction Experience in Key Activities*					
Participation as Prime contractor, management contractor, or subcontractor, within a last ten (10) years, For the above or other contracts stipulated in 2.4.2(a) above, a minimum annual production rate on construction experience in the following key activities that have been successfully or substantially[a] completed: **-Procurement, Supply and Laying and Jointing of minimum 20 km HDPE/ GI/ DI/ Seamless Pipe of size not less than 32 mm diameter in a single or combinedly in multiple projects.**	must meet all requirements	must meet all requirements	not applicable	not applicable	Form EXP - 2(b)

- *Under Criterion 2.4.2 (a), the specified requirements define the similarity of contracts, whereas the key activities or production rates to be specified under Criterion 2.4.2 (b) define the required capability of the Bidder to execute key components of the Works. There shall be no inconsistency or duplication of requirements between Criteria 2.4.2(a) and 2.4.2(b).*
- *For the rate of production, the rate of production shall be on the basis of the average during the entire contract period.*
- *Only the activities having weightage 10 percent or more of the total estimated amount that should be manufactured or built by contractor should be considered as key activities.*
- *Key activities or production rates to be specified shall not restrict innovation and better quality.*
- *Key activities or production rates of different contracts for a particular duration can be added while evaluating. The annual production rate of key activities can be converted to a monthly production rate during the overlap period for better interpretation and evaluation.*
- *While specifying key activities or production rates, it shall be assured and to be recorded by public entity so that sufficient bidders with required qualification are available in market for adequate competition.*
- *Key activities or production rates to be specified shall be unambiguous e.g. environmentally friendly, international/high standard, complex technology etc.*
- *While specifying Key activities or production rates, the similarity shall be based on the complexity, methods or technology to be adopted.*
- *The activities that can be sub-contracted or readily available in the market (e.g. lift, elevator, electrical works, special type of facilities etc.) shall not considered as key activities.*

2.5 Subcontractors

The experience and financial capacity of the sub-contractors shall not be added to those of the Bidder for purposes of qualification of the Bidder.

The sub-contractors proposed shall be fully qualified for their work proposed, and meet the following criteria:

2.5 (a) Nature of Works that can be sub contracted:

(i)***Pipe Line Works***

Note: Employer should specify the nature of work, if sub-contracting is permitted.

2.5 (b) Qualification Criteria

The proposed sub-contractor shall meet the following requirements:

1) Within the last ten (10) years, completion of at least NRs. 42,80,000.00 *for work of a similar nature to the work being subcontracted.*
2) Minimum average annual construction turnover for the work being sub contracted of NRs 1,33,75,000.000, calculated as total certified payments received for construction contracts in progress or completed, within best three years out of last ten fiscal years.

Note: Delete 2.5(b) if 2.5(a) is not applicable

(5) 80% of the value in Nepalese Rupees (NRs).

*(6) The amount stated should not be less than 1.5 * V/T where V is the proposed value of sub contract works and T is estimated time in year for which the intended sub-contracting work is to be completed. For intended Sub contracting work duration of up to 1 year, T shall be "1".*

Section IV: Bidding Forms

This Section contains the forms which are to be completed by the Bidder and submitted as part of its Bid.

Letter of Technical Bid

The Bidder must accomplish the Letter of Technical Bid in its letter head clearly showing the Bidder's complete name and address.

Date: .....

Name of the contract: .....

Invitation for Bid No.: .....

To: ***[Insert Complete name of Employer]*** …….....

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) Clause 8.

(b) We offer to execute in conformity with the Bidding Documents the following Works: ***[Insert Description of the works]***

(c) Our Bid consisting of the Technical Bid and the Price Bid shall be valid for a period of ***[insert validity period as specified in ITB 18.1 of the BDS]*** days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

(d) Our firm, including any subcontractors or suppliers for any part of the Contract, have nationalities from eligible countries in accordance with ITB 4.2 and meet the requirements of ITB 3.4,& ITB 3.5

(e) We are not participating, as a Bidder or as a subcontractor, in more than one Bid in this bidding process in accordance with ITB 4.3(e), other than alternative offers submitted in accordance with ITB 13.

(f) Our firm, its affiliates or subsidiaries, including any Subcontractors or Suppliers for any part of the contract, has not been declared ineligible by DP, under the Employer's country laws or official regulations or by an act of compliance with a decision of the United Nations Security Council;

(g) [We are not a government owned entity] / [We are a government owned entity but meet the requirements of ITB 4.5];[1]

(h) We declare that, we including any subcontractors or suppliers for any part of the contract do not have any conflict of interest in accordance with ITB 4.3 and we have not been punished for an offense relating to the concerned profession or business.

(i) We declare that we are solely responsible for the authenticity of the documents submitted by us. The document and information submitted by us are true and correct. If any document/information given is found to be concealed at a later date, we shall accept any legal actions by the Employer.

(j) We agree to permit the Employer/DP or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by the Employer.

(k) If our Bid is accepted, we commit to mobilizing key equipment and personnel in accordance with the requirements set forth in Section VI (Works Requirement) and our technical proposal, or as otherwise agreed with the Employer.

(l) We declare that we have not yet secured five (5)[4] number of construction contract (in open competitive bidding) as described in ITB Sub-Clause 4.9.

Name: ***[insert complete name of the person signing the Bid]*****.....**

In the capacity of ***[insert legal capacity of person signing the Bid]*****.....**

Signed ***[signature of the person whose name and capacity are shown above]*****……...**

Duly authorized to sign the Bid for and on behalf of ***[insert complete name of the Bidder]*****……**

Date ***[insert date of signing]*****…….....**

[1] Note: Use one of the two options as appropriate.

[4] Note: Following Procurement of Works contracts shall not be counted for this purpose:

a) The works for which tender were invited or contracts accepted before 2078-12-03 B.S (March 17, 2022 A.D).

b) The works for which tender have been invited and contracts accepted after 2078-12-03 B.S (March 17, 2022 A.D) but the work acceptance report has been approved according to Rule 117 of PPR.

c) The works for which tenders were invited or contracts accepted under all types of foreign assistance.

Letter of Price Bid

The Bidder must accomplish the Letter of Price Bid in its letterhead clearly showing the Bidder's complete name and address.

Date: .....

Name of the contract: .....

Invitation for Bid No.: .....

To: ***[Insert Complete name of Employer]*** …….....

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) Clause 8;

We offer to execute in conformity with the Bidding Documents the following Works: ***[Insert Description of the works]*** .

(c)The total price of our Bid, excluding any discounts offered in item (d) below is: ***[Insert one of the options below as appropriate]*** or when left blank is the Bid Price indicated in the Bill of Quantities.

Option 1, in case of single contract: Total price is: ***[insert the total price of the Bid in words and figures];***

Or

Option 2, in case of multiple lots (contracts): (i) Total price of each lot (contracts): ***[insert the total price of each lot in words and figures]***; (ii) Total price of subject contract [say Lot1] and Lot2 [another contract] ***[insert the total price in words and figures];*** (iii) Total price of subject contract [say Lot1]and Lot3 [another contract] ***[insert the total price in words and figures];*** Total price of subject contract [say Lot1], Lot2 [another contract], Lot3 [another contract], ***……..[insert the total price in words and figures]***;

(d) The discounts offered and the methodology for their application for subject contract [single contract] are:…….. [For Bidding Documents not provisioning multiple contracts]

Add following if Bidding Document provisions applicability of multiple contracts:

The discounts offered and the methodology for their application for subject contract [say Lot1] and Lot2 [another contract] are:……..

The discounts offered and the methodology for their application for subject contract [say Lot1] and Lot3 [another contract] are:……..

The discounts offered and the methodology for their application for subject contract [say Lot1], Lot2 [another contract] and Lot3 [another contract],……,
are:……..

[Note:
1. Formulate possible combinations depending upon the number of lots under Bidding Process and modify accordingly Paragraph (c) and (d)]

(e) Our bid shall be valid for a period of ***[insert validity period as specified in ITB 18.1]*** days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(f) If our bid is accepted, we commit to obtain a performance security in accordance with the Bidding Document;

(g) We have paid, or will pay the following commissions, gratuities, or fees with respect to the bidding process or execution of the Contract:[5]

Name of Recipient	**Address**	**Reason**	**Amount**
.....	.....	.....	.....
.....	.....	.....	.....

(h) We understand that this bid, *together with your written acceptance thereof i*ncluded **i**n your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed;

(i) We understand that you are not bound to accept the bid closest to the Average Bid Price or any other bid that you may receive; and

(j) We declare that we are solely responsible for the authenticity of the documents submitted by us.

(k) We agree to permit the Employer/DP or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by the Employer.

Name: ***[insert complete name of the person signing the Bid]***.....

In the capacity of ***[insert legal capacity of person signing the Bid]*****.....**

Signed ***[signature of the person whose name and capacity are shown above]*** ……...

Duly authorized to sign the Bid for and on behalf of ***[insert complete name of the Bidder]*****……**

Date ***[insert date of signing]***…… ……....

---

5 If none has been paid or is to be paid, indicate "None".

Table of Price Adjustment Data[6]

[To be used if Price Adjustment is applicable as per GCC 53.1]

Code	Index Description	Source of Index*	Base Value and Date	Employer's Proposed Weighting Range (coefficient)	Bidder's Proposed Weighting (coefficient)**
1	2	3	4	5	6
	Non - Adjustable (A)			0.15	0.15
	Labor (b)	NRB	30 days before last date of Submission.	0.15-0.25	
	Materials (c)***	NRB	30 days before last date of Submission.	0.40-0.60	
	Equipment usage (d)	NRB	30 days before last date of Submission.	0.05-0.15	
		Total			1.00

*Normally following source of index shall apply. Public Entity shall choose applicable Index for each item.

(a) Labor: "National Salary and Wage Rate Index"- "Construction Labor" of Nepal Rastra Bank or rate fixed by District Rate Fixation Committee

[6] Non-compliance of the data (stipulated by the bidder in this table) with requirements described here shall not be grounds for bid rejection and such non-compliance will be subject to clarification and rectification prior to contract award.

(b) Material: "National Wholesale Price Index" - Construction Materials" of Nepal Rastra Bank

(c) Equipment usage: "National Wholesale Price Index" - Machinery and Equipment" of Nepal Rastra Bank or "Fuel" Price fixed by Nepal Oil Corporation.

** Bidders proposed weightings should be within the range specified by the Employer in column - 5
*** The materials can be broken down into major construction materials if necessary. In this case the source of index shall be the specified by Employer, preferably as per the published ex-factory price or published price from the sole authorized seller.

Table of Price Adjustment Data[7]

[To be used if Price Adjustment is applicable as per GCC 53.6]

Code	Construction Material*	Unit	Base Price (NRs/Unit) (Ex-factory)	Source (Factory)**
1	2	3	4	5

* Major construction materials to be specified by Employer in column - 2.

** Base Price and source normally to be specified by Employer (or alternatively informed to be proposed by bidder) in column 4 and 5.

Note:
The base prices of the construction materials shall be taken as of 30 days before the deadline for submission of the Bid as quoted by the Bidder and verified by the Employer. For the purpose of calculation of price adjustment, the Ex-factory price of the same source shall be taken into consideration.

[7] Non-compliance of the data (stipulated by the bidder in this table) with requirements described here shall not be grounds for bid rejection and such non-compliance will be subject to clarification and rectification prior to contract award.

Bid Security

Bank Guarantee

Bank's Name, and Address of Issuing Branch or Office

(On Letter head of the Bank)

Beneficiary: ***.....[Insert name and address of Employer]*** ……

Date: ……Bid Security No.: .....

We have been informed that. ……. ***[insert name of the Bidder]*** (hereinafter called "the Bidder")intends to submit its bid (hereinafter called "the Bid") to you for the execution of ***……....[Insert name of Contract]*** …… under Invitation for Bids No. ……***[insert IFB No.]*** ("the IFB").

Furthermore, we understand that, according to your conditions, bids must be supported by a bid guarantee.

At the request of the Bidder, we…….. . [***Insert name of Bank]*** …….. hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of Nepalese Rupees . . ……...***[Insert amount in figures and amount in words} ……..*** upon receipt by us of your first demand in writing accompanied by a written statement stating that the Bidder is in breach of its obligation(s) under the bid conditions, because the Bidder:

(a) has withdrawn or modifies its Bid:

i) during the period of bid validity specified by the Bidder on the Letter of Technical and Price Bid, in case of electronic submission

(ii) from the period twenty-four hours prior to bid submission deadline up to the period of bid validity specified by the Bidder on the Letter of Technical Bid and Price Bid, in case of hard copy submission; or

(b) does not accept the correction of errors in accordance with the Instructions to Bidders (hereinafter "the ITB"); or

(c) changes the prices or substance of the bid while providing information pursuant to clause 27.1 of ITB; or

(d) having been notified of the acceptance of its Bid by the Employer during the period of bid validity, (i) fails or refuses to execute the Contract Agreement, or (ii) fails or refuses to furnish the performance security, in accordance with the ITB; or

(e) is involved in fraud and corruption in accordance with the ITB; or

(f) if the bidder fails to inform about the saturation of the maximum number of contracts as per ITB 4.10.

This guarantee will remain in force up to and including the date ……***number***……days after the deadline for submission of Bids as such deadline is stated in the instructions to Bidders or as it may be extended by the Employer, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this guarantee should reach the Bank not letter than the above date.

This Bank guarantee shall not be withdrawn or released merely upon return of the original guarantee by the Bidder unless notified by you for the release of the guarantee.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG), 2010 Revisions, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.

. . .Bank's seal and authorized signature(s) . . .

Note:

The bid security of ……..……. has been counter guaranteed by the Bank ……..……..…… on ……... ....……..……. (Applicable for Bid Security of Foreign Banks).

Technical Proposal Format

Personnel

Equipment

Site Organization

Method Statement

Mobilization Schedule

Construction Schedule

Others

Personnel

Form PER - 1: Proposed Personnel

Bidders should provide the names of suitably qualified personnel to meet the specified requirements for each of the positions listed in Section VI (Work Requirements). The data on their experience should be supplied using the Form below for each candidate.

No.	Name	Position*	Academic Qualification	Total Work Experience [Years]	Experience in Similar Works [years]
1.					
2.					
3.					
4.					
5.					

* As listed in Section VI (Work Requirements).

Form PER - 2: Resume of Proposed Personnel

The Bidder shall provide all the information requested below.

Position*		
Personal Information	Name	Date of Birth
	Professional qualifications	
Present employment	Name of employer	
	Address of employer	
	Telephone	Contact (manager/personnel officer)
	Fax	E-mail
	Job title	Years with present employer

Summarize professional experience over the last twenty years in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

From	**To**	**Company, Project, Position and Relevant Technical and Management Experience**

Equipment

Form EQU: Equipment

The Bidder shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in Section VI (Work Requirements). A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Bidder.

(i) For the equipment under Bidder's ownership

No.	Equipment Type and Characteristics	Total Nos. of Equipment under Bidder's Ownership	No. of Equipment engaged/proposed for ongoing/committed contracts	Nos. of Equipment proposed for this contract
1.				
2.				
3.				
4.				
5.				

(ii) For the Equipment to be leased/hired

No.	Equipment Type and Characteristics	Total Nos. of Equipment under the ownership of lease/hire provider	No. of Equipment engaged/committed for other works	Nos. of Equipment proposed to be leased/hired for this contract
1.				
2.				
3.				
4.				
5.				

Type of Equipment		
Equipment Information	Name of manufacturer	Model and power rating
	Capacity	Year of manufacture
Current Status	Current location	
	Details of current commitments	
Source	Indicate source of the equipment ☐ Owned ☐ Rented ☐ Leased ☐ Specially manufactured	

The following information shall be provided only for equipment not owned by the Bidder.

Owner	Name of owner	
	Address of owner	
	Telephone	Contact name and title
	Fax	email
Agreements	Details of rental / lease / manufacture agreements specific to the project	

The Bidder shall be solely responsible for the data provided. However, this shall not limit the right of Employer to verify the authenticity of submitted information.

Bidder's Information and Qualification Format

Site Organization

Method Statement

Mobilization Schedule

Construction Schedule

Others

Bidder's Qualification

To establish its qualifications to perform the contract in accordance with Section III (Evaluation and Qualification Criteria) the Bidder shall provide the information requested in the corresponding Information Sheets included hereunder.

Form ELI - 1: Bidder's Information Sheet

Bidder's Information	
Bidder's legal name	
In case of JV, legal name of each partner	
Bidder's country of constitution	
Bidder's year of constitution	
Bidder's legal address in country of constitution	
Bidder's authorized representative (name, address, telephone numbers, fax numbers, e-mail address)	
Attached are copies of the following original documents.	
1. In case of single entity, articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and 4.2. 2. Authorization to represent the firm or JV named in above, in accordance with ITB 20.2. 3. In case of JV, letter of intent to form JV or JV agreement, in accordance with ITB 4.1. 4. In case of a government-owned entity, any additional documents not covered under 1 above required to comply with ITB 4.5.	

Form ELI - 2: JV Information Sheet

Each member of a JV must fill in this Form.

JV / Specialist Subcontractor Information	
Bidder's legal name	
JV Partner's or Subcontractor's legal name	
JV Partner's or Subcontractor's country of constitution	
JV Partner's or Subcontractor's year of constitution	
JV Partner's or Subcontractor's legal address in country of constitution	
JV Partner's or Subcontractor's authorized representative information (name, address, telephone numbers, fax numbers, e-mail address)	
Attached are copies of the following original documents.	
1. articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and 4.2. 2. Authorization to represent the firm named above, in accordance with ITB 20.2. 3. In the case of government-owned entity, documents establishing legal and financial autonomy and compliance with commercial law, in accordance with ITB 4.5.	

Form ELI - 3: Bidder's Running Contracts[8]

Each member of a JV must fill in this Form

	Bidder's Running Contracts				
Name of office	**Contract Identification no.**	**Source of Fund***	**Date of issuance of Letter of Acceptance**	**Status of contract****	**Date of Issuance of Taking Over Certificate*****

* Mention GON funded or DP funded or Other PE (Insert name) funded

** Mention "Yet to sign" if contract is not signed, "Running" if contract has been signed and contract is running and "Substantially completed" if taking over certificate has been issued.

** Insert date of issuance of taking over certificate if the awarded contract has been substantially completed and taking over certificate has been issued.

[8]:Note Following Procurement of Works contracts shall not be counted for this purpose

a) The works for which tender were invited or contracts accepted before 2078-12-03 B.S (March 17, 2022 A.D).

b) The works for which tender have been invited and contracts accepted after 2078-12-03 B.S (March 17, 2022 A.D) but the work acceptance report has been approved according to Rule 117 of PPR.

c) The works for which tenders were invited or contracts accepted under all types of foreign assistance

Form LIT - 1: Pending Litigation

Each member of a JV must fill in this Form.

Pending Litigation			
☐ No pending litigation in accordance with Criteria 2.2 of Section III (Evaluation and Qualification Criteria) ☐ Pending litigation in accordance with Criteria 2.2 of Section III (Evaluation and Qualification Criteria)			
Year	**Matter in Dispute**	**Value of Pending Claim in NRS**	**Value of Pending Claim as a Percentage on Net Worth**

Form FIN - 1: Financial Situation

Each Bidder or member of a JV must fill in this form

Financial Data for Previous 3 Years [in NRS]		
Year 1 :	**Year 2 :**	**Year 3 :**

Information from Balance Sheet

Total Assets			
Total Liabilities			
Net Worth			
Current Assets			
Current Liabilities			

Information from Income Statement

Total Revenues			
Profit Before Tax			
Profit After Tax			

- Attached are copies of financial statements (balance sheets including all related notes, and income statements) for the last three or above years, as indicated above, complying with the following conditions.
- All such documents reflect the financial situation of the Bidder or partner to a JV, and not sister or parent companies.
- Historic financial statements must be audited by a certified auditor.
- Historic financial statements must be complete, including all notes to the financial statements.
- Historic financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted).

Form FIN - 2: Average Annual Construction Turnover

Each Bidder or member of a JV must fill in this form

The information supplied should be the Annual Turnover of the Bidder or each member of a JV in terms of the amounts billed to clients for each year for work in progress or completed to NRs at the end of the period reported.

Annual Turnover Data for the Last 10 Years (Construction only)	
Year	Amount Currency

- **Average Annual Construction Turnover (Best three years within the last 10 years)**

Form FIN - 3: Financial Resources

Specify proposed sources of financing, such as liquid assets, unencumbered real assets and other financial means, net of current commitments, available to meet the total construction cash flow demands of the subject contract or contracts as indicated in Section III (Evaluation and Qualification Criteria).

Financial Resources		
No.	**Source of financing**	**Amount (in NRS)**
1		
2		
3		

Form FIN – 4: Bid Capacity

Each Bidder or member of a JV shall fill in this form

Bid Capacity = [(5 x A) – B]

A = Average Annual Turnover of best three years out of last ten fiscal years.

B = Annual Value of the existing commitments and works (ongoing) to be completed, calculated from **FIN-4.**

SN	Name of Bidder	Pan No.	A, in Million	B, in Million	Bid Capacity, in Million
1					
2					
3					

Total Bid Capacity:

Signature of Bidder

Form FIN- 5: Current Contract Commitments / Works in Progress

Bidders and each partner to a JV should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

Current Contract Commitments (For Calculation of B with reference of FIN-3)									
No.	**Name of Contract**	**Name of the Contractor/s**	**Employer's Contact Address, Tel, Fax**	**Contract Share in % (a)**	**Contract Amount in Millions (b)**	**Contract Date(yyyy-mm) (c)**	**Initial or Revised Contract Duration (months) (d)**	**Value of outstanding works [In Millions, NRS]# (e)**	**Estimated Time in Month to Complete the outstanding works (f) = (c) + (d) – Date of Invitation of Bid (f)**
1									
2									
3									
4									

Signature of Bidder

 # The Outstanding Works means Contract Price (excluding Vat) minus Work Evaluated by Employer till the reference date. Bidder shall have to submit the relevant documentary evidence to substantiate the facts/figures.

Note 1: "B" shall be calculated as : $B = \sum \left[\frac{(e) \times (a)}{(f)} \right] x12$ **, If (f) is less than 12, then value of (f) shall be taken as 12.**

Note 2: If Initial or Revised Contract Date is run out with respect to Date of Invitation of Bid, the Estimated Time in Month to Complete the outstanding works shall be taken equal to 12 months.

Form EXP - 1: General Construction Experience

Each Bidder or member of a JV must fill in this form.

General Construction Experience				
Starting Month Year	**Ending Month Year**	**Year**	**Contract Identification and Name and Address of Employer Brief Description of the Works Executed by the Bidder**	**Role of Bidder**

नेपाल सरकार
भौतिक पूर्वाधार विकास मन्त्रालय
खानेपानी तथा ढल व्यवस्थापन विभाग
खानेपानी तथा ढल व्यवस्थापन कार्यालय
लमजुङ

Form EXP - 2(a): Specific Construction Experience

Fill up one (1) form per contract.

Contract of Similar Size and Nature			
Contract No…… of…..	**Contract Identification**		
Award Date		**Completion Date**	
Role in Contract	☐ **Contractor**	☐ **Management Contractor**	☐ **Subcontractor**
Total Contract Amount	☐ **NRS ……..**		
If Partner in a JV or subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**	
Employer's Name **Address** **Telephone/Fax** **Number** **E-mail**			
Description of the similarity in accordance with Criteria 2.4.2 (a) of Section III			
Note : ***The Employer should insert here contract size, complexity, methods, technology, or other characteristics as described in Section III (EQC), 2.4.2 (a) against which the bidder demonstrates similarity in the box on the right-hand-side.***			

Form EXP - 2(b): Specific Construction Experience in Key Activities

Fill up one (1) form per contract.

Contract of Similar Size and Nature			
Contract No…… of……..	**Contract Identification**		
Award Date		**Completion Date**	
Role in Contract	🗀 **Contractor**	🗀 **Management Contractor**	🗀 **Subcontractor**
Total Contract Amount	🗀 **NRS ……..**		
If Partner in a JV or subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**	
Employer's Name **Address** **Telephone/Fax** **Number** **E-mail**			
Description of the similarity in accordance with Criteria 2.4.2 (a) of Section III			
Note : *The Employer should insert here production rate(s) for the key activity (activities) subject contract against which the bidder demonstrates in the box on the right-hand-side production rates achieved by him on previous contracts.*			

Section V - Eligible Countries

[This section contains the list of eligible countries. Select one option, either GoN Funded or DP Funded.]

For GoN funded*: [with estimate up to NRs. 5 billion]*

For the purpose of ITB 4.2: "**Nepal"**; and

For the purpose of Country-of-Origin ITB 5.1 and GCC 79.2: **"all Countries"**

For DP funded: N/A

Part II: REQUIREMENTS

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Section VI: Works Requirements

This Section contains the Scope of Work, Specification, the Drawings, supplementary information that describe the Works to be procured, Personnel Requirements and Equipment Requirements.

Scope of Work

Belchautara Co-Financing Water Supply Project, Shuklagandaki Municipality, Tanahun, comprises the construction of Valve Chambers, Pipeline works- About 32 km, House Connections, fittings etc. in Belchautara, Shuklagandaki Municipality of Tanahun district.

Specifications

Notes on the Specifications

A set of precise and clear specifications is a prerequisite for Bidders to respond realistically and competitively to the requirements of the Employer without qualifying or conditioning their Bids. The specifications must be drafted to permit the widest possible competition and, at the same time, present a clear statement of the required standards of workmanship, materials, and performance of the goods and services to be procured. Only if this is done will the objectives of economy, efficiency and fairness in procurement be realized, responsiveness of Bids be ensured, and the subsequent task of bid evaluation facilitated. The specifications should require that all goods and materials to be incorporated in the Works be new, unused, of the most recent or current models, and incorporate all recent improvements in design and materials unless provided otherwise in the Contract.

Samples of specifications from previous similar projects are useful in this respect. The use of metric units is encouraged by the Funding Agency in case of funding assisted projects. Most specifications are normally written specially by the Employer or Project Manager to suit the Contract Works in hand. The available standard specification of works of Ministry of Physical Infrastructure and Transport, DoLI and Other line Ministries can be adopted for respective civil construction works.

There are considerable advantages in standardizing General Specifications for repetitive Works in recognized public sectors, such as highways, urban housing, irrigation, and water supply, in the same country or region where similar conditions prevail. The General Specifications should cover all classes of workmanship, materials, and equipment commonly involved in construction; however, it may not necessarily be adequate to be used in a particular Works Contract and may necessitate preparation of Particular (Special) Specifications to amend and or supplement the provision of the General Specifications to meet the requirement of the particular Works.

Care must be taken in drafting specifications to ensure that they are not restrictive. In the specification of standards for goods, materials, and workmanship, recognized international standards should be used as much as possible. Where other particular standards are used, whether national standards of Nepal or other standards, the specifications should state that goods, materials, and workmanship that meet other authoritative standards, and which ensure substantially equal or higher quality than the standards mentioned, will also be acceptable.

Employers should decide whether technical solutions to specified parts of the Works are to be permitted. Alternatives are appropriate in cases where obvious (and potentially less costly) alternatives are possible to the technical solutions indicated in the Procurement Documents for certain elements of the Works, taking into consideration the comparative specialized advantage of potential bidders. For example:

The Employer should provide a description of the selected parts of the Works with appropriate references to Drawings, Specifications, Bill of Quantities, and Design or Performance criteria, stating that the alternative solutions if applicable shall be at least structurally and functionally equivalent to the basic design parameters and specifications.

Such alternative solutions shall be accompanied by all information necessary for a complete evaluation by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, proposed construction methodology, and other relevant details.

Sample Clause: Equivalency of Standards and Codes

Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national, or relate to a particular country or region, other authoritative standards that ensure a substantially equal or higher quality than the standards and codes specified will be accepted subject to the Project Manager's prior review and written consent. Differences between the standards specified and the proposed alternative standards shall be fully described in writing by the Contractor and submitted to the Project Manager at least 30 days prior to the date when the Contractor desires the Project Manager's consent. In the event the Project Manager determines that such proposed deviations do not ensure substantially equal or higher quality, the Contractor shall comply with the standards specified in the documents.

These Notes for Preparing Specifications are intended only as information for the Employer or the person drafting the Procurement Documents. They should not be included in the final documents.

[General Technical Specification attached at Bottom]

Drawings

Note:

1. It is customary to bind the drawings in a separate volume, which is often larger than other volumes of the contract documents. The size will be dictated by the scale of the drawings, which must not be reduced to the extent that details are reduced illegible.

2. A simplified map showing the location of the Site in relation to the local geography, indicating major roads, posts, airports, and railroads, is helpful.

3. The construction drawings, even if not fully developed, must show sufficient details to enable bidders to understand the type and complexity of the work involved and the price the Bill of Quantities.

[Drawings attached at Bottom]

Supplementary Information

[insert supplementary information if any]

Personnel Requirements

Using Form PER-1 and PER-2 in Section IV (Bidding Forms), the Bidder must demonstrate it has personnel that meet the following requirements:

SN.	Position	Required No.	Academic Qualification *[When position demands]*	Total Work Experience [Years]	Experience in Similar Works [years]
1.	Project Manager	**1**	**Bachelor in civil engineering or equivalent**	**5**	**3**
2.	Junior Engineer	**1**	Diploma in civil Engineering or Equivalent	**3**	**1**

Equipment Requirements

Using Form EQU in Section IV (Bidding Forms), the Bidder must demonstrate it has the key equipment listed below:

No.	Equipment Type and Characteristics	Min. Number Requirement
1.	Excavator (0.5 Cum Capacity)	1
2.	Concrete Mixture	1

Section VII: Bill of Quantities[9]

Notes for Unit Rate Contracts:

Objectives

The objectives of the Bill of Quantities are
(a) to provide sufficient information on the quantities of Works to be performed to enable Bids to be prepared efficiently and accurately; and
(b) when a Contract has been entered into, to provide a priced Bill of Quantities for use in the periodic valuation of Works executed.

In order to attain these objectives, Works should be itemized in the Bill of Quantities in sufficient detail to distinguish between the different classes of Works, or between Works of the same nature carried out in different locations or in other circumstances which may give rise to different considerations of cost. Consistent with these requirements, the layout and content of the Bill of Quantities should be as simple and brief as possible.

Content
The Bill of Quantities should be divided generally into the following sections:
(a) Preamble;
(b) Work Items (grouped into parts);
(c) Day works Schedule;
d) Provisional Sums; and
(d) Summary.

Preamble
The Preamble should indicate the inclusiveness of the unit prices, and should state the methods of measurement which have been adopted in the preparation of the Bill of Quantities and which are to be used for the measurement of any part of the works.

Work Items

[9]In lump sum contracts, delete "Bill of Quantities" and replace with "Schedule of Activities" throughout this section.

The items in the Bill of Quantities should be grouped into sections to distinguish between those parts of the Works which by nature, location, access, timing, or any other special characteristics may give rise to different methods of construction, or phasing of the Works, or considerations of cost. General items common to all parts of the works may be grouped as a separate section in the Bill of Quantities.

Day work Schedule

A Day work Schedule should be included only if the probability of unforeseen work, outside the items included in the Bill of Quantities, is high. To facilitate checking by the Employer of the realism of rates quoted by the Bidders, the Day work Schedule should normally comprise the following:

(a) A list of the various classes of labour, materials, and Constructional Plant for which basic day work rates or prices are to be inserted by the Bidder, together with a statement of the conditions under which the Contractor will be paid for work executed on a day work basis.

(b) Nominal quantities for each item of Day work, to be priced by each Bidder at Day work rates as bid. The rate to be entered by the Bidder against each basic Day work item should include the Contractor's profit, overheads, supervision, and other charges.

Provisional Sums

Provisional Sums included and so designated in the Bill of Quantities shall be expended in whole or in part at the direction and discretion of the Project Manager in accordance with the Conditions of Contract.

Summary

The Summary should contain a tabulation of the separate parts of the Bill of Quantities carried forward, with provisional sums for Day work, for physical (quantity) contingencies, and for price contingencies (upward price adjustment) where applicable.

Preamble of Bill of Quantities

A. General

1. The Bill of Quantities shall be read in conjunction with the Instructions to Bidders, General and Special Conditions of Contract, Technical Specifications, and Drawings.

2. The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the Contractor and verified by the Project Manager and valued at the rates and prices bid in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Project Manager may fix within the terms of the Contract.

3. For any item for which measurement is based on records made before or during construction the records shall be prepared and agreed between the Engineer and the Contractor. Should the Contractor carry out such work without the prior agreement of the Engineer, the Engineer may request the Contractor to carry out investigations to confirm the extent of the work and the quantity of work certified for payment shall be solely at the Engineer's discretion. The cost of any such investigation shall be borne by the Contractor.

4. The rates and prices bid in the priced Bill of Quantities shall, except as otherwise provided under the Contract, include all construction equipment, labor, supervision, materials, erection, maintenance, insurance, profit, taxes, and duties, together with all general risks, liabilities, and obligations set out or implied in the Contract.

5. A rate or price shall be entered against each item in the priced Bill of Quantities, whether quantities are stated or not. The cost of items against which the Contractor has failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bill of Quantities.

6. The whole cost of complying with the provisions of the Contract shall be included in the Items provided in the priced Bill of Quantities, and where no Items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related Items of Work.

7. General directions and descriptions of work and materials are not necessarily repeated nor summarized in the Bill of Quantities. References to the relevant sections of the Contract documentation shall be made before entering prices against each item in the priced Bill of Quantities. The Specification Clause references where given in the item description of the Bills of Quantities are for the convenience of bidders and generally refer to the principal relevant- specification clause but do not necessarily represent the whole of the specification requirements for the work required within the item. The presence of a Specification clause reference shall not in any way reduce the Bidders obligation to complete work in accordance with all the requirements of the Specification.

8. Provisional Sums included and so designated in the Bill of Quantities shall be expended in whole or in part at the direction and discretion of the Project Manager in accordance with the Conditions of Contract.
9. The method of measurement of completed work for payment shall be in accordance with the Specifications.
10. The abbreviations and symbols used in this Bill of Quantities are:***[Insert as applicable]***

B. Day work Schedule

a)General

1. Work shall not be executed on a day work basis except by written order of the Project Manager. Bidders shall enter basic rates for day work items in the Schedules. These rates shall apply to any quantity of day work ordered by the Project Manager. Nominal quantities have been indicated against each item of day work, and the extended total for day work shall, be carried forward as a Provisional Sum to the Summary Total Bid Amount. Unless otherwise adjusted, payments for day work shall be subject to price adjustment in accordance with the provisions in the Conditions of Contract.

b) Day work Labor

1. In calculating payments due to the Contractor for the execution of day works, the hours for labor will be reckoned from the time of arrival of the labor at the job site to execute the particular item of day work to the time of departure from the job site, but excluding meal breaks and rest periods. Only the time of classes of labor directly doing work ordered by the Project Manager and are competent to perform such work will be measured. The time of gangers (charge hands) actually doing work with the gangs will also be measured but not the time of foremen or other supervisory personnel.

2. The Contractor shall be entitled to payment in respect of the total time that labor is employed on day work, calculated at the basic rates entered by it in the " SCHEDULE OF DAY WORK RATES: 1. LABOR". The rates for labor shall be deemed to cover all costs to the Contractor including (but not limited to) i) the amount of wages paid to such labor, transportation time, overtime, subsistence allowances, ii) any sums paid to or on

behalf of such labor for social benefits in accordance with Nepal law, iii) Contractor's profit, overheads, superintendence, liabilities and insurance and iv) charges incidental to the foregoing.

c) Day work Equipment

1. The Contractor shall be entitled to payments in respect of Constructional Plant already on site and employed on day work at the basis rental rates entered by him in the "SCHEDULE OF DAY WORK RATES:2 EQUIPMENT". The said rates shall be deemed to include due and complete allowance for depreciation, interest, indemnity and insurance, repairs, maintenance, supplies, fuel, lubricant, and other consumables and all overhead, profit and administrative costs related to the use of such equipment. The cost of drivers, operators and assistants also shall be included in the rate of the equipment and no separately payment shall be made for it.
2. In calculating the payment due to the Contractor for Constructional Plant employed on day work, only the actual number of working hours will be eligible for payment, except that where applicable and agreed with the Project Manager, the travelling time from the part of the Site where the Construction Plant was located when ordered by the Project Manager to be employed on day work and the time for return journey there to shall be included for payment.

d) Day work Materials

1. The Contractor shall be entitled to payment in respect of materials used for day work (except for materials for which the cost is included in the percentage addition to labor costs as detailed heretofore), at the rates entered by him in the "SCHEDULE OF DAY WORK RATES: 3 MATERIALS" and shall be deemed to include overhead charges and profit as follows;
   (i) the rates for materials shall be calculated on the basis of the invoiced price, freight, insurance, handling expenses, damage, losses, etc. and shall provide for delivery to store for stockpiling at the Site.
   (ii) the cost of hauling materials for use on work ordered to be carried out as day work, from the store or stockpile on the Site to the place where it is to be used also shall be include in the same rate.

Provisional Sums

The estimated cost of specialized work to be carried out, or of special goods to be supplied, by other contractors should be indicated in the relevant part of the Bill of Quantities as a particular provisional sum with an appropriate brief description. A separate procurement procedure is normally carried out by the Employer to select such specialized contractors. To provide an element of competition among the Bidders in respect of any facilities, amenities, attendance, etc., to be provided by the successful Bidder as prime Contractor for the use and convenience of the specialist contractors, each related provisional sum should be followed by an item in the Bill of Quantities inviting the Bidder to quote a sum for such amenities, facilities, attendance, etc.

1 INTRODUCTION

The Bill of Quantities includes this preamble, the parts of the Bill of Quantities and the schedules.

The Bill of Quantities shall be read in conjunction with the Conditions of Contract, the Specifications, and the Drawings. The work or materials covered by items in the Bill of Quantities are as detailed in the Specifications and Drawings.

The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding therefore they are not to be taken as accurate quantities of the Works to be executed by the Contractor in fulfillment of his obligations under the Contract. The basis of payment will be the actual quantities of work ordered and carried out, as measured and verified by the Engineer and valued at the rates and prices bid in the priced Bill of Quantities, wherever applicable, and otherwise at such rates and prices as the Engineer may fix within the terms of the Contract.

The Bidder must see the site condition and take account of all the aforesaid and foregoing factors while quoting the rates, as no extra will be allowed on any grounds arising out of or relating to the aforesaid and foregoing.

Errors during bidding process will be corrected by the Employer for any arithmetic errors pursuant to Clause 33 of the Instructions to Bidders.

2 RATES & PRICES

The unit rates of each item shall be exclusive of Value Added Taxes (VAT). The VAT shall be added separately as prescribed in Summary of Bill of Quantities

The rates and prices in the Bill of Quantities shall, except where otherwise provided in the Contract, cover all the Contractor's obligations under the Contract and all matters and items necessary as survey using survey instruments to verify the alignment , preparation of pre-construction investigation, contractor’s working drawings, shop drawings, as-built drawings, mobilization of Constructional Plant and equipment and management and technical personnel for execution and supervision labour, material, supervision, erection, maintenance, protection, insurance, profit, taxes and duties for the proper construction and completion of the Works including testing and remedy of detects Works as specified in or reasonably to be inferred from the Contract. Unless the method of measurement makes a specific promise of measurement no further payment shall be made in respect of anything described in the Contract for which apparently no corresponding item is given in the Bill of Quantities. The cost of any item that is necessary for successful completion of the works but not mentioned in the bill of quantities and against which no Contract Rate has been entered, shall be deemed to be covered by other Quoted Item Rates.

If any item required for successful completion of works is inadvertently missed out in the Bill of Quantities, the Bidder shall include the cost of its supply in the relevant laying or

install item (including all the relevant small ancillary items required for social, safety and environmental concerns).

Therefore, the prices and rates entered by the Contractor in the Bill of Quantities shall cover the complete and finished work in final position as required by the Contract Document including, inter alia, all costs and expenses which may be required in and for the construction and maintenance of the Works, together with all risks, liabilities, contingencies, insurance and obligations imposed or implied by the Contract.

Price quoted against each item, must be reasonable reflecting the actual cost of the work plus expenses and must correspond to the relative value of each item in relation to the total amount of the Bid. They must in particular not be of such nature as to distort the comparison of bids or to result in interim payments which are clearly disproportionate to the normal value of the services to be rendered.

Without affecting the generality of the foregoing provisions, the prices and rates entered by the Contractor in the Bill of Quantities shall include, inter alia, all cost and expenses involved with or arising from the following:

- the provision, storage, transport, handling, use distribution and maintenance of all materials, plant, equipment, machinery and tools including all costs, charges, dues, demurrage or other outlays involved in carriage and importation;
- the provision and maintenance of all staff and labour and their payment, accommodation, transport fares and other requirements
- setting out, including the location and preservation of survey markers, measurement and supervision;
- the provision, operation, maintenance and removal upon completion of the Contract of all Contractor's Site Installation;
- the provision, storage, transport, use, handling, distribution and maintenance of all consumable stores, fuel, water and electricity for the Contractor's Site Installation;
- the opening, operation and reinstatement upon completion of all sources for concrete, aggregates, earthworks etc.
- the provision and maintenance of all temporary detours, of traffic control measures and of reinstatement upon completion of the existing roads;
- protection against failure of property adjoining the excavations for pipelines to be laid;
- all contractual submissions by the Contractor except spare parts and photographs;
- all quality control measures including inspections and tests;
- damage caused to the Works under construction, Plant, materials and consumable stores by weather;

- repairs to the Works, either prior to or during the Defects Liability Period;
- maintenance of total work from commencement day to end of defect liability period;
- coordination with other Contractors or Authorities carrying out work either in connection with or adjacent to the Works;
- Overheads, on-costs and profit.

A price or rate shall be entered against each item in the Bill of Quantities whether quantities are stated or not. Items against which the bidder does not enter a price or rate shall be deemed included in other prices and rates quoted in the Bill of Quantities. The unit price or rate entered against any item shall take precedence over any miscalculation in the total sum against that item. Where separate items have not been provided in the Bill of Quantities for work required under the Contract, then the cost of such work shall be deemed to have been included in the unit prices and rates for other items.

3 BILL OF QUANTITIES

The total quantity included in the final measurement of each item shall be measured to the nearest integer relative to that item, or to one decimal place if so indicated in the Bill of Quantities.
The following abbreviations are used in the Bill of quantities:

Sq	Square	Mm	millimeter
Cu	Cubic	M	meter
Nr	Number	Km	kilometer
Hr	Hour	%	percent
Kg	Kilogram	d or dia	diameter
Ha	Hectare	t or Mt	Metric ton
Prov. Sum	Provisional Sum	NRs	Nepali
US$	United states Dollars	NRs.	Nepali
md	Mandays		

Where in the Bill of Quantities there is a Schedule or subsidiary bill setting out the quantities of component materials and work which comprise a unit of work measured under a single item in a Part of the Bill of Quantities, the said quantities shall be subject to admeasurement and valued at the rates and prices entered therein and the total thereof shall be the rate for the item in the part.

4 ITEM

The item descriptions in the Bill of Quantities are only in sufficient detail to ensure identification of the work covered with that shown on the Drawings and described in the Specification. Description of the work given on the Drawings or in the Specification is not necessarily repeated in the identifying descriptions of the items in the Bill of Quantities. A

reference Clause number set against each item in Bill of Quantities indicates a Clause in the Specification in which work or material covered by the item is described. While every care is taken to provide reference to Specification in the item description, the contractor shall have no claim in cases where such reference is absent. The bidder is advised to bring such discrepancies to the notice of the Employer before submitting the tender.

The items described as " Procurement Supply and Installation of Fittings and Valves' of any kind and for any diameter of fitting and valves include all associated works such as transportation of delivered fittings and valves to the concerned Site, handling, storage, protection of flanges and other connection ends, installation of fittings and valves with necessary bolts, collars, gaskets etc as required to make a complete watertight joint to the corresponding pipe, testing, backfilling compaction and disposal of excess materials as per specification and drawings..

Further requirements for the work or material in question may be stated in other Clauses in the specification or on the Drawings and the Contract Rates shall be deemed to cover also the cost of complying with any such further requirements.

5 METHOD OF MEASUREMENT

The method of measurement of completed work (supply, delivery and installation including testing) for payment shall be in accordance with provisions made and specified in the Technical Specifications and any other related document forming part of the Contract Documents.

. Other cost not mentioned in BOQ for pipeline works as an item shall be arranged by Contractor at his own cost.

6 PROVISIONALWORK, SUM AND QUANTITIES

Provisional Sums included and so designated in the Bill of Quantities shall be expended in whole or in part at the direction and discretion of the Engineer in accordance with the Conditions of Contract against provisional work mentioned under part of BOQ. It will be used by the Engineer for nominated sub-contractors, line agencies, third party inspecting agencies, charges levied by statutory electrical, telephone, or other authorities, or for other miscellaneous works. The use of provisional sum will also be for relocation of utilities above or under the ground that conflict with the existing or permanent line or level or the works; independent sampling and laboratory testing as directed by the Engineer, Replacement or Compensation for Plants and Trees removed due to the works etc. as directed by the Engineer.

The rates set out for such items shall be used for the valuation of works so ordered by the Engineer in writing whether the quantities are shown or not. If the amount of work ordered by the Engineer to be executed under a Provisional Quantity item exceeds the quantity shown in the Bill of Quantities, the rate for that item set out in the Contract shall not necessarily be deemed applicable to the excess.

A general provision for physical contingencies (quantity overruns) may be made by including a provisional sum in the Summary Bill of Quantities. Similarly, a contingency allowance for possible price increases should be provided as a provisional sum in the Summary Bill of Quantities. The inclusion of such provisional sums often facilitates

budgetary approval by avoiding the need to request periodic supplementary approvals as the future need arises. Where such provisional sums or contingency allowances are used, the SCC should state the manner in which they will be used, and under whose authority (usually the Project Manager's).

7 OTHER COST

Cost of temporary works like construction and maintenance of road diversions including traffic control; construction and maintenance of dewatering and drainage arrangements, establishment and maintenance of contractor's site office, store, establishment and maintenance of workshops, plant and equipment, including Project sign boards etc if unless and otherwise mentioned in BOQ, will be deemed part of priced work and shall not be paid extra.

8 DAYWORKS SCHEDULE

General

The Contractor will be paid for daywork which may be required by the Engineer in writing during the course of the Contract at the rates set down by him in the Schedule. All profit and overhead must be included in these rates which shall also include all other costs of whatever nature necessary for and incidental to the performance of extra expenditures, such as royalties, payment to third party transportation, tools, housing for personnel, laboratory equipment and personnel for testing.

Time actually engaged in the works will be the only time allowed. No allowance will be made for travelling time even if it is necessary to import labor to the site for the execution of the Daywork item.

Rates quoted for Daywork will be taken into consideration when the bids are examined. Rates for Daywork shall show a reasonable relationship with unit rates entered elsewhere in the documents.

These rates will be subject to review by the Engineer and if unreasonably high (as determined by the Engineer) will not be used; in lieu of their use, the Engineer may accomplish any required extra work in the manner as set out in Clause 13 of the Conditions of Contract.

All quantities in the Dayworks Schedule are provisional but the amounts shall be extended and totals carried to the Summaries of each of the all Schedules.

The Contract Rates in the Daywork Schedule shall apply up to the date of expiry of the Defects Liability Period.

Labour Rates

For the purpose of payment for Daywork, labour shall be grouped into the classes contained in the Daywork Schedule and the classes shall have the meanings assigned to them therein. Provided that if the Contractor employs a man on daywork for lower classification than that for which the man is qualified, then in respect of such a man the Contractor will be paid only at the rate for the lower classification.

Rates for the various classes of labour in the Daywork Schedule shall cover all the Contractor's obligations whatsoever in providing and maintaining such labour at the

place of work including wages, payment for conditions and for skill, bonus travelling and subsistence all allowance and expenses, watching and insurances of all kinds, site supervision, administrative clothing, the use and maintenance of staging, scaffolding, portable electric tools, non-mechanical plant and hand tools of every kind, overheads, profit and all incidental expense.

The rates for labour are for units of man-days and a day shall be deemed to be a normal working day of 8 hours. Any less time shall be paid for proportionately.

Material Rates

Materials used on daywork shall be as specified for the works. The rates shall include delivery to the concerned pipe laying stretches and reservoir construction area (hereinafter referred as Project Sites). Should any materials be required for use on dayworks which are not included in the Schedule, the lowest current net market price shall apply, plus the cost of loading, transporting and unloading to the Project Sites including 15% allowance for overhead and profit. Should the Engineer instruct that the materials be ordered from abroad, then the lowest current net manufacturer's C.I.F. (Cost, Insurance, Freight) price shall apply, plus the cost of customs and handling charges, transporting and unloading to the Project Sites and 15% allowance for overhead and profit. All rates shall include storing and protecting the materials as necessary, plus any and all additional handling cost and taxes.

Plant and Equipment Rates

The Contract Rates for plant in the Daywork Schedule shall apply to all plant whether belonging to the Contractor or hired by him and shall cover all the Contractor's obligations whatsoever in providing and maintaining such plant at the place of work including all fuel, lubricants, all auxiliary equipment consumable stores, overhauls, repairs, replacement and all other charges necessary for efficient operation and use of the plant, overheads and profits but excluding operators and attendants for whom labour charges shall apply. The amounts charged shall be the actual hours worked at the direction of the Engineer, no allowance being made for standing time, at the rates laid down for Contractors' own plant in the Daywork Schedule.

Payment for plant of daywork will be limited to items listed in the Daywork Schedule or added thereto by the Contractor when tendering, unless otherwise agreed by the Engineer.

The Contract Rates for plant shall be apply both to plant which is already available at Site and to plant brought to site especially for daywork but in the later case the Contractor shall be reimbursed his additional net costs in transporting such plant to and from the site.

9 Insurance

The cost of providing insurance of Works and Contractor’s Equipment shall be paid to the Contractor as provisional sum amount against submission of required insurance policies with the appropriate payment receipts, in the form acceptable to the Employer.

The cost of providing Third Party Insurance (Including Employer’s Property) shall be paid to the Contractor as provisional sum amount against submission of required insurance policies with the appropriate payment receipts, in the form acceptable to the Employer.

The cost of providing Insurance against accident to workmen shall be paid to the Contractor as provisional sum amount against submission of required insurance policies with the appropriate payment receipts, in the form acceptable to the Employer.

The Contractor shall extend the validity period of all kinds of insurances until the completion of the project including extension of time given, if any, plus defect liability period. No extra/additional cost will be paid for the extension of validity period after original time of completion until the revised time of completion, if any, plus defect liability period.

10 Quality Control

This covers the provision of quality control plan and procedures, sampling, material / plant certificates, maintaining of site records and daily log books and testing facilities and laboratories including materials, manpower and equipment needed for all testing required to ensure quality of work, and all other requirements shall be as per relevant clauses of Technical Specifications. Unless otherwise mentioned in BOQ, no separate measurements and/or payment shall be made for the works required under this Clause. All the cost associated with this Clause is deemed to be included in the item rates of the Bill of Quantities

The personnel requirements submitted is deemed to be part of BOQ item and shall present for Quality control.

To test the RCC Reservoir's water tightness, water shall be filled one third of the total capacity and retained for three days for each segment.

11 Preparation of As-built Drawings

Unless otherwise mentioned in BOQ, no separate measurements and/or payment shall be made for the works required under this Clause. All the cost associated with this Clause is deemed to be included in the item rates of the Bill of Quantities. Final payment shall be made after the submission of as built drawing of project along with other documents as specified. For each IPC contractor shall submit as built drawing of works mentioned in IPC.

12 Pipe Trenches

All pipe line trench excavation for pipe line trench excavation shall be excavated as instructed by the Engineer. Excavation shall be paid in cum of actual work done at site. For the pipe laying works, the width of trench will not be more than the width given in the pipe trench drawing/ table.

The Contractor shall backfill the trench up to the existing level. The additional earth work at reinstatement will be the temporary works and will not be paid additional. The backfilling works will be paid only after the compaction.

13 Disinfection of Treatment Plant , Reservoir Tanks and Pipe Line

Unless otherwise mentioned in BOQ, no separate measurements and/or payment shall be made for works as per instruction of Engineer using disinfectants required under this Clause. All the cost associated with this Clause is deemed to be included in the item rates of the Bill of Quantities.

14 Payment

With respect to the items regarding the supply of pipes and fittings given in the Bill of Quantities, brought by the Contractor to the Site for incorporation in the Permanent Works, partial payment shall be made to the Contractor provided the following conditions are met:

I. The materials have been delivered to the Site and properly stored and protected against loss, damage, or deterioration:

II. The Contractor's records of the requirements, orders, receipts, and use of materials are kept in a from approved by the Project Manager, and such records are available for inspection by the Project Manager.

III. The Contractor has submitted a statement for the supply pipes and fittings delivered to the site as per approved schedule together with test certificate that the materials supplied are as per specification:

IV. The materials are to be used as per construction schedule.

Payment against pipes and valves, specials etc. intended to form part of permanent works shall be made to the contractor as per following provision:-

A: Pipes/Fittings

Payment for the supply, delivery, laying, and jointing of all pipes, fittings, and appurtenances shall be made in three (3) installments as follows:

First Installment (70%): Seventy percent (70%) of the total item rate shall be paid upon the successful delivery, acceptance, and final inspection of the materials at the designated stockpiling site.

Second Installment (25%): Twenty five percent (25%) of the total item rate shall be paid upon the successful laying and jointing of the pipes and fittings.

Third Installment (5%): The remaining five percent (5%) shall be paid upon the successful pressure testing and final commissioning of the pipeline section.

Payment for Unused Surplus Materials:

In the event that supplied pipes and fittings—delivered to the site strictly as per the prior instruction of the Engineer—remain unused upon project completion, the Contractor shall be compensated only for the supply and delivery of these materials. Because no laying and jointing work was performed on these specific items, **fifteen percent (15%)** of the total item rate shall be deducted.

The acceptance shall be considered only after the certified pass certificate issued by National Bureau of Standard and Metrology for HDPE (PE-100) and Galvanized Iron. Similarly, acceptance of the Seamless and Ductile Iron(DI) pipe shall be considered after the submission of required test /pass certificates approved by manufacturer and other certificates as needed by the client if any.

B: Deep Tube well

a) In case of failure of well payment of drilling of Pilot hole and Electro-Logging of the hole only shall be made.

D: RCC Reservoir / BPT

a) RCC Overhead Tank and other water retaining structures shall be water tight itself. Contractor shall use suitable techniques for making the structure water tight. All the cost associated with achieving water tightness is deemed to be included in the item rates of the Bill of Quantities

The Interim payment made to the contractor under Clause 14 of the condition of contract and any other amounts are advance payments. Only the payments made under final payment certificate is considered as payment for the permanent Works completed. If at any time, prior to the issue Defects Liability certificate, the quality or quantity of the works found to be unsatisfactory or do not conform to the requirement of the Contract, the Engineer is entitled to deduct or withhold the amount sufficient to remedy such unsatisfactory works, from the successive interim or other payments to the Contractor.

15.Third Party Inspection

Contractor shall manage third party inspection for the pipes (HDPE, Seamless, DI) at manufacturing place. The transportation and accommodation cost is deemed to be in supply item of BOQ itself.

Bill of Quantities

[attached at Bottom]

Part III: CONDITIONS OF CONTRACT AND CONTRACT FORMS

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Section VIII: General Conditions of Contract

Construction of Belchautara Co-Financing Water Supply Project, Shuklagandaki Municipality, Tanahun (Package-II)

Contract Identification No.: WSSMOLMG/NCB/Works/083/84-05

General Conditions of Contract

This Section provides the General Conditions of Contract that will apply to the Contract for which the Biding document is issued.

A. General	
1. Definitions	1.1 Boldface type is used to identify defined terms. (a) The **Accepted Contract Amount** means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects. (b) The **Activity Schedule** is a schedule of the activities comprising the construction, installation, testing, and commissioning of the Works in a lump sum contract. It includes a lump sum price for each activity, which is used for valuations and for assessing the effects of Variations and Compensation Events. (c) **Bill of Quantities** means the priced and completed Bill of Quantities forming part of the Bid. (d) **Compensation Events** are those defined in GCC 50 hereunder. (e) The **Completion Date** is the date of completion of the Works as certified by the Project Manager, in accordance with GCC 68.1. (f) The **Contract** is the Contract between the Employer and the Contractor to execute, complete, and maintain the Works. It consists of the documents listed in GCC 2.3 below. (g) The **Contractor** is the party whose Bid to carry out the Works has been accepted by the Employer. (h) The **Contractor's Bid** is the completed bidding document submitted by the Contractor to the Employer. (i) The **Contract Price** is the Accepted Contract Amount stated in the Letter of Acceptance and thereafter as adjusted in accordance with the Contract. (j) **Days** are calendar days; months are calendar-months. (k) **Dayworks** are varied work inputs subject to payment on a time basis for the Contractor's employees and Equipment, in addition to payments for associated Materials and Plant. (l) A **Defect** is any part of the Works not completed in accordance with the Contract. (m) The **Defects Liability Certificate** is the certificate issued by Project Manager upon correction of defects by the Contractor. (n) The **Defects Liability Period** is the period calculated from the Completion Date where the Contractor remains responsible for remedying defects. (o) **Drawings** include calculations and other information provided or approved by the Project Manager for the execution of the Contract. (p) The **Employer** is the party who employs the Contractor to carry out the Works, as **specified in the SCC**.

(q) **Equipment** is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.

(r) **Force Majeure** means an exceptional event or circumstance: which is beyond a Party's control; which such Party could not reasonably have provided against before entering into the Contract; which, having arisen, such Party could not reasonably have avoided or overcome; and, which is not substantially attributable to the other Party.

(s) The **Initial Contract Price** is the Contract Price listed in the Employer's Letter of Acceptance.

(t) **In writing** or **written** means hand written, type written, printed or electronically made, and resulting in permanent record.

(u) The **Intended Completion Date** is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is **specified in the SCC**. The Intended Completion Date may be revised only by the Project Manager by issuing an extension of time or an acceleration order.

(v) **Letter of Acceptance** means the formal acceptance by the Employer of the Bid and denotes the formation of the contract at the date of acceptance.

(w) **Materials** are all supplies, including consumables, used by the Contractor for incorporation in the Works.

(x) **Party** means the Employer or the Contractor, as the context requires.

(y) **SCC** means Special Conditions of Contract

(aa) **Plant** is any integral part of the Works that shall have a mechanical, electrical, chemical, or biological function.

(bb) The **Project Manager** is the person **named in the SCC** (or any other competent person appointed by the Employer and notified to the Contractor, to act in replacement of the Project Manager) who is responsible for supervising the execution of the Works and administering the Contract.

(cc) **Retention Money** means the aggregate of all monies retained by the Employer pursuant to GCC 54.1.

(dd) **Schedules** means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Bids, as included in the Contract. Such document may include the Bill of Quantities, data, lists, and schedules of rates and/or prices.

(ee) The **Site** is the area defined as such in the SCC

(ff) **Site Investigation Reports** are those that were included in the bidding documents and are factual and interpretative reports about the surface and subsurface conditions at the Site.

(gg) **Specification** means the Specification of the Works included in the Contract and any modification or addition made or approved by the Project Manager.

(hh) The **Start Date** is given i**n the SCC**. It is the latest date when the Contractor shall commence execution of the Works. It does not necessarily coincide with any of the Site Possession Dates.

(ii) A **Subcontractor** is a person or corporate body who has a Contract with

	the Contractor to carry out a part of the work in the Contract, which includes work on the Site. (jj) **Temporary Works** are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works. (kk) **Variation** is an instruction given by the Project Manager which varies the Works. (ll) The **Works** are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as **defined in the SCC**.
2. Interpretation	2.1 In interpreting these GCC, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Project Manager shall provide instructions clarifying queries about these GCC.
	2.2 If sectional completion is **specified in the SCC**, references in the GCC to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).
	2.3 The documents forming the Contract shall be interpreted in the following order of priority: (a) Contract Agreement, (b) Letter of Acceptance, (c) Letters of Technical Bid and Price Bid, (d) Special Conditions of Contract, (e) General Conditions of Contract, (f) Specifications, (g) Drawings, (h) Bill of Quantities (or Schedules of Prices for lump sum contracts), and (i) Any other document **listed in the SCC** as forming part of the Contract.
3. Language and Law	3.1 The language of the Contract and the law governing the Contract are **stated in the SCC**.
	3.2. Throughout the execution of the Contract, the Contractor shall comply with the import of goods and services prohibitions in the Employer's country when (a) by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, the Employer's Country prohibits any import of goods from, or any payments to, a particular country, person, or entity. Where the employer's country prohibits payments to a particular firm or for particular goods by such an act of compliance, that firm may be excluded.
4. Contract Agreement	4.1 The Parties shall enter into a Contract Agreement within 15 days after the Contractor receives the Letter of Acceptance, unless the Special Conditions establish otherwise. The Contract Agreement shall be based upon the attached Contract forms in Section X.
	4.2 Without altering the basic nature or scope of work, the contract may be

	amended upon mutual written consent as per prevailing Public Procurement Law.
5. Assignment	5.1 Neither Party shall assign the whole or any part of the Contract or any benefit or interest in or under the Contract. However, either Party (a) may assign the whole or any part with the prior agreement of the other Party, at the sole discretion of such other Party; and (b) may, as security in favor of a bank or financial institution, assign its right to any moneys due, or to become due, under the Contract.
6. Care and Supply of Documents	6.1 The Specification and Drawings shall be in the custody and care of the Employer. Unless otherwise stated in the Contract, one copy of the Contract and of each subsequent Drawing shall be supplied to the Contractor, who may make or request further copies at the cost of the Contractor.
	6.2 Each of the Contractor's Documents shall be in the custody and care of the Contractor, unless and until taken over by the Employer. Unless otherwise stated in the Contract, the Contractor shall supply to the Engineer six copies of each of the Contractor's Documents.
	6.3 The Contractor shall keep, on the Site, a copy of the Contract, publications named in the Specification, the Contractor's Documents (if any), the Drawings and Variations and other communications given under the Contract. The Employer's Personnel shall have the right of access to all these documents at all reasonable times.
	6.4 If a Party becomes aware of an error or defect in a document which was prepared for use in executing the Works, the Party shall promptly give notice to the other Party of such error or defect.
7. Confidential Details	7.1 The Contractor's and the Employer's Personnel shall disclose all such confidential and other information as may be reasonably required in order to verify the Contractor's compliance with the Contract and allow its proper implementation.
	7.2 Each of them shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out their respective obligations under the Contract or to comply with applicable Laws. Each of them shall not publish or disclose any particulars of the Works prepared by the other Party without the previous agreement of the other Party. However, the Contractor shall be permitted to disclose any publicly available information, or information otherwise required to establish his qualifications to compete for other projects.
	7.3 Notwithstanding the above, the Contractor may furnish to its Subcontractor(s) such documents, data and other information it receives from the Employer to the extent required for the Subcontractor(s) to perform its work under the Contract, in which event the Contractor shall obtain from such Subcontractor(s) an undertaking of confidentiality similar to that imposed on the Contractor under this Clause.
8. Compliance with Laws	8.1 The Contractor shall, in performing the Contract, comply with applicable Laws of Nepal.
9. Joint and	9.1 If the Contractor is a joint venture of two or more entities, all such entities

Several Liability	shall be jointly and severally liable to the Employer for the fulfillment of the provisions of the Contract, and shall designate one of such persons to act as a leader with authority to bind the joint venture. The contractor shall not handover the responsibility of the contract to any one member or some members of Joint Venture or any other parties, not involved in the contract. The composition or the constitution of the joint venture shall not be altered without the prior consent of the Employer.
10. Project Manager's Decisions	10.1 Except where otherwise specifically stated, the Project Manager shall decide contractual matters between the Employer and the Contractor in the role representing the Employer.
11. Delegation	11.1 The Project Manager may delegate any of his duties and responsibilities to other people after notifying the Contractor, and may cancel any delegation after notifying the Contractor.
12. Communications	12.1 Communications between parties that are referred to in the Conditions shall be effective only when in writing. Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices and requests, these communications shall be: (a) in writing and delivered by hand (against receipt), sent by mail or courier, or transmitted using any of the agreed systems of electronic transmission as **stated in the SCC**; and (b) delivered, sent or transmitted to the address for the recipient's communications as stated in the Contract. However: (i) if the recipient gives notice of another address, communications shall thereafter be delivered accordingly; and (ii) if the recipient has not stated otherwise when requesting an approval or consent, it may be sent to the address from which the request was issued. Approvals, certificates, consents and determinations shall not be unreasonably withheld or delayed.
	12.2 A Notice shall be effective when delivered or on the Notice's effective date, whichever is later.
13. Subcontracting	13.1 **For GON Funded:** A list of approved Subcontractors including its value/works is included as Article 2 (k) of Contract Agreement Approval by the Employer for any of the Subcontractors shall not relieve the Contractor from any of its obligations, duties, or responsibilities under the contract. **For DP Funded:** The Contractor may subcontract with the approval of the Project Manager, but may not assign the Contract without the approval of the Employer in writing. Subcontracting shall not alter the Contractor's obligations. Bidders may propose subcontracting up to the percentage of total value of contracts as specified in the SCC. The Sub contractor shall meet the qualification requirement as specified **in SCC.**

	13.2 The contractor shall give prior notice to the Employer clearly specifying the nature, scope, and responsibilities of the work to be performed, to engage other subcontractors, material suppliers, equipment suppliers, service providers, or other persons or entities during the implementation of the contract. 13.3 Before notifying the Employer as per GCC 13.2, the contractor shall enter into written agreement with the subcontractors, material suppliers, equipment suppliers, service providers, or other persons or entities clearly specifying the scope of work, responsibilities, quality requirements, duration, payment terms, security, labor-related obligations, and conditions relating to performance of the work. 13.4 Any subcontracting arrangement made in accordance with GCC 13.2 shall not relieve the Contractor of any of its obligations or liabilities under the Contract. 13.5 The contractor shall provide the Employer with details of the payments made to the subcontractors, material suppliers, equipment suppliers, service providers, or other persons or entities engaged under GCC 13.1 and/or GCC 13.2. 13.6 If the contractor is found not to have made payment to the subcontractor, material suppliers, equipment suppliers, service providers, or other persons or entities engaged under GCC 13.1 and/or GCC 13.2 in accordance with the terms of the agreement, the Employer may determine the amount payable to such subcontractor, material suppliers, equipment suppliers, service providers, or other persons or entities and make payment to them from any remaining dues to be paid to the contractor, retention money, or forfeited performance security.
14. Other Contractors	14.1 The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Employer between the dates given in the Schedule of Other Contractors, **as referred to in the SCC**. The Contractor shall also provide facilities and services for them as described in the Schedule. The Employer may modify the Schedule of Other Contractors, and shall notify the Contractor of any such modification
15 Personnel and Equipment	15.1 The Contractor shall employ the key personnel and use the equipment identified in its Bid to carry out the Works, or other personnel and equipment approved by the Project Manager. The Project Manager shall approve any proposed replacement of key personnel and equipment only if their relevant qualifications or characteristics are substantially equal to or better than those proposed in the Bid.
	15.2 If the Project Manager asks the Contractor to remove a person who is a member of the Contractor's staff or work force, stating the reasons, the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the work in the Contract.
	15.3 If the Employer, Project Manager, or Contractor determines, that any employee of the Contractor be determined to have engaged in corrupt, fraudulent, collusive, coercive, or other prohibited practices during the execution of the Works, then that employee shall be removed in accordance with Clause 15.2 above.
16. Employer's and	16.1 The Employer carries the risks which this Contract states are Employer's risks, and the Contractor carries the risks which this Contract states are

Contractor's Risk	Contractor's risks.
17. Employer's Risks	17.1 From the Start Date until the Defects Liability Certificate has been issued, the following are Employer's risks: (a) The risk of personal injury, death, or loss of or damage to property (excluding the Works, Plant, Materials, and Equipment), which are due to (i) use or occupation of the Site by the Works or for the purpose of the Works, which is the unavoidable result of the Works or (ii) negligence, breach of statutory duty, or interference with any legal right by the Employer or by any person employed by or contracted to him except the Contractor. (b) The risk of damage to the Works, Plant, Materials, and Equipment to the extent that it is due to a fault of the Employer or in the Employer's design, or due to war or radioactive contamination directly affecting the country where the Works are to be executed.
	17.2 From the Completion Date until the Defects Liability Certificate has been issued, the risk of loss of or damage to the Works, Plant, and Materials is an Employer's risk except loss or damage due to (a) a Defect which existed on the Completion Date, (b) an event occurring before the Completion Date, which was not itself an Employer's risk, or (c) the activities of the Contractor on the Site after the Completion Date.
18. Contractor's Risks	18.1 From the Starting Date until the Defects Liability Certificate has been issued, the risks of personal injury, death, and loss of or damage to property (including, without limitation, the Works, Plant, Materials, and Equipment) which are not Employer's risks are Contractor's risks.
19. Insurance	19.1 The Contractor shall provide insurance in the joint names of the Employer and the Contractor from the Start Date to the end of the Defects Liability Period, in the amounts and deductibles **stated in the SCC** for the following events which are due to the Contractor's risks: (a) loss of or damage to the Works, Plant, and Materials; (b) loss of or damage to Equipment; (c) loss of or damage to property (except the Works, Plant, Materials, and Equipment) in connection with the Contract; and (d) Personal injury or death.
	19.2 Policies and certificates for insurance shall be delivered by the Contractor to the Project Manager for the Project Manager's approval before the Start Date. All such insurance shall provide for compensation to be payable in the proportions of Nepalese Rupees required to rectify the loss or damage incurred.
	19.3 If the Contractor does not provide any of the policies and certificates required, the Employer may affect the insurance which the Contractor should have provided and recover the premiums the Employer has paid

	from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due.
	19.4 Alterations to the terms of insurance shall not be made without the approval of the Project Manager.
	19.5 Both parties shall comply with any conditions of the insurance policies.
20. Site Investigation Reports	20.1 The Contractor, in preparing the Bid, shall rely on any Site Investigation Reports referred to **in the SCC**, supplemented by any information available to the Contractor.
21. Contractor to Construct the Works	21.1 The Contractor shall construct and install the Works in accordance with the Specifications and Drawings.
22. The Works to Be Completed within intended Completion Date	22.1 The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the Program submitted by the Contractor, as updated with the approval of the Project Manager, and complete them within the intended Completion Date.
23. Design by contractor and Approval by the Project Manager	23.1 The contractor shall be responsible for the design of permanent works as **specified in SCC**.
	23.2 Contractor shall be responsible for design of the Temporary Works. The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Project Manager, for his approval.
	23.3 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, shall be subject to prior approval by the Project Manager before their use.
	23.4 The Project Manager's approval shall not alter the Contractor's responsibility for design of temporary works.
24. Safety, Security and Protection of the Environment	24.1 The Contractor shall, throughout the execution, and completion of the works and remedying of any defects therein: a. Have full regard for the safety of all persons entitled to be upon the site and keep the site (so as the same is under his control) and the works (so far as the same are not completed or occupied by the Employer) in an orderly state appropriate to the avoidance of danger to such persons. b. Provide and maintain at his own cost all lights, guards, fencing, warning signs and watching, when necessary or required by the Project Manager or by any duly constituted authority, for the protection of the Works of for the safety and convenience of the public or others. c. Take all reasonable steps to protect the environment on and off the site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation. d. Ensure that any cut or fill slopes are planted in grass or other plant cover as

	soon as possible to protect them from erosion. e. Any spoil or material removed from drains shall be disposed of to designated stable tipping areas as directed by the Project Manager. f. Shall not use fuel wood as a means of heating during the processing or preparation of any materials forming part of the works. g. The Project Manager shall have the power to disallow any working practice or activity of the Contractor or direct that such practices or activities be modified should the Project Manager consider, on the advice of the relevant Government Departments, that the practices or activities will be harmful to wildlife. h. Provide on the Site such lifesaving apparatus as may be appropriate and an adequate and easily accessible first aid outfit or such outfits as may be required by any government ordinance, factory act, etc., subsequently published and amended from time to time.
	24.2 The Contractor shall comply with the Employer's Occupational Health and Safety (OHS) Policy, Guideline and/or Operating Manual, if any, **as specified in the SCC.**
25. Discoveries	25.1 Anything of historical or other interest or of significant value unexpectedly discovered on the Site shall be the property of the employer. The Contractor shall notify the Project Manager of such discoveries and carry out the Project Manager's instructions for dealing with them.
26. Possession of the Site	26.1 The Employer shall give possession of all parts of the Site to the Contractor. If possession of a part is not given by the date **stated in the SCC**, the Employer shall be deemed to have delayed the start of the relevant activities, and this shall be a Compensation Event.
27. Access to the Site	27.1 The Contractor shall allow the Project Manager and any person authorized by the Project Manager access to the Site and to any place where work in connection with the Contract is being carried out or is intended to be carried out.
28. Instructions, Inspections and Audits	28.1 The Contractor shall carry out all instructions of the Project Manager which comply with the applicable laws where the Site is located.
	28.2 The Contractor shall keep, and shall make all reasonable efforts to cause its Subcontractors and sub consultants to keep accurate and systematic accounts and records in respect of the Works in such form and details as will clearly identify relevant time changes and costs.
	28.3 The Contractor shall permit the GoN/DP and/or persons appointed by the GoN/DP to inspect the Site and/or the accounts and records of the Contractor and its sub-contractors relating to the performance of the Contract, and to have such accounts and records audited by auditors appointed by the GoN/DP if required by the GoN/DP. The Contractor's attention is drawn to Sub-Clause 73.2 which provides, inter alia, that acts intended to materially impede the exercise of the GoN's/DP's inspection and audit rights provided for under this Sub-Clause constitute a obstructive practice subject to contract termination.
29. Dispute Settlement	29.1 The Employer and the Contractor shall attempt to settle amicably by direct negotiation any disagreement or dispute arising between them under or in connection with the Contract.
	29.2 Any dispute between the Parties as to matters arising pursuant to this Contract which cannot be settled amicably within thirty (30) days after

	receipt by one Party of the other Party 's request for such amicable settlement may be referred to Arbitration within 30 days after the expiration of amicable settlement period.
30. Procedures for Disputes	30.1 In case of arbitration, the arbitration shall be conducted in accordance with the arbitration procedures in accordance with law of Nepal at the place within the territory of Nepal **given in the SCC**.
B1. Staff and Labor	
31. Forced Labor	31.1 The Contractor shall not employ forced labor, which consists of any work or service, not voluntarily performed, that is exacted from an individual under threat of force or penalty. This covers any kind of involuntary or compulsory labor, such as indentured labor, bonded labor, or similar labor–contracting arrangements.
32. Child Labor	32.1 The Contractor shall not employ children in a manner that is economically exploitative, or is likely to be hazardous, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. Where national laws have provisions for employment of minors, the Contractor shall follow those laws applicable to the Contractor. Children below the age of 18 years shall not be employed in dangerous work.
33.Non-discrimination and Equal Opportunity	33.1 The Contractor shall not make employment decisions on the basis of personal characteristics unrelated to inherent job requirements. The Contractor shall base the employment relationship on the principle of equal opportunity and fair treatment, and shall not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. In countries where national law provides for non-discrimination in employment, the Contractor shall comply with national law. When national laws are silent on nondiscrimination in employment, the Contractor shall meet this Sub clause's requirements. Special measures of protection or assistance to remedy past discrimination or selection for a particular job based on the inherent requirements of the job shall not be deemed discrimination.
B. Time Control	
34. Program	34.1 Within the time **stated in the SCC**, after the date of the Letter of Acceptance, the Contractor shall submit to the Project Manager for approval a Program showing the general methods, arrangements, order, and timing for all the activities in the Works. In the case of a lump sum contract, the activities in the Program shall be consistent with those in the Activity Schedule.
	34.2 An update of the Program shall be a program showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work, including any changes to the sequence of the activities.
	34.3 The Contractor shall submit to the Project Manager for approval an updated Program at intervals no longer than the period **stated in the SCC**. If the Contractor does not submit an updated Program within this period, the Project Manager may withhold the amount **stated in the SCC** from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program has been submitted. In

	the case of a lump sum contract, the Contractor shall Provide an updated Activity Schedule within 15 days of being instructed to by the Project Manager.
	34.4 The Project Manager's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Project Manager again at any time. A revised Program shall show the effect of Variations and Compensation Events.
35. Extension of the Intended Completion Date	35.1 The Project Manager shall extend the Intended Completion Date if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date without the Contractor taking steps to accelerate the remaining work, which would cause the Contractor to incur additional cost.
	35.2 The Project Manager shall decide whether and by how much to extend the Intended Completion Date within 21 days of the Contractor asking the Project Manager for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information at least 21 days prior to the intended completion date. If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date. Along with full supporting information, the contractor shall also submit a revised work schedule and ensure that the Performance Security, Insurance, and Advance Payment Security (if any) remain valid. The contractor shall submit Performance Security, Advanced Payment Guarantee (if any) and Insurance Policy documents, as required with extended validity, within fifteen (15) days of receiving the Letter of Extension of Intended Completion Date from the Employer.
	35.3 If the contractor fails to submit Performance Security, Advanced Payment Guarantee (if any) and Insurance Policy documents, as required with extended validity within the prescribed time as per GCC 35.2, the Contractor shall pay a fine at the rate of 0.01% of the final contract price (without VAT but including PS) per day for a maximum of fifteen (15) days. The Employer may deduct the fine from payments due to the Contractor.
36. Acceleration	36.1 When the Employer wants the Contractor to finish before the Intended Completion Date, the Project Manager shall obtain priced proposals for achieving the necessary acceleration from the Contractor. If the Employer accepts these proposals, the Intended Completion Date shall be adjusted accordingly and confirmed by both the Employer and the Contractor.
	36.2 If the Contractor's priced proposals for acceleration are accepted by the Employer, they are incorporated in the Contract Price and treated as a Variation.
37. Delays Ordered by the Project Manager	37.1 The Project Manager may instruct the Contractor to delay the start or progress of any activity within the Works.
38. Management Meetings	38.1 Either the Project Manager or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.
	38.2 The Project Manager shall record the business of management meetings and provide copies of the record to those attending the meeting and to the

	Employer. The responsibility of the parties for actions to be taken shall be decided by the Project Manager either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.
39. Early Warning	39.1 The Contractor shall warn the Project Manager at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract Price, or delay the execution of the Works. The Project Manager may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate shall be provided by the Contractor as soon as reasonably possible.
	39.2 The Contractor shall cooperate with the Project Manager in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Project Manager.
C. Quality Control	
40.Identifying Defects	40.1 The Project Manager shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Project Manager may instruct the Contractor to search for a Defect and to uncover and test any work that the Project Manager considers may have a Defect.
41. Tests	41.1 If the Project Manager instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect, the test shall be a Compensation Event.
42. Correction of Defects	42.1 The Project Manager shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at issuance of taking over certificate pursuant to GCC clause 69.2, and is **defined in the SCC**. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.
	42.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Project Manager's notice.
43.Uncorrected Defects	43.1 If the Contractor has not corrected a Defect within the time specified in the Project Manager's notice, the Project Manager shall assess the cost of having the Defect corrected, and the Contractor shall pay this amount.
D. Cost Control	
44. Contract Price	44.1 In the case of a Unit Rate contract, the Bill of Quantities shall contain priced items for the Works to be performed by the Contractor. The Bill of Quantities is used to calculate the Contract Price. The Contractor will be paid for the quantity of the work accomplished at the rate in the Bill of Quantities for each item.
	44.2 In the case of a lump sum contract, the Activity Schedule shall contain the priced activities for the Works to be performed by the Contractor. The Activity Schedule is used to monitor and control the performance of activities on which basis the Contractor will be paid. If payment for Materials on Site

	shall be made separately, the Contractor shall show delivery of Materials to the Site separately on the Activity Schedule.
45. Changes in the Contract Price	45.1 In the case of a Unit Rate contract: (a) If the final quantity of the work done differs from the quantity in the Bill of Quantities for the particular item by more than 25 percent, provided the change exceeds 2 percent of the Initial Contract Price, the Project Manager shall adjust the rate to allow for the change. (b) If requested by the Project Manager, the Contractor shall provide the Project Manager with a detailed cost breakdown of any rate in the Bill of Quantities.
	45.2 In the case of a lump sum contract, the Activity Schedule shall be amended by the Contractor to accommodate changes of Program or method of working made at the Contractor's own discretion. Prices in the Activity Schedule shall not be altered when the Contractor makes such changes to the Activity Schedule.
46. Variations	46.1 All Variations shall be included in updated Programs, and, in the case of a lump sum contract, also in the Activity Schedule, produced by the Contractor.
	46.2 The Contractor shall provide the Project Manager with a quotation for carrying out the Variation when requested to do so by the Project Manager. The Project Manager shall assess the quotation, which shall be given within seven (7) days of the request or within any longer period stated by the Project Manager and before the Variation is ordered.
	46.3 If the Contractor's quotation is unreasonable, the Project Manager may order the Variation and make a change to the Contract Price, which shall be based on the Project Manager's own forecast of the effects of the Variation on the Contractor's costs.
	46.4 If the Project Manager decides that the urgency of varying the work would prevent a quotation being given and considered without delaying the work, no quotation shall be given and the Variation shall be treated as a Compensation Event.
	46.5 The Contractor shall not be entitled to additional payment for costs that could have been avoided by giving early warning.
	46.6 In the case of a Unit Rate contract, if the work in the Variation corresponds to an item description in the Bill of Quantities and if, in the opinion of the Project Manager, the quantity of work above the limit stated in **GCC 45.1** or the timing of its execution do not cause the cost per unit of quantity to change, the rate in the Bill of Quantities shall be used to calculate the value of the Variation. If the cost per unit of quantity changes, or if the nature or timing of the work in the Variation does not correspond with items in the Bill of Quantities, the quotation by the Contractor shall be in the form of new rates for the relevant items of work.
47. Cash Flow Forecasts	47.1 When the Program, or, in the case of a lump sum contract, the Activity Schedule, is updated, the Contractor shall provide the Project Manager with an updated cash flow forecast.
48. Payment Certificates	48.1 The Contractor shall submit to the Project Manager monthly statements of the estimated value of the work executed less the cumulative amount certified

	previously.
	48.2 The Project Manager shall check the Contractor's monthly statement and certify the amount to be paid to the Contractor within 30 days of submission by Contractor.
	48.3 The value of work executed shall be determined by the Project Manager.
	48.4 The value of work executed shall comprise: (a) In the case of a Unit Rate contract, the value of the quantities of work in the Bill of Quantities that have been completed; or (b) In the case of a lump sum contract, the value of work executed shall comprise the value of completed activities in the Activity Schedule.
	48.5 The value of work executed shall include the valuation of Variations and Compensation Events.
	48.6 The Project Manager may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.
49. Payments	49.1 Payments shall be adjusted for deductions for advance payments and retention. The Employer shall pay the Contractor the amounts certified by the Project Manager within 30 days of the date of each certificate. If the Employer makes a late payment, the Contractor shall be paid interest as **indicated in the SCC** on the late payment in the next payment. Interest shall be calculated from the date by which the payment should have been made up to the date when the late payment is made.
	49.2 If an amount certified is increased in a later certificate or as a result of an award by an Arbitrator, the Contractor shall be paid interest upon the delayed payment as set out in this clause. Interest shall be calculated from the date upon which the increased amount would have been certified in the absence of dispute.
	49.3 Items of the Works for which no rate or price has been entered in BOQ shall not be paid for by the Employer and shall be deemed covered by other rates and prices in the Contract.
50. Compensation Events	50.1 The following shall be Compensation Events: (a) The Employer does not give access to a part of the Site by the Site Possession Date pursuant to GCC 26.1. (b) The Employer modifies the Schedule of Other Contractors in a way that affects the work of the Contractor under the Contract. (c) The Project Manager orders a delay or does not issue Drawings, Specifications, or instructions required for execution of the Works on time. (d) The Project Manager instructs the Contractor to uncover or to carry out additional tests upon work, which is then found to have no Defects. (e) The Project Manager unreasonably does not approve a subcontract to

	be let. (f) Ground conditions are substantially more adverse than could reasonably have been assumed before issuance of the Letter of Acceptance from the information issued to bidders (including the Site Investigation Reports), from information available publicly and from a visual inspection (g) The Project Manager gives an instruction for dealing with an unforeseen condition, caused by the Employer, or additional work required for safety or other reasons. (h) Other contractors, public authorities, utilities, or the Employer does not work within the dates and other constraints stated in the Contract, and they cause delay or extra cost to the Contractor. (i) The advance payment is delayed. (j) The effects on the Contractor of any of the Employer's Risks. (k) The Project Manager unreasonably delays issuing a Certificate of Completion.
	50.2 If a Compensation Event would cause additional cost or would prevent the work being completed before the Intended Completion Date, the Contract Price shall be increased and/or the Intended Completion Date shall be extended. The Project Manager shall decide whether and by how much the Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended.
	50.3 As soon as information demonstrating effect of each Compensation Event upon the Contractor's forecast cost has been provided by the Contractor, it shall be assessed by the Project Manager, and the Contract Price shall be adjusted accordingly. If the Contractor's forecast is deemed unreasonable, the Project Manager shall adjust the Contract Price based on the Project Manager's own forecast. The Project Manager shall assume that the Contractor shall react competently and promptly to the event.
	50.4 The Contractor shall not be entitled to compensation to the extent that the Employer's interests are adversely affected by the Contractor's not having given early warning or not having cooperated with the Project Manager.
51. Tax	51.1 The Project Manager shall adjust the Contract Price if taxes, duties, and other levies are changed between the date 30 days before the submission of bids for the Contract and the date of the last Completion certificate. The adjustment shall be the change in the amount of tax payable by the Contractor, provided such changes are not already reflected in the Contract Price or are a result of GCC 53.
52. Currency	52.1 The currency of Contracts shall be Nepalese Rupees.
53. Price Adjustment	53.1 Prices shall be adjusted for fluctuations in the cost of inputs only if provided for **in the SCC**. If so provided, the amounts certified in each payment certificate, before deducting for Advance Payment, shall be adjusted by applying the respective price adjustment factor to the payment amounts due.

53.2 Adjustment Formulae[10]: The formulae will be of the following general type:

$$pn = A + b\frac{Ln}{Lo} + c\frac{Mn}{Mo} + d\frac{En}{Eo} + etc.$$

Where:

pn is a price adjustment factor to be applied to the amount for the payment of the work carried out in the subject month, determined in accordance with Clause 49;

A is a constant, specified in the Bidding Forms- Table of Price Adjustment data, representing the nonadjustable portion in contractual payments;[11] b, c, d, etc., coefficients representing the estimated proportion of each cost element (labor, materials, equipment usage, etc.) in the Works or sections thereof, net of Provisional Sums, **as specified in the SCC;**

Ln, Mn, En, etc., are the current cost indices or reference prices of the cost elements for month "n," determined pursuant to Sub-Clause 53.4, applicable to each cost element; and

Lo, Mo, Eo, etc., are the base cost indices or reference prices corresponding to the above cost elements at the date specified in Sub-Clause 53.4.

53.3 Sources of Indices and Weightings: The sources of indices shall be those listed in the Bidding Forms- Table of Price Adjustment data, as approved by the Project Manager and stated in SCC. Indices shall be appropriate for their purpose and shall relate to the Contractor's proposed source of supply of inputs on the basis of which his Contract shall have been computed. As the proposed basis for price adjustment, the Contractor shall have submitted with his bid the tabulation of Weightings and Source of Indices in the Bidding Forms, which shall be subject to approval by the Project Manager.

53.4 Base, Current and Provisional Indices: The base cost indices or prices shall be those prevailing on the day 30 days prior to the latest date for submission of bids. Current indices or prices shall be those prevailing on the day 30 days prior to the last day of the period to which a particular Interim Payment Certificate is related. If at any time the current indices are not available, provisional indices as determined by the Project Manager will be used, subject to subsequent correction of the amounts paid to the Contractor when the current indices become available.

53.5 Weightings: The weightings for each of the factors of cost given in the Bidding Forms shall be adjusted if, in the opinion of the Project Manager, they have been rendered unreasonable, unbalanced or inapplicable as a result of varied or additional work already executed or instructed under Clause 46 or for any other reason.

53.6 Where, price adjustment provision is not applicable pursuant to Sub-clause

[10] For complex Works involving several types of construction work with different inputs, a family of Formulae will be necessary. The various items of Day work may also require different formulae, depending on the nature and source of the inputs

[11] Insert a figure for factor A only where there is a part of the Contractors' expenditures which will not be subject to fluctuation in cost or to compensate for the unreliability of some indices. A should normally be 0.15. The sum of A, b, c, d, etc., should be one.

	53.1 then the Contract is subject to price adjustment only for construction material in accordance with this clause. If the prices of the construction materials stated in the contract is increased or decreased in an unexpected manner in excess of ten (10%) percent in comparison to the base price construction material stated in Section –IV, Bidding Forms-Table of Price Adjustment Data, then the price adjustment for the increase or decrease of price of the construction material beyond 10% shall be made by applying the following formulas: For unexpected increase in price $P = [R_1 - (R_0 \times 1.10)] \times Q$ For unexpected decrease in price P $= [R_1 - (R_0 \times 0.90)] \times Q$ Where: "P" is price adjustment amount "R_1" is the present price of the construction material (Source of indices shall be those listed in the Bidding forms) "R_0" is the base price of the construction material "Q" is quantity of the construction material consumed in construction during the period of price adjustment consideration If the Base price and source is to be proposed by the Bidder as per the provision made in Section –IV, Bidding Forms-Table of Price Adjustment Data then the Base price and source filled by Bidder for the construction material stated in the Bidding Form shall be subject to the approval of the Project manager and shall be as **stated in SCC**.
	53.7 The Price Adjustment amount shall be limited to a maximum of the initial Contract Amount **as specified in the SCC**.
	53.8 The Price Adjustment provision shall not be applicable for delayed period if the contract is not completed in time due to the delay caused by the contractor or the contract is a Lump sum Contract.
54. Retention	54.1 The Employer shall retain from each payment due to theContractor the proportion **stated in the SCC** until Completion of the whole of the Works.
	54.2 Upon the issue of a Defects Liability Certificate by the Project Manager, **in accordance with GCC** 70.1, half the total amount retained shall be repaid to the Contractor and half when the Contractor has submitted the evidence of submission of tax return to the concerned Internal Revenue Office.
	54.3 The Contractor may substitute retention money with an unconditional bank guarantee issued from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law if: (a) at least eighty (80) percent of the whole works have been completed, (b) progress of the works is satisfactory in accordance with the Contract as per approved work schedule, and (c) it can be assured that the works can be completed at the intended

	completion date. The validity of the bank guarantee under this sub-clause shall be at least 30 days beyond the end of Defect Liability Period.
	54.4 If retention money is substituted by bank guarantee in accordance with clause 52, the bank guarantee shall be submitted either using the Retention Money Security Form included in Section X (Contract Forms) or in another Form acceptable to the employer. The validity of the bank guarantee shall be at least one month more than the end of defect liability period.
55. Liquidated Damages	55.1 The Contractor shall pay liquidated damages to the Employer at the rate per day **stated in the SCC** for each day that the Completion Date is later than the Intended Completion Date. The total amount of liquidated damages shall not exceed the amount **defined in the SCC**. The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages shall not affect the Contractor's liabilities.
	55.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Project Manager shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate. The Contractor shall be paid interest on the overpayment, calculated from the date of payment to the date of repayment, at the rates specified in GCC 49.
56. Bonus	56.1 The Contractor shall be paid a Bonus calculated at the rate per calendar day **stated in the SCC** for each day (less any days for which the Contractor is paid for acceleration) that the Completion is earlier than the Intended Completion Date. The Project Manager shall certify that the Works are complete, although they may not be due to be complete.
57. Advance Payment	57.1 Unless otherwise **stated in SCC,** the Employer shall make advance payment to the Contractor of the amounts stated in the SCC in a separate bank account maintained for the contract in two equal installments by the date **stated in the SCC**, against provision by the Contractor of an unconditional bank guarantee from Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal in a form acceptable to the Employer in amounts equal to the advance payment. The guarantee shall remain effective until the advance payment has been repaid, but the amount of the guarantee shall be progressively reduced by the amounts repaid by the Contractor. Interest shall not be charged on the advance payment. The validity of the bank guarantee under this sub-clause shall be at least 30 days beyond the end of intended completion date. The contractor shall submit the list of activities for which the Advance Payment for mobilization is to be used along with their time schedules.
	57.2 The Contractor is to use the advance payment only to pay for the purpose of construction site preparation, establishment of temporary camp facilities, construction of workers' housing, mobilization of labors, materials or equipment etc. required specifically for execution of the Contract. The Contractor shall demonstrate that advance payment has been

	used in this way by supplying copies of invoices or other documents to the Project Manager.
	57.3 The advance payment shall be repaid by deducting proportionate amounts, **as stated in SCC**, from payments otherwise due Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuations of work done, Variations, price adjustments, Compensation Events, Bonuses, or Liquidated Damages.
	57.4 If the advance provided under GCC 57.1 is not repaid due to non-performance of the works under the contract, by the Contractor within the time period specified in the Contract, the Employer shall recover the advance by enforcing the bank guarantee as provided under GCC 57.1, and shall also recover interest on the advance amount from the Contractor at a rate **stated in SCC.**
58. Securities	58.1 The Performance Security, including any additional security required as per ITB 35.5, shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in an amount **specified in the SCC,** by a Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal in accordance with the conditions of Contract using Sample Form for the Performance Security included in Section X (Contract Forms), or another form acceptable to the Employer, and denominated in Nepalese Rupees. The Performance Security shall be valid until a date 30 days beyond the end of the Defect Liability Period. However, any additional performance security required as per ITB 35.5 shall be valid until a date 30 days beyond the end of the intended completion date.
	58.2 The performance security issued by any foreign Bank outside Nepal must be counter guaranteed by Commercial Bank or Financial Institution eligible to issue Bank Guarantee as per prevailing Law in Nepal.
59. Dayworks	59.1 If applicable, the Dayworks rates in the Contractor's Bid shall be used for small additional amounts of work only when the Project Manager has given written instructions in advance for additional work to be paid for in that way.
	59.2 All work to be paid for as Dayworks shall be recorded by the Contractor on forms approved by the Project Manager. Each completed form shall be verified and signed by the Project Manager within two days of the work being done.
	59.3 The Contractor shall be paid for Dayworks subject to obtaining signed Dayworks forms.
60. Cost of Repairs	60.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.
F. Force Majeure	
61. Definition of Force Majeure	61.1 In this Clause, "Force Majeure" means an exceptional event or circumstance, (a) which is beyond a Party's control; (b) which such Party could not reasonably have provided against before

	entering into the Contract; (c) which, having arisen, such Party could not reasonably have avoided or overcome; and (d) which is not substantially attributable to the other Party.
	61.2 Force Majeure may include, but is not limited to, exceptional events or circumstances of the kind listed below, so long as conditions (a) to (d) above are satisfied: (a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies; (b) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war; (c) riot, commotion, disorder, strike or lockout by persons other than the Contractor's Personnel; (d) munitions of war, explosive materials, ionizing radiation or contamination by radio-activity, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity; and (e) natural catastrophes such as earthquake, hurricane, typhoon or volcanic activity.
62. Notice of Force Majeure	62.1 If a Party is or will be prevented from performing its substantial obligations under the Contract by Force Majeure, then it shall give notice to the other Party of the event or circumstances constituting the Force Majeure and shall specify the obligations, the performance of which is or will be prevented. The notice shall be given within 14 days after the Party became aware, or should have become aware, of the relevant event or circumstance constituting Force Majeure.
	62.2 The Party shall, having given notice, be excused performance of its obligations for so long as such Force Majeure prevents it from performing them.
	62.3 Notwithstanding any other provision of this Clause, Force Majeure shall not apply to obligations of either Party to make payments to the other Party under the Contract.
63. Duty to Minimize Delay	63.1 Each Party shall at all times use all reasonable endeavors to minimize any delay in the performance of the Contract as a result of Force Majeure.
	63.2 A Party shall give notice to the other Party when it ceases to be affected by the Force Majeure.
64. Consequences of Force Majeure	64.1 If the Contractor is prevented from performing its substantial obligations under the Contract by Force Majeure of which notice has been given under GCC 62, and suffers delay and/or incurs Cost by reason of such Force Majeure, the Contractor shall be entitled subject to GCC 30 to

	(a) an extension of time for any such delay, if completion is or will be delayed, under GCC35; and (b) if the event or circumstance is of the kind described in sub-paragraphs (a) to (d) of GCC 61.2 and, in the case of subparagraphs (a)-(d), occurs in the Country, payment of any such Cost, including Costs of rectifying or replacing the Works and/or Goods damaged or destructed by Force Majeure, to the extent they are not indemnified through the insurance policy referred to in GCC 19.
	64.2 After receiving this notice, the Project Manager shall proceed in accordance with GCC 10 to agree or determine these matters.
65. Force Majeure Affecting Subcontractor	65.1 If any Subcontractor is entitled under any contract or agreement relating to the Works to relief from force majeure on terms additional to or broader than those specified in this Clause, such additional or broader force majeure events or circumstances shall not excuse the Contractor's nonperformance or entitle him to relief under this Clause.
66. Optional Termination, Payment and Release	66.1 If the execution of substantially all the Works in progress is prevented for a continuous period of 90 days by reason of Force Majeure of which notice has been given under GCC 62, or for multiple periods which total more than 150 days due to the same notified Force Majeure, then either Party may give to the other Party a notice of termination of the Contract. In this event, the termination shall take effect 7 days after the notice is given, and the Contractor shall proceed in accordance with GCC 72.5.
	66.2 Upon such termination, the Project Manager shall determine the value of the work done and issue a Payment Certificate, which shall include (a) the amounts payable for any work carried out for which a price is stated in the Contract; (b) the Cost of Plant and Materials ordered for the Works which have been delivered to the Contractor, or of which the Contractor is liable to accept delivery: this Plant and Materials shall become the property of (and be at the risk of) the Employer when paid for by the Employer, and the Contractor shall place the same at the Employer's disposal; (c) other Costs or liabilities which in the circumstances were reasonably and necessarily incurred by the Contractor in the expectation of completing the Works; (d) the Cost of removal of Temporary Works and Contractor's Equipment from the Site and the return of these items to the Contractor's works in his country (or to any other destination at no greater cost); and (e) the Cost of repatriation of the Contractor's staff and labor employed wholly in connection with the Works at the date of termination.
67. Release from Performance	67.1 Notwithstanding any other provision of this Clause, if any event or circumstance outside the control of the Parties (including, but not limited to, Force Majeure) arises, which makes it impossible or unlawful for either or both Parties to fulfill its or their contractual obligations or which, under

	the law governing the Contract, entitles the Parties to be released from further performance of the Contract, then upon notice by either Party to the other Party of such event or circumstance, (a) the Parties shall be discharged from further performance, without prejudice to the rights of either Party in respect of any previous breach of the Contract; and (b) the sum payable by the Employer to the Contractor shall be the same as would have been payable under GCC 66 if the Contract had been terminated under GCC 66.
G. Finishing the Contract	
68. Completion	68.1 The Contractor shall request the Project Manager to issue a certificate of Completion of the Works, and the Project Manager shall do so upon deciding that the work is completed.
	68.2 In addition to the other provisions, before acceptance of the completed works, Employer shall verify and assure that such works are within the set objective, quality and appropriate to operate and use.
69. Taking Over	69.1 In the contractor's Opinion, if the works are complete and ready for taking over, the contractor may apply by notice to the Project Manager for a Taking-Over Certificate. If the Works are divided into Sections, the Contractor may similarly apply for a Taking-Over Certificate for each Section. 69.2 The Project Manager shall, within 30 days after receiving the Contractor's application: (a) issue the Taking-Over Certificate to the Contractor if physical progress of works is at least ninety (90) percent in accordance with the Contract except for any minor outstanding work and defects (as listed in the Taking-Over Certificate) which will not substantially affect the use of the Works or Section for their intended purpose (either until or whilst this work is completed and these defects are remedied); or (b) reject the application, giving reasons and specifying the work required to be done by the Contractor to enable the Taking-Over Certificate to be issued. The Contractor shall then complete this work before issuing a further notice under this Sub-Clause. 69.3 If the Engineer fails either to issue the Taking-Over Certificate or to reject the Contractor's application within the period of 30 days, and if the Works or Section (as the case may be) are substantially completed in accordance with the Contract, the Taking-Over Certificate shall be deemed to have been issued on the last day of that period.
70. Final Account	70.1 The Contractor shall supply the Project Manager with a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Project Manager shall issue a Defects Liability Certificate and certify any final payment that is due to the Contractor within 60 days of receiving the Contractor's account if it is correct and complete. If it is not, the Project Manager shall issue within 60 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Project Manager shall decide on the amount payable to the Contractor and issue a payment certificate.
71. Operating	71.1 If "as built" Drawings and/or operating and maintenance manuals are required,

and Maintenance Manuals	the Contractor shall supply them by the **dates stated in the SCC**.
	71.2 If the Contractor does not supply the Drawings and/or manuals by the dates **stated in the SCC** pursuant to **GCC 71.1,** or they do not receive the Project Manager's approval, the Project Manager shall withhold the amount **stated in the SCC** from payments due to the Contractor.
72. Termination	72.1 The Employer may terminate the Contract at any time if the contractor; a. does not commence the work as per the Contract, b. abandons the work without completing, c. fails to achieve progress as per the Contract.
	72.2 The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.
	72.3 Fundamental breaches of Contract shall include, but shall not be limited to, the following: a. the Contractor uses the advance payment for matters other than the contractual obligations, b. the Contractor stops work for 30 days when no stoppage of work is shown on the current Program and the stoppage has not been authorized by the Project Manager; c. the Project Manager instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within 30 days; d. the Employer or the Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation. e. a payment certified by the Project Manager is not paid by the Employer to the Contractor within 90 days of the date of the Project Manager's certificate; f. the Project Manager gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Project Manager; g. the Project Manager gives two consecutive Notices to update the Program and accelerate the works to ensure compliance with GCC Sub clause 22.1 and the Contractor fails to update the Program and demonstrate acceleration of the works within a reasonable period of time determined by the Project Manager; h. the Contractor does not maintain a Security, which is required; i. the Contractor has delayed the completion of the Works by the number of days for which the maximum amount of liquidated damages can be paid, **as defined in the SCC**; and j. If the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in executing the Contract, pursuant to GCC 73.1. k. If the Contractor fails to submit Performance Security, Advanced Payment Guarantee (if any) and Insurance Policy documents even after the time period indicated in GCC 35.3.
	72.4 When either party to the Contract gives notice of a breach of Contract to the Project Manager for a cause other than those listed under GCC 72.3 above, the Project Manager shall decide whether the breach is fundamental or not.
	72.5 Notwithstanding the above, the Employer may terminate the Contract for

	convenience.
	72.6 If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible.
73. Fraud and Corruption	73.1 If the Employer determines that the Contractor has engaged in corrupt, fraudulent, collusive, coercive or obstructive practices, in competing for or in executing the Contract, then the Employer may, after giving 15 days' notice to the Contractor, terminate the Contractor's employment under the Contract and expel him from the Site.
	73.2 Should any employee of the Contractor be determined to have engaged in corrupt, fraudulent, collusive, coercive, or obstructive practice during the execution of the Works, then that employee shall be removed in accordance with GCC Clause 15. For the purposes of this GCC 73; (i) "corrupt practice" is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party. (ii) "fraudulent practice"[5] is any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation; (iii) "collusive practice"[6] is an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party; (iv) "coercive practice"[7] is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party; (v) "obstructive practice" is (aa) deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; or (bb) acts intended to materially impede the exercise of the GON's/DP's inspection and audit rights provided for under GCC28.3.
	73.3 The contractor shall be prosecuted for offenses under prevailing criminal laws, if the contractor: (i) Misuses the Advance Payment or payments received from the Employer; (ii) Receives payment by submitting false information or documents; (iii) Abandons the works before completion; (iv) Commits a serious violation of the contract; or (v) Causes loss or damage to the Employer.
74. Black Listing	74.1 Without prejudice to any other rights of the Employer under this Contract, GoN, Public Procurement Monitoring Office (PPMO), on the recommendation of procuring entity, may blacklist a Bidder or contractor for its conduct for a period of one (1) to three (3) years on the following grounds and seriousness of the act committed by the bidder or contractor: (a) if it is established that the Contractor has committed substantial defect in implementation of the contract or has not substantially fulfilled its

	obligations under the contract or the completed work is not of the specified quality as per the contract. (b) If convicted from a court of law in a criminal offense liable to be disqualified for taking part in procurement contract, (c) If it is established that the Contractor has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.
75. Payment upon Termination	75.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Project Manager shall issue a certificate for the value of the work done and Materials ordered less advance payments received up to the date of the issue of the certificate. Additional Liquidated Damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor, the difference shall be a debt payable to the Employer.
	75.2 If the Contract is terminated for the Employer's convenience or because of a fundamental breach of Contract by the Employer, the Project Manager shall issue a certificate for the value of the work done, Materials ordered, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works, and less advance payments received up to the date of the certificate.
	75.3 If the Contract is terminated because of fundamental breach of Contract or for any other fault by the Contractor, the Employer may: (a) withhold further payments to the Contractor until the costs of design, execution, completion and remedying of any defects, liquidated damages (if any), and all other costs incurred by the Employer, have been established, and/or (b) recover from the Contractor any losses and damages incurred by the Employer and any additional costs of completing the Works, after allowing for any sum due to the Contractor, as Government dues. After recovering any such losses, damages and extra costs, the Employer shall pay any balance to the Contractor. (c) forfeit the Performance Security. If the total amount due to the Employer exceeds any payment due to the Contractor, the difference shall be a debt payable to the Employer.
76. Property	76.1 All Materials on the Site, Plant, Equipment, Temporary Works, and Works shall be deemed to be the property of the Employer if the Contract is terminated because of the Contractor's default.
77. Release from Performance	77.1 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either the Employer or the Contractor, the Project Manager shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which a commitment was made.
78.Suspension of DP Loan/Credit/ Grant	78.1 In the event that the DP suspends the loan/ credit/grant to the Employer from which part of the payments to the Contractor are being made: a. the Employer is obligated to notify the Contractor of such suspension within 7 days of having received the DP's suspension notice; and b. if the Contractor has not received sums due him within the 30 days for payment provided for in GCC 49.1, the Contractor may immediately issue a 15-day termination notice.

79. Eligibility	79.1 The Contractor shall have the nationality of an eligible country as specified in Section V of the bidding document. The Contractor shall be deemed to have the nationality of a country if the Contractor is a citizen or is constituted, or incorporated, and operates in conformity with the provisions of the laws of that country. This criterion shall also apply to the determination of the nationality of proposed subcontractors or suppliers for any part of the Contract including related services.
	79.2 The materials, equipment, and services to be supplied under the Contract shall have their origin in eligible source countries as specified in Section V of the bidding document and all expenditures under the Contract will be limited to such materials, equipment, and services. At the Employer's request, the Contractor may be required to provide evidence of the origin of materials, equipment, and services.
	79.3 For purposes of GCC 79.2, "origin" means the place where the materials and equipment are mined, grown, produced, or manufactured, and from which the services are provided. Materials and equipment are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that differs substantially in its basic characteristics or in purpose or utility from its components.
80. Project Manager's Duties and Authorities	80.1 The Project Manager's duties and authorities are restricted to the extent as **stated in the SCC**.
81. Quarries and Spoil Dumps	81.1 Any quarry operated as part of this Contract shall be maintained and left in a stable condition without steep slopes and be either refilled or drained and be landscaped by appropriate planting. Rock or gravel taken from a river shall be removed over some distance so as to limit the depth of material removed at any one location, not disrupt the river flow or damage or undermine the river banks. The Contractor shall not deposit excavated material on land in Government or private ownership except as directed by the Project Manager in writing or by permission in writing of the authority responsible for such land in Government ownership, or of the owner or responsible representative of the owner of such land in private ownership, and only then in those places and under such conditions as the authority, owner or responsible representative may prescribe.
82. Local Taxation	82.1 The prices bid by the Contractor shall include all taxes that may be levied in accordance to the laws and regulations in being in Nepal on the date 30 days prior to the closing date for submissions of Bids on the Contractor's equipment, plant and materials acquired for the purpose of the Contract and on the services performed under the Contract. Nothing in the Contract shall relieve the Contractor from his responsibility to pay any tax that may be levied in Nepal on profits made by him in respect of the Contract.
83. Value Added Tax	83.1 The Contract is not exempted from value added tax. An amount specified in the schedule of taxes shall be paid by the Contractor in the concerned VAT office within time frame specified in VAT regulation.
84. Income Taxes on Staff	84.1 The Contractor's staff, personnel and labor will be liable to pay personal income taxes in Nepal in respect of their salaries and wages, as are chargeable under the laws and regulations for the time being in force, and the Contractor shall perform such duties in regard to such deductions as may be imposed on

	him by such laws and regulations.
	84.2 The issue of the Final Account Certificate pursuant to clause GCC 70 shall be made only upon submittal by the Contractor of a certificate of income tax clearance from the Government of Nepal.
85. Duties, Taxes and Royalties	85.1 Any element of royalty, duty or tax in the price of any goods including fuel oil, and lubricating oil, cement, timber, iron and iron goods locally procured by the Contractor for the works shall be included in the Contract rates and prices and no reimbursement or payment in that respect shall be made to the Contractor.
	85.2 The Contractor shall familiarize himself with GON the rules and regulations with regard to customs, duties, taxes, clearing of goods and equipment, immigration and the like, and it will be necessary for him to follow the required procedures regardless of the assistance as may be provided by the Employer wherever possible.
	85.3 The Contractor shall pay and shall not be entitled to the reimbursement of cost of extracting construction materials such as sand, stone/boulder, gravel, etc. from the river beds or quarries. Such prices will be levied by concerned Local Government as may be in force at the time. The Contractor, sub-contractor(s) employed directly by him and for whom he is responsible, will not be exempted from payment of royalties, taxes or other kinds of surcharges on these construction materials so extracted and paid for to the concerned Local Government.
86. Member of Government, etc, not Personally Liable	86.1 No member or officer of GoN or the Employer or the Project Manager or any of their respective employees shall be in any way personally bound or liable for the act or obligations of the Employer under the Contract or answerable for any default or omission in the observance or performance of any of act, matter or thing which are herein contained.
87. Approval of Use of Explosives	87.1 No explosives of any kind shall be used by the Contractor without the prior consent of the Employer in writing and the Contractor shall provide, store and handle these and all other items of every kind whatsoever required for blasting operations, all at his own expense in a manner approved in writing by the Employer.
88 Compliance with Regulations for Explosives	88.1 The Contractor shall comply with all relevant ordinances, instructions and regulations which the Government, or other person or persons having due authority, may issue from time to time regarding the handling, transportation, storage and use of explosives.
89. Permission for Blasting	89.1 The Contractor shall at all times maintain full liaison with and inform well in advance, and obtain such permission as is required from all Government authorities, public bodies and private parties whatsoever concerned or affected, or likely to be concerned or affected by blasting operation.
90. Records of Explosives	90.1 Before the beginning of the Defects Liability Period, the Contractor shall account to the satisfaction of the Project Manager for all explosives brought on to the Site during the execution of the Contract and the Contractor shall remove all unused explosives from the Site on completion of works when ordered by the Project Manager.
91.Traffic Diversion	91.1 The Contractor shall include the necessary safety procedures regarding and pedestrian traffic diversion that is needed in execution of the works. The Contractor shall include in his costing of works, any temporary works or diversion that are needed during the construction period. All traffic diversion should be designed for the safety of both the motoring public and the men at

	work. It shall ensure the uninterrupted flow of traffic and minimum inconvenience to the public during the period concerned. As such, adequate warning signs, flagmen and other relevant safety precautionary measures shall be provided to warn motorists and pedestrians well ahead of the intended diversion as directed by the Project Manager. All traffic devices used shall be designed in accordance with the instruction of Project Manager.
92 Social Security Fund	92.1 The Contractor shall enroll the laborers, employees, or other workforce engaged in such work in the Social Security Fund in accordance with prevailing laws.
	92.2 The contractor shall be responsible to disburse the remuneration, benefits, and other payments of the laborers, employees, or workforce into the bank account of the concerned individual.
	92.3 The contractor shall be responsible for ensuring that the required work permit has been obtained in accordance with prevailing laws in respect of foreign personnel.,

Section IX: Special Conditions of Contract

The following Special Conditions of Contract shall supplement the GCC. Whenever there is a conflict, the provisions herein shall prevail over those in the GCC.

Water Supply and Sewerage Management Office, Lamjung

Construction of Belchautara Co-Financing Water Supply Project, Shuklagandaki Municipality, Tanahun (Package-II)

Contract Identification No.: WSSMOLMG/NCB/Works/083/84-05

Special Conditions of Contract

A. General	
GCC 1.1 (p)	The Employer is ***Water Supply and Sewerage Management Office, Besishahar-8, Lamjung, Gandaki Province, Nepal.***
GCC 1.1 (u)	The Intended Completion Date for the whole of the Works shall be: ***18 months.***
GCC 1.1(bb) & GCC10.1	The Project Manager is Office Chief. The Project Manager and Engineer are synonyms.
GCC 1.1 (ee)	The Site is located at ***Shuklagandaki Municipality-05, Tanahun.***
GCC 1.1 (hh)	The Start Date shall be **specified in the Work Order**
GCC 1.1 (ll)	The Works consist of Construction of Belchautara Co-Financing Water Supply Project, Shuklagandaki Municipality, Tanahun (Package-II).
GCC 2.2	Sectional Completions are: ***N/A***
GCC 2.3(i)	The following documents also form part of the Contract: ***N/A***
GCC 3.1	The language of the contract is **ENGLISH/NEPALI** The law that applies to the Contract is the law of NEPAL
GCC 11.1	The Project Manager ***may*** delegate any of his duties and responsibilities.
GCC 12.1 (a)	The agreed electronic transmission shall be ***E-mail*** ***fwssmplamjung@gmail.com***
GCC 13.1	**<u>For GoN Funded:</u>** **Maximum percentage of subcontracting permitted is 25% of the total contract amount (**without VAT but including PS)**.** **Nature of Works that agreed to be subcontracted and Details of Sub-Contractors: 1. Pipeline Works** **For DP Funded: N/A** ***[insert the following text if sub-contracting is permitted]*** Maximum percentage of subcontracting permitted is: **[*sub-contracting percentage should be same as in ITB 34.4*] % of the total contract amount (without VAT but including PS).** **Nature of Works that can be sub contracted:** 1. …….. 2. …….. **Qualification Criteria**

	The proposed sub-contractor shall meet the following requirements: 1) Completion of 80% of the amount in NRs. with similar size and nature of the work being sub contracted 2) Average Annual Construction Turnover for the work being sub contracted should be at least 1.5 * V/T where V is the proposed value of sub contract and T is estimated time in year for which the intended sub-contracting work is to be completed. For intended Sub contracting work duration of up to 1 year, T shall be "1".
GCC 14.1	Schedule of other contractors: ***N/A***
GCC 19.1	The minimum insurance amounts and deductibles shall be: 1. The minimum cover for loss of or damage to the Works, Plant and Materials is: ***115%*** of the Contract Amount. 2. The maximum deductible for insurance of the Works and of Plant and Materials is: ***5% of Claim Amount or 1% of sum insured whichever is lower***. 3. The minimum cover for loss or damage to **immovable** Equipment/**plants** is: ***100 % (i.e Replacement Cost).*** **4.** The maximum deductible for insurance of immovable Equipment/**plant** is: ***[value as per the provision of Nepal Insurance Authority].*** 5. The minimum **cover for loss of or damage to** other property is: NRs. **300,000.00** with unlimited number of occurrences. **6.** The maximum deductible for insurance of other property is: ***value as per the provision of Nepal Insurance Authority.*** 7. The minimum cover for personal injury or death insurance i. for the Contractor's employees is that specified in the Labor act of Nepal and ii. for other people is***: 1 million*** with an unlimited number of occurrences.
GCC 20.1	Site Investigation Reports are: ***N/A.***
GCC 23.1	The following shall be designed by the Contractor: ***as per requirement.***
GCC 24.2	***[Insert OHS Policy, Guideline and/or Operating Manual, if any]. as per prevailing law.***
GCC 26.1	The Site Possession Date(s) shall be: ***immediately after the date of agreement.***
GCC 30.1	The place of arbitration shall be: ***Nepal Council of Arbitration (NEPCA), Lalitpur.***
C. Time Control	
GCC 34.1	The Contractor shall submit for approval a Program for the Works within **28** days from the date of the Letter of Acceptance.
GCC 34.3	The period between Program updates is **60** days. The amount to be withheld for late submission of an updated Program is **50000.00**
D. Quality Control	

GCC 42.1	The Defects Liability Period is: **365** days.
	E. Cost Control
GCC 49.1	***Prevailing Interest Rate Interest rate of Nepal Rastra Bank. %***
GCC 53.1	The Contract **is** subject to price adjustment, and the following information regarding coefficients ***does apply***. The coefficients and indices for adjustment of prices in Nepalese Rupees shall be as specified in the Table of Adjustment Data submitted by bidder together with the Letter of Price Bid which is approved by the Project manager and attached as Annex-1.
GCC 53.6	Base Price of Construction Materials applicable for price adjustment shall be as per the Table of Adjustment Data submitted by Bidder together with the Letter of Price Bid which is approved by the Project manager and attached as Annex-1.
GCC 53.7	The Price Adjustment amount shall be limited to a maximum of: For GoN Funded: ***25 %*** percentage of the initial Contract Amount (without VAT but including PS) For DP Funded: **Not Applicable**
GCC 54.1	The proportion of payments retained is: 5 (five) percent For GoN Funded: 5 (five) percent For DP Funded: N/A ***[Insert 5 (five) to 10 (ten) percent]***
GCC 55.1	The liquidated damages for the whole of the Works are 0.05 Percent of the final Contract Price (without VAT but including PS) per day. The maximum amount of liquidated damages for the whole of the Works is 10 Percent of the final Contract Price (without VAT but including PS).
GCC 56.1	The provision of bonus ***Not Applicable*** in the contract. If Applicable, the Bonus for the whole of the Works is 0.05 Percent per day of final contract price (without VAT but including PS). The maximum amount of Bonus for the whole of the Works is ***Zero Percentage*** of the final Contract Price (without VAT but including PS).
GCC 57.1	The provision of Advance Payments ***Applicable*** in the contract. If Applicable, the Advance Payments shall be: ***20 percent of initial contract amount*** (without VAT but including PS) and shall be paid in two equal installments and to the Contractor.

Installment	**Percentage**	**Requirement**
First Installment	10.0	Shall be made to the contractor upon submission of equivalent acceptable bank guarantee for advance payment, insurance document and Quality Assurance Plan as per condition of contract.
Second Installment	10.0	Shall be made after the contractor completes the physical progress which is not less than 10 (Ten) % of the contact price upon submission of equivalent acceptable bank guarantee for advance payment.

	The Advance Payment Guarantee shall be valid until 30 days beyond the intended completion date for whole of the work.
GCC 57.3	Deductions from Payment Certificates will commence in the first certificate in which the value of work executed exceeds 30% of the Contract Price. Deduction will be at the rate of **40%** of the respective Monthly Interim Payment Certificate until such time as the advance payment has been repaid; provided that the advance payment shall be completely repaid prior to the end of 80 % of the approved contract price.
GCC 57.4	Recover interest on the advance amount from the Contractor should be at a rate of **10 %**.
GCC 58.1	The Performance Security amount is: 5% (Five) ***including an additional amount based on ITB 40.1 and/or ITB 35.5 if the Employer has increased the Performance Security amount.***
G. Finishing the Contract	
GCC 71.1	The date by which operating and maintenance manuals are required is; 30 days
GCC 71.2	The date by which "as built" drawings are required is: ***30 days after work acceptance date.*** The amount to be withheld for failing to produce "as built" drawings and/or Operating and maintenance manuals is: NRs. 100000.00
GCC 72.3 (i)	The maximum number of days is: **200**
GCC 80	The Project Manager has to obtain the specific approval of the Employer for taking any of the following actions : a. Approving subcontracting of any part of the works under General Conditions of Contract Clause 13; b. Certifying additional costs determined under General Conditions of Contract Clause 50; c. Determining start date under General Conditions of Contract Clause 1; d. Determining the extension of the intended Completion Date under General Conditions of Contract Clause 35; e. Issuing a Variation under General Conditions of Contract Clause 1 and 46, except in an emergency situation, as reasonably determined by the Project Manager; emergency situation may be defined as the situation when protective measures must be taken for the safety of life or of the works or of adjoining property. f. Adjustment of rates under General Conditions of Contract Clause 45;

Section X: Contract Forms

This Section contains forms which, once completed, will form part of the Contract. The forms for Performance Security and when required Advance Payment Security and Retention Money Security shall only be completed by the successful Bidder after contract award.

Letter of Intent

[on letterhead paper of the Employer]

Date: ... ……

To: .....***Name and address of the Contractor***.....

Subject: …… Issuance of letter of intent to award the contract.....

This is to notify you that, it is our intention to award the contract ..... ***[insert date]*** .....for execution of the ... . ***[insert name of the contract and identification number, as given in the Contract Data/SCC]*** to you as your bid price Nepalese Rupees ..... ***[insert amount of contract price in figures and words including taxes]*** as corrected and modified in accordance with the Instructions to Bidders is hereby selected as substantially responsive evaluated bid closest to the Average Bid Price.

Authorized Signature: ……

Name: ... …….

Title: …….

CC:

[Insert name and address of all other Bidders, who submitted the bid]

[Notes on Letter of Intent

The issuance of Letter of Intent is the information of the selection of the bid of the successful bidder by the Employer and for providing information to other unsuccessful bidders who participated in the bid as regards to the outcome of the procurement process. This standard form of Letter of Intent to Award should be filled in and sent to the successful Bidder only after evaluation and selection of substantially responsible evaluated bid closest to the Average Bid Price.]

Letter of Acceptance

[On letterhead paper of the Employer]

Date: ……..

To: ……*Name and address of the Contractor*……...

Subject: ……*Notification of Award*

This is to notify that your Bid for the Invitation of Bids dated .....[***Insert date of bid invitation]*** ……..for execution of the……..[***Insert name of the contract and identification number, as given in the Contract BDS/SCC]*** ……... for the Contract price of Nepalese Rupees ***[insert amount of contract price in figures and words including taxes],*** as corrected in accordance with the Instructions to Bidders is hereby accepted in accordance with the Instruction to Bidders.

You are hereby instructed to contact this office to sign the formal contract agreement within 15 days with Performance Security of **NRs**. ……. in accordance with the Conditions of Contract, using for that purpose the Performance security Form included in Section X (Contract Forms) of this Bidding Document.

Authorized Signature: ……...

Name and Title of Signatory: ……

Contract Agreement

THIS AGREEMENT made the .....day of…..between……. name of the Employer ***……(hereinafter "the Employer"),*** of the one part, and ……name of the Contractor ……(hereinafter "the Contractor"), of the other part:

WHEREAS the Employer desires that the Works known as …….... name of the Contract .....should be executed by the Contractor, and has accepted a Bid by the Contractor for the execution and completion of these Works and the remedying of any defects in the sum of NRs ***….....…..[insert amount of contract price in words and figures including taxes]***(hereinafter "the Contract Price").

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Contract documents referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement. This Agreement shall prevail over all other Contract documents.
   (a) the Letter of Acceptance;
   (b) the Letters of Technical and Price Bid;
   (c) the Addenda Nos ..... ***Insert addenda numbers if any*** ……
   (d) the Special Conditions of Contract;
   (e) the List of Eligible Countries that was specified in Section V of the bidding document,
   (f) the General Conditions of Contract;
   (g) the Specification;
   (h) the Drawings;
   (i) Bill of Quantities (or Schedules of Prices for lump sum contracts), and
   (j) Table of Price Adjustment Data
   (k) List of Approved Subcontractors *[For GoN funded project]*
   (l) .....***[Specify if there are any other document]***

3. In consideration of the payments to be made by the Employer to the Contractor as indicated in this Agreement, the Contractor hereby covenants with the Employer to execute the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with the laws of Nepal on the day, month and year indicated above.

Signed by …….
for and on behalf the Contractor in the presence of

Witness, Name Signature, Address, Date

Signed by……..
for and on behalf of the Employer in the presence of

Witness, Name, Signature, Address, Date

List of Approved Subcontractors

In accordance with GCC & PCC Clause 13.1, The following Subcontractors are approved for carrying out the work as specified below.

Name of Subcontractors	Description of Works	Value/Percentage of subcontract

Performance Security

(On letterhead paper of the Bank)

..... ***Bank's Name, and Address of Issuing Branch or Office*** .....

Beneficiary: ***..... [insert Name and Address of Employer***]…….....

Date: .....

Performance Guarantee No.:…….

We have been informed that ... ... ***[insert name of the Contractor, which in the case of a joint venture shall be the name of the joint venture]*** (hereinafter called "the Contractor") has been notified by you to sign the Contract No. …….. ***[insert reference number of the Contract]***, for the execution of …….. ***[insert name of contract and brief description of Works]*** (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a performance guarantee is required.

At the request of the Contractor, we... ..... ***[insert name of the Bank]*** ……., hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of Nepalese Rupees.....***[insert amount in figures*and amount in words]…..*** such sum being payable in Nepalese Rupees, upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or to show grounds for your demand or the sum specified therein.

This guarantee shall expire, no later than the……***[[insert day].***Day of ***……[[insert month, year]****, ***, and any demand for payment under it must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG), 2010 Revisions, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.

……

Seal of Bank and Signature(s)

Note:

All italicized text is for guidance on how to prepare this demand guarantee and shall be deleted from the final document.

** The Guarantor shall insert an amount representing the percentage of the Contract Price specified in the Contract in Nepalese Rupees.*

*** Insert the date thirty days after the date specified for the Defect Liability Period. The Employer should note that in the event of an extension of the time for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee.*

Advance Payment Security

(On letterhead paper of the Bank)

…….. Bank's Name, and Address of Issuing Branch or Office.....

Beneficiary: ……*[insert Name and address of employer]*

Date : ……

Advance Payment Guarantee No……..

We have been informed that …… ***[insert name of the Contractor, which in the case of a joint venture shall be the name of the joint venture]*** …… (hereinafter called "the Contractor") has entered into Contract No. .....***[insert refrence number of the contract]*** dated ……***[date]***…… with you, for the execution of …….*[* ***insert*** *name of contract and brief description of Works]* ……. (hereinafter called "the Contract").

Furthermore, we understand that, according to the Conditions of the Contract, an advance payment in the sum Nepalese Rupees ***……. [Insert amount in figures*and in words]*** is to be made against an advance payment guarantee.

At the request of the Contractor, we... ..... . ***[insert name of the Bank]*** ……,, hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of Nepalese Rupees ***……..[insert amount in figures* and amount in words]*** upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation under the Contract because the Contractor:

(a).....Used the advance payment for purposes other than the costs of mobilization in respect of the Works; or

(b)... Has failed to repay the advance payment when it has become due and payable in accordance with the conditions of the contract, specifying the amount payable by the contractor.

The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Contractor as indicated in copies of interim statements or payment certificates which shall be presented to us. This guarantee shall expire, at the latest, upon our receipt of a copy of the interim payment certificate indicating that eighty (80) percent of the Contract Price has been certified for payment, or on the ***…..[date].....*** day of ***...[month],[year]...**,*** whichever is earlier. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG), 2010 Revisions, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.

……

Seal of Bank and Signature(s)

Note:

All italicized text is for guidance on how to prepare this demand guarantee and shall be deleted from the final document.

**The Guarantor shall insert an amount representing the amount of the advance payment in Nepalese Rupees of the advance payment as specified in the Contract.*

*** Insert the date Thirty days after the intended completion date. The Employer should note that in the event of an extension of the time for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee.*

Retention Money Security

(On letterhead paper of the Bank)

..... ***Bank's Name, and Address of Issuing Branch or Office*****.....**

Beneficiary: _____ ***[Insert name and Address of Employer]***

Date: _____***[Insert date of issue]***

RETENTION MONEY GUARANTEE No.: ***[Insert guarantee reference number]***

We have been informed that _____ ***[insert name of Contractor, which in the case of a joint venture shall be the name of the joint venture]*** (hereinafter called "the Contractor") has entered into Contract No. _____ ***[insert reference number of the contract]*** dated _____ with the Beneficiary, for the execution of _____ ***[insert name of contract and brief description of* Works*]*** (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, the Beneficiary retains moneys up to the limit set forth in the Contract ("the Retention Money"), and that when at least eighty (80) percent of the whole works have been completed, progress of the works is satisfactory in accordance with the Contract as per approved work schedule and it can be assured that the works can be completed at the intended completion date, payment of ***[insert the amount of the Retention Money]*** is to be made against a Retention Money guarantee.

At the request of the Contractor, we, .. . ***[insert name of the Bank]*** ……..,as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of Nepalese Rupees _____ ***[insert amount in figures and amount in words][1]*** upon receipt by us of the Beneficiary's complying demand supported by the Beneficiary's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or show grounds for your demand or the sum specified therein.

This guarantee shall expire no later than the …. day of ……, … [2], and any demand for payment under it must be received by us at the office indicated above on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG), 2010 Revisions, ICC Publication No. 758, except that the supporting statement under Article 15(a) is hereby excluded.

_____

[Seal of Bank and signature(s)]

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

[1] *The Guarantor shall insert the amount of the Retention Money.*

[2] *Insert the same expiry date which is 30 days more than the end of Defect Liability Period. The Employer should note that in the event of an extension of this date for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee.*

Annex-1

Table of Price Adjustment Data
[SCC 53.1]

Code	Index Description	Source of Index*	Base Value and Date	Employer's Proposed Weighting Range (coefficient)	Bidder's Proposed Weighting (coefficient)**
1	**2**	**3**	**4**	**5**	**6**
	Non - adjustable (A)			0.15	0.15
	Labor (b)	NRB	30 days before last date of Submission.	0.15-0.25	
	Materials (c)	NRB	30 days before last date of Submission.	0.40-0.60	
	Equipment usage (d)	NRB	30 days before last date of Submission.	0.05-0.15	
		Total			**1.00**

Note: Base value and Bidder's proposed weighting coefficient to be filled as per "Bid Form of Table of Price Adjustment Data" in Bidding Forms (Section-IV) after verification by the Employer in case of the alternative provision of Bidder proposed value and weighting coefficient.

Table of Price Adjustment Data
[SCC 53.6]

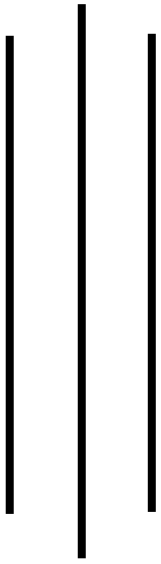
Code	Construction Material*	Unit	Base Price (NRs/Unit) ** (Ex-factory)	Source (Factory)**
1	**2**	**3**	**4**	**5**

** For the purpose of calculation of price adjustment, the Ex-factory price of the same source mentioned in the table shall be taken into consideration.

Note: Base Price and source to be filled as per "Bid Form of Table of Price Adjustment Data" in Bidding Forms (Section-IV) after verification by the Employer in case of the alternative provision of Bidder proposed source and base price.

Government of Nepal
Ministry of Infrastructure Development
Department of Water Supply and Sewerage Management
Water Supply and Sewerage Management Office
Lamjung

TECHNICAL SPECIFICATIONS



General Technical Specification

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लमजुङ

1 ITEMS OF GENERAL APPLICATION

1.1 General

1.1.1 Scope

These Technical Specifications cover principles, responsibilities, and requirements for items that will be applicable to all works pertinent for laying of transmission pipeline, Construction of intake, reservoir and other civil works including laying of pipelines, repair, rehabilitation, cleaning, other small works and operation and maintenance of the system.

These specifications shall be read in conjunction with the Conditions of Contract, The Agreement, the Bills of Quantities (BOQ) and the Drawings.

The specification provided cover the Works under the Contract, If the Contractor requires additional specifications for more explicit description of the Works or to supplement the existing specifications, or any other specifications to complete the Works, the Contractor shall submit such additional or supplementary specifications for the approval by the Engineer. All costs incurred for the additional specifications under the clause are deemed to be included in other unit rates quoted in the Bill of Quantities.

1.1.1.1 Scope of the Contract

This Contract includes but is not limited to the procurement and construction of:

- Construction of infiltration gallery.
- Construction of water treatment plant.
- Construction of RCC reservoir tanks
- Supply and laying of SS, DI, GI and PE pipes and fittings for proposed transmission and distribution lines
- Supply and erection of transmission lines and other electrical connections
- Construction of Water User Association's Office building, pump operation houses, Latrines, retaining wall and boundary wall.
- Construction of valve chamber, break pressure tank, air valve chamber, distribution chambers, thrust blocks, anchor blocks, gabion walls, and stream/river crossings.
- Supply and installation of pumps, generators, electrical panels, and it's all related accessories.
- Supply and installation of house connections.
- Rehabilitation works at the existing reservoir tank in the instructed area.

In order to complete above mentioned construction works the contractor shall carry out:

a) All temporary works and facilities including establishment and removal thereof support, supplement, or aid construction, access and other related works for the below.

b) Dismantling and removing of all damaged pipelines and civil structure as per the instructions of the Engineer including supply of all pipes, fittings, appurtenances, other specials and other construction materials required for the work.

c) Preparation of Site and storage-area/store-house for proper storage of the materials and goods to smooth implementation of the work.

d) Laying of High Tensile Steel (HTS), Ductile Iron (DI), Galvanized Iron (GI) and Polyethylene (PE) pipes for transmission and distribution with installation of fittings, appurtenances, and other specials.

e) Joining of old DI/GI/PE pipes with newly supplied HTS/DI/GI/PE pipes for all type of connection.

f) All necessary valve chambers (for air, pressure-relief, scour-washout and line control valves), special river/stream crossing, thrust block, anchor blocks, installation of all related pipe fittings and concrete works.

g) Supply of all necessary material and laying/installation for the complete work of reinstatement (water mains, sewer pipes, other utilities and associated civil works including road reinstatement) in service area.

h) Production of working and "as-built drawings and training of staff of the Employer in the installation of the pipelines and other related facilities.

i) Supply of all necessary material and installation to connect the communication pipe (House Connection) from where users can connect house connection pipe as per WUA instruction.

j) Operation of constructed system for one year after the completion.

1.1.2 Scope of Works

The activities to be undertaken by the Contractor within this Contract include the following: -

a) To carry out all necessary topographic surveys, soils investigations, laboratory analyses or related investigations where necessary to supplement the data provided by the employer. The Contractor`s attention is drawn to:

- The need to carry out regular soil pH and resistivity measurement to determine the type of corrosion for ductile iron pipes.
- The need to determine the bearing pressure at the location of storage tank, water treatment plant, office buildings, in thrust block and other structures as per the recommended by the engineer.
- Hydrogeological investigation for infiltration gallery to confirm the design discharge.

b) To prepare working drawings for all elements of the works.

c) To undertake all steps necessary for temporary way, leave facilities and/or upgrading of roads and bridges, all related to access to the Site, or other related matters, where his opinion differ significantly from those produced by the Employer.

d) Setup/Preparation of stockyards and store house for pipes, valves fitting and other materials and equipment.

e) To take all steps necessary for the temporary or permanent diversion of services and the maintenance of services during the execution of the works, including diversion of overhead power lines, sewers and other underground services along the route of the pipelines.

f) To supply all pipes, valves, fittings, appurtenances and other materials and equipment required for construction of the works. The Contractor's supply items for the installation may include manufacture, testing, collection, transportation and delivery to Site. The Contractor will be responsible for ensuring that all procedures are adequately covered and that the materials fully conform to the Contract requirements. These responsibilities will include all necessary charges or dues related to insurance, freight, taxes (including customs and excise duties, surcharges etc.) and all testing and inspection for quality control.

g) To provide all necessary staff (including project manager, civil engineers, administrators, site supervision personnel) and workmen (including all necessary specialists, operators, tradesmen, artisans etc. in addition to semi-skilled and unskilled workers) necessary for execution of the works through to completion and for commissioning/trial run and defect liability period. Where appropriate, the contract shall provide all suitable facilities and accommodation for the staff and workmen and he/she shall make provision for all costs related to such provision and for medical, re-location, taxes or other expenses.

h) To provide all equipment, machinery, tools etc. and related spares for maintenance and consumables necessary for implementation of the works.

i) To provide all project offices, stores, workshops and facilities necessary for use by the Employer, Engineer and support staff and for the Contractor himself and his support staff.

j) To undertake all operations necessary to complete the works. These operations shall include: excavation, provision, haulage and installation of suitable bedding and backfill material and disposal of surplus excavated material; distribution, laying and jointing of pipes; installation of all special pipe work, valves etc. and construction of all related concrete or other activities together with all testing and disinfection of completed works. The Contractor's attention is drawn to the restricted working space in some of the stretches. In this stretches work in addition to that associated with the water main, will include but not be limited to, removal and replacement of existing sewer and water mains laid in the road.

k) To liaise with other contractors on the site and to ensure harmonious co-operation with them so that conflicts are avoided and areas of common interest, construction interface or potential overlaps are addressed without cost to the Employer or delays in completion.

l) To prepare documentary records of the works in the form of "as-built" drawings and GIS data, schedules etc., and to train staff of the Employer in the procedures for laying pipes, valves and fittings.

m) All the above activities shall be performed in a professional way and with good engineering and/or constructional practice. Upon completion of the works the scheme shall be fully operational with minimum disruption or inconvenience to interested parties, including landowners, and there shall be no outstanding matters requiring attention.

1.1.2.1 Definitions

1.1.2.2 General

Acceptable/Approved (Approval) - Acceptable to/approved (approval) by the Engineer in writing. Agreed -

Agreed in writing.

As detailed - As detailed on the drawings.

Authorized/ordered/rejected - Authorized/ordered/rejected by the Engineer in writing.

Designated - Shown on the drawings or otherwise specified by the Engineer or, in relation to an item scheduled in the Bill of Quantities, description of an item.

Indicated - Indicated in or reasonably to be inferred from the contract or indicated in writing by the Engineer.

Instructed/directed/permitted - Instructed/directed/ permitted by the Engineer.

Satisfactory - Capable of fulfilling or having fulfilled the intended function.

Service - Any pipeline, cable, duct etc. for conveying or transmitting any fluid, power, or other matter. Submitted

- Submitted to the Engineer.

Working easement – Area required by the Contractor for execution of the Works, including the permanent right of way obtained or land purchased by the Employer plus any temporary way leaves arranged by the Contractor.

Working strip - The working easement on the pipeline route.

1.1.2.3 Tolerances

Deviation - The difference between the actual (i.e., measured) size or position and the specified size or position. Permissible deviation

- The specified limit(s) of deviation.

Tolerance - The range between the limits within which a size or position must lie.

1.1.2.4 Measurement and Payment

Bill/schedule - The bill/schedule of quantities.

Billed/scheduled rate - The unit rate or price entered in the bill/schedule at which the Contractor undertakes to execute the particular work or to provide the required material, article or service, or to do any or all of these things, as set out in the item concerned.

Billed/scheduled - Listed in the bill/schedule of quantities.

1.1.3 Languages

All drawings, instructions, signs, notices, nameplates, etc. for use in the operation and maintenance of the completed works shall be in English.

1.2 Facilities for the Engineer

1.2.1 Engineering Laboratory

The Laboratory shall be at vicinity of the project site and provided to the dimensions herein after given and as directed by the Engineer to the full satisfaction of the Engineer. On completion of the project, the facilities and contents, equipment and furniture will become the property of the Contractor.

The laboratory building shall contain the following rooms and with net areas approximately as follows:

1. Laboratory	12 m2
2. Office	9 m2
3. Toilet with commode, washbasin, mirror, towels holder, etc.	4 m2
4. Storage room	9 m2

The Contractor shall provide sufficient water supply as well as power at all times for all lighting, other electrical appliances and apparatus. All power shall be 220 volts 50 cycles except as otherwise specified or directed by the Engineer or may be required for equipment contained in the laboratory or supplied by the Contractor. Room(s) shall be to the satisfaction of Engineer with acceptable finish.

1.2.1.1 Furniture for Engineering Laboratory

Following Furniture shall be supplied by the Contractor for the Laboratory: Worktables and shelves shall be provided as directed by the Engineer.

- 5 wooden chairs
- 2 wooden tables, 70x140cm
- 1 steel almirah (large) locking type

1.2.1.2 Laboratory Equipment and Testing

i. All equipment/ apparatus necessary for the regular testing of material and workmanship shall be provided by the Contractor in the field for the purposes of conducting the test of the works. The Contractor shall provide field laboratory testing apparatus required for tests such as moisture content, Sieve analysis, liquid limit, plastic limit, penetration permeability density, compaction, compression strength etc. Any Site tests needed to be conducted outside the Contractor's laboratory has to be approved by the Engineer.

ii. The Contractor shall also be responsible for proper maintenance, lighting, power, water supply, and all consumables required for testing for the duration of the contract. Laboratory equipment shall be maintained and be in good working all the time.

iii. The laboratory shall be adequately staffed and equipped by the Contractor so that there shall never occur any interruption to construction activities resulting from the need to carry out tests required under the contract. All samples and records shall be preserved as per the instruction of the Engineer.

The Contractor shall make all arrangements for sampling, transportation, and preparations for regular site laboratory testing as well as off- site testing by the Engineer.

1.2.2 Delay in provision of engineer's facilities

In the event the Contractor does not provide, or complete to the satisfaction of the Engineer, the required facilities outlined in the Clause 1.2 FACILITIES FOR ENGINEER, herein within the specified time limit of two weeks after award of the Contract then the Engineer may arrange to rent alternate equivalent facilities. This requirement will be related to the Contractor's own schedule and level of activity. The Contractor will be responsible for the cost of providing such temporary facilities as the engineer may deem necessary in this period. Furthermore, the Contractor's first monthly Payment Certificate may be submitted only after written acceptance by the Engineer of the facilities.

1.2.3 Cost for engineer facilities

The cost of the facilities for the Engineer as mentioned in the clause "1.2 Facilities for engineer, shall be covered under Contractor's overhead cost. The cost should compensate for furnishing all material, equipment, tools and incidental necessary to complete and maintain the facilities including all furniture, potable water, electricity, sanitary installations, expendables and providing support staff etc.

The following items shall also be provided by the Contractor at his own expenses until expiration of the Contract.

a) Building and accommodation for the Contractor's own and his workmen use.
b) Supply of water for Works and for drinking purposes by means of storage tanks and available at all times.
c) Supply of electricity at all times including standby generators to make the electricity available at all times.
d) Maintenance and replacement parts for repairs of the laboratory.
e) Unskilled labour at least (Six) for materials testing and field surveys.

All the laboratory equipment including all other additional purchase for laboratory provided by the Contractor will remain the property of the Contractor.

1.2.4 Provision of Vehicle Facility

The vehicle supplied for the use of Engineer (for construction supervision purpose) during the project period (max of 90 days) should be four-wheel drive with double cab.

1.2.5 Operation and Maintenance of Vehicle

The vehicle shall be licensed and insured for use on the public highway with comprehensive insurance cover for any qualified driver authorized by the Engineer, together with any authorized passengers and the carriage of good or samples. The Contractor shall provide a competent, qualified driver, subject to approval by Engineer, or Engineer's Representative, holding a valid driver's license as a driver of similar vehicle types. The Contractor shall provide fuel, oil and maintenance in conformity with the vehicle manufactures.

1.2.6 Survey Equipment and Field Assistance

The Contractor shall make available to the Engineer suitably educated and trained surveyors/ assistants and laborers for use on and about the Site in sufficient numbers and at all reasonable times.

The following set of survey equipment shall be provided in the project for the use of the Engineer's staff, and these equipment's shall be maintained in good condition throughout the Contract period:

a) 1 no electronic total station with optical plummet, automatic vertical index, data storage on memory card, single prism range 1 km, internal battery, down and uploading of data via memory card and serial port, internal programs for setting out, traverse and free stationing. Accuracy: Distance □□ 2 mm + 2 ppm; Angle □□ 3" include Accessories for total station as: Tripod, Tribrach, 2 internal batteries, 2 external batteries with cables, Charger with cables and Accessories for targets to include: 4 tripods, 4 targets (tribrach with optical plummet, adapter with 1 prism), adapter with 3 prisms, pole with adapter and 1 prism, pole extension;

b) 1 no. engineering levels - Wild NAKI with Tripod GST20 or equivalent,

c) 1 nos 100 m tapes (fibreglass) and 2 nos 30 m tapes (fibreglass)

d) 2 nos metric metal levelling staffs (3 packs of 4 pieces each) 3 meter long

e) 4 nos surveyors' umbrellas with accessories.

Other equipment such as ranging rods, survey pegs, light and heavy hammers, nails, chords, etc. required for setting out the Works, testing, inspection and any attendances shall be provided as and when required by the Engineer.

The above-mentioned equipment shall be the property of the Contractor upon the completion of the Contract.

1.2.7 Safety Equipment

The Contractor shall provide the Engineer with the safety equipment set as required in project office. The Contractor shall replace each item after it wears out and becomes unsuitable for use.

1.2.8 Testing of Material and Workmanship

Testing of material and workmanship which may be required upon instruction of the Engineer for the quality control of the Works shall be carried out by the Contractor at his own laboratory or laboratories acceptable to the Engineer. The Contractor shall be responsible for sampling, curing, and transport to laboratory for testing of materials and workmanship.

1.2.9 Measurement and Payment

No separate measurements and/or payment shall be made for all materials and works required under this Clause (1.2). All the cost associated with this Clause is deemed to be included in the item rates of the Bill of Quantities.

1.3 Access to and Possession of Site

The leaves, right-of-way, easement, and access to the site shall be governed by the rules of the country and by-laws of the local government.

1.3.1 The Site

The Site is:

a) That land purchased for the construction of water treatment plant, reservoirs, office buildings and other civil structures by the WUSC.

b) That land along pipeline alignments which are within the right-of-way of road.

c) That land under the ownership of WUSC or Nepal Government

d) As presented in the drawings.

Final Possession of the Site, or Parts thereof, for the purpose of carrying out the execution of the works to be given by the employer pursuant to Clause 2.1 of the Conditions of Contract shall be subject to any restrictions mentioned in the Contract.

The Contractor shall himself obtain temporary wayleaves on whatever additional lands or working easements are required by him to carry out the works.

1.3.2 Temporary Wayleaves and Access

The Contractor shall be responsible for obtaining temporary wayleaves.

The cost of obtaining wayleaves, including crop compensation, for temporary working areas, additional working easement and for any additional areas, required by the Contractor in connection with the Works as well as for the access to all of these shall be borne by the Contractor himself. The Contractor shall arrange for the serving of any Statutory Notices as per Clause 1.6 in connection with any temporary working area and shall give to the occupier of each such area seven day notice of his intention to enter and shall ensure that his methods of working cause the minimum of disturbance to the land and to its owners and occupiers.

The Contractor shall at all times provide proper facilities for access and inspection of the Works by the Engineer, his assistants, inspectors, agents and representatives of public agencies having jurisdiction.

The extent of each temporary working area and the period of time for its occupation shall be such as the Engineer considers necessary having regard to the Contractor's reasonable requirements which shall be submitted together with the Work Program to the Engineer.

The Contractor shall reinstate any temporary working areas to the condition prevailing prior to his initial entry as soon as possible after the work in those areas has been completed so as to keep the period of occupation to a minimum. The Contractor shall in any event restore the areas to a tidy and workmanlike condition. Boundary walls, fences and other structures that have been damaged, removed or otherwise interfered with by the Contractor shall be restored to a condition at least equivalent to their original condition.

1.3.3 Access to Adjoining Property

If the Contractor's work will cause unavoidable interference with access to adjoining property, the Contractor shall first give 7 days' notice to the occupier of such property and shall provide temporary means of access for vehicles, animals and pedestrians.

Convenient access to driveways, houses and buildings adjoining the work shall be maintained and temporary approaches to intersecting streets and alleys shall be provided and kept in good condition by the Contractor.

As soon as a section of surfacing, pavement, or a structure has been completed, it shall be opened for use by traffic at the request of the Engineer.

The Contractor shall not prevent the free access to public water valves, water hydrants, or utility valves.

1.3.4 Permanent Right-of-Way

The Employer will make all statutory arrangements necessary for obtaining the final possession of the Site and the permanent right-of-way in the shortest possible time.

1.3.5 Measurement and Payment

No separate measurements and/or payment shall be made for all materials and works required under this Clause (1.3). All the cost associated with this Clause is deemed to be included in the item rates of the Bill of Quantities.

1.4 Provision and Maintenance of Site Installations

1.4.1 Camp for Contractor's Staff

The Contractor shall provide adequate temporary accommodation with all necessary amenities and facilities for his staff and labor. The location and type of accommodation whether pre-fabricated or in-situ buildings or rental is the Contractor's choice.

During the whole period of existence, from setting up through operation to final removal upon completion of the Works, the Contractor shall be fully responsible for constantly carrying out all measures necessary for safeguarding the natural environment affected by his camp or camps.

He shall cause the least possible interference with existing amenities, whether man-made or natural. No trees shall be felled except as authorized by the Engineer

Latrine and ablution facilities and first-aid services shall be provided in sufficient type and numbers to the satisfaction of the Engineer and shall be maintained in a clean and sanitary condition at all times.

On completion of the Works or as soon as the facilities provided by the Contractor are no longer required, the Contractor shall remove such facilities and clear away all surface indications of their presence. Each camp area shall be reinstated to the satisfaction of the Engineer.

1.4.2 Contractor's Offices, Stores and Services

The Contractor shall provide, erect, construct, maintain, and subsequently remove proper offices, stores, workshops, laboratories, storage, and parking areas for his own use. Such facilities shall be sufficiently sized and equipped to enable him to manage his operations and those of his Subcontractors in a professional manner and to enable him to carry out all his obligations under the Contract.

Sheds for storage of materials that may deteriorate or corrode if exposed to the weather shall be weatherproof, adequately ventilated and provided with raised floors. No material or equipment shall be placed directly on the ground.

Within his offices, a meeting room shall be available for site meetings with the Engineer and the Employer.

These Contractor's facilities shall be subject to the same stipulations regarding sitting, interference with amenities and environmental protection as the Contractor's camp.

1.4.3 Preparation of the temporary Stockyard in the Site of Sub-project

The preparation of the stockyard for pipes valves and fittings shall include:

a) Clearance of the Site
b) Construction of side drains around the stockyards to avoid water logging Construction of access tracks
c) Covering of pipe and fittings storage areas with a 150mm thick layer of granular material that will discourage the growth of vegetation
d) Provisions to carry the loads from the pipes and fittings.
e) Erection of a security fence
f) Construction of a guard house / store keepers office
g) Erection of stores for jointing material etc. including the provision of air-conditioning where necessary.

1.4.4 Contractor's Construction Equipment

When working in built-up areas, the Contractor shall provide and use suitable and effective silencing devices for pneumatic tools and other Equipment that would otherwise cause a noise level exceeding 85 dB (A) during drilling, excavation and other work. Alternatively, he shall, by means of barriers, effectively isolate the source of any such noise in order to comply with above requirement.

1.4.5 Water Supply

The Contractor shall make his own arrangements for the supply of water for his camp, office and other temporary buildings as well as for the execution of the Works.

Temporary water connection may be arranged with nearby local system if any exist, at established rates.

When using other sources of water such as stone spouts, etc. the Contractor shall have due regard to and coordinate with other users, particularly with the local communities.

Water for drinking purposes shall be of drinking water quality, and shall be tested for proper disinfection.

1.4.6 Sanitation

The Contractor shall maintain the Site and all working areas in a hygienic condition. In all matters of health and sanitation he shall comply with the requirements of the local Health or other competent authority.

1.4.7 Sewage and Waste Disposal

The Contractor shall make provision for the discharge or disposal of from his camp, offices, and the Works of all wastewater as well as of all liquid and solid waste products however arising. The methods of disposal shall be to the satisfaction of the Engineer and of any authority or person having an interest in any land or watercourse over or in which water and waste products may be so discharged, and shall not in any manner be disposed of untreated to the environment.

1.4.8 Energy Supply

The Contractor shall install, operate, maintain and subsequently remove temporary supplies of electricity for power, heating, cooling, lighting and ventilation of all camps, offices, stores, laboratories and other temporary buildings used by the Contractor in addition to all electricity requirements in connection with the construction, testing and Defects Correction of the Works.

The Contractor shall ensure that all proposed electrical installations comply with the requirements of the Nepal Electricity Authority and shall be responsible for and shall bear all costs associated with obtaining the written approval of that authority for such installations and their operation.

Prior to placing orders for transformers, conductors, cables and associated equipment, the Contractor shall ensure by enquiry with the Nepal Electricity Authority that his proposed equipment is suitable for use with the existing or proposed medium/high tension electricity supply lines.

1.4.9 Pollution

The Contractor shall take all reasonable measures to minimize any dust nuisance, sound pollution, pollution of streams and inconvenience to or interference with the public (or others) as a result of the execution of the Works.

1.4.10 Supply of Fuel, Lubricants, etc.

The Contractor shall be responsible for arranging and ensuring that adequate supplies of petrol, diesel oil, motor oil, kerosene, lubricants and other petroleum products are available at all times to meet his requirements for the purpose of or in connection with the Contract; the Contractor's particular attention is drawn to this requirements as from time to time shortages and interruptions in the supply of fuel oils, etc., may occur.

The Contractor is required to store fuel to cover a minimum of 30 days of its requirements. It should provide additional stored fuel if supply conditions require so.

The Contractor is not allowed to purchase and use firewood.

With regard to the transportation, storage and handling of all his fuel requirements, including all electrical connections, he must strictly comply with all relevant safety codes and regulations.

Particular care is to be taken to avoid pollution due to spillage of fuel and oils. They shall be stored within a bunded area, all equipment drive by diesel or petrol engines shall be installed on a drip tray, waste oils shall be disposed of in a proper manner.

1.4.11 Temporary Telephone and Internet Connections

The Contractor shall arrange at his own cost for temporary telephone and internet connections to his offices and other installations.

He shall be responsible for all installations, connection and disconnection charges for his and his Representative's offices.

1.4.12 First Aid

The Contractor shall make his own arrangements for treatment of casualties on the Site. First-aid kits or units shall be provided. The Contractor shall be responsible for the construction of such first-aid units and their management and operation and rapid removal by ambulance of injured or sick employees to nearby hospitals. The first-aid service shall cover the Contractor's own personnel as well as that of the Employer, the Engineer, and all Subcontractors while working on the Site.

1.4.13 Fire Protection

No naked fire shall be used by the Contractor on or about the Site without the permission of the Engineer in writing. If in the Engineer's opinion the use of naked fire may cause a fire hazard, the Contractor shall at no extra cost to the Employer take such additional precautions and provide such additional firefighting equipment as the Engineer considers necessary.

The term "naked fire" shall be deemed to include electric arcs and oxyacetylene or other flames used in welding or cutting metals.

Compliance with the requirements of the Engineer shall not relieve the Contractor of any of his obligations under the Contract.

1.4.14 Contractor's Canteen

The Contractor shall provide adequate eating facilities for his employees and workmen.

1.4.15 Testing Facilities, Laboratory

The Contractor shall use an approved material testing laboratory for testing required by these specifications at his cost. An on-site laboratory staffed by qualified personnel may also be provided and used if allowed by the Engineer.

The name and qualifications of independent testing laboratories shall be submitted to Engineer for approval no less than thirty calendar days prior to the date the laboratories are to be used. Once approved, dismissal and replacement of the approved independent testing laboratory shall require written authorization by the Engineer.

The Contractor shall be responsible for the sampling, curing, and transport to the laboratories of all materials for testing, and all testing costs including laboratory fees, and/or all costs in running the on-site laboratory, i.e., chemicals, reagents, and other test consumables, staff, and utilities.

1.4.16 Site Safety

The Contractor shall at all times in the conduct of his work and that of his Subcontractors adhere to the established rules and regulations concerning all safety matters at Site such as the recommendations contained in the "Manual of Accident Prevention in Construction", published by the Associated General Contractors of America, Inc., or other internationally recognized recommendations to the extent that such provisions do not conflict with the applicable laws. This is especially important wherever it is necessary to enable the free passage of the public through the Site.

The Contractor's Safety Officer shall have the qualification and the authority to issue instructions to the Contractor's personnel regarding protection measures to prevent accidents.

The Contractor shall provide the public with adequate information on all risks with respect to the construction works. If the general public sustains any kind of bodily injury or death, the Contractor shall be responsible for providing all necessary medical care and compensation.

During construction the Contractor shall erect, maintain and subsequently remove sufficient barricades, guards, lighting, sheeting, shoring, temporary sidewalks and bridges, danger signals as well as temporary covering of potential accident areas.

If and where required the Contractor shall erect and maintain suitable and approved temporary fencing, to BS 1722 Part 1 Type PLC 180A or better, to enclose such areas of construction and areas of land occupied by the Contractor within the Site as may be necessary to implement his obligations under the Contract. Where temporary fencing has to be erected alongside a public road, foot-path, etc., it shall be of the type required by and shall be erected to the satisfaction of the authority concerned.

All open excavations along pipe lines shall be protected sufficiently to keep out livestock, and ensure the safety of workmen and members of the public and be in accordance with the directives of the police and the other local regulations.

The Contractor shall be responsible for ensuring that all persons working in the vicinity of power lines are aware of the relatively large distance that high voltage electricity can "short" to earth when cranes or other large masses of steel are in the vicinity of power lines.

Where work is to be carried out in the proximity of buildings, bridges, tanks or other structures, the Contractor shall take all necessary precautions, including shoring and strutting, where necessary, to ensure the safety of the structures that are at risk.

The Contractor shall be responsible for all damages or injury which may be caused on any property by trespass by the Contractor's or his Subcontractor's employees in the course of their employment, whether the said trespass was committed with or without the consent or knowledge of the Contractor.

1.4.17 Protection of Overhead and Underground Services

The Contractor will be held responsible for any damage to known services (i.e. overhead services that are visible within the Site and underground services shown on the drawings) and he shall take all necessary measures to protect them. All work or protective measures shall be subject to approval of the Engineer. In the event of a service being damaged he shall inform the Engineer and the authority concerned, the Contractor shall not repair any such service unless instructed to do so.

Where no underground services are shown on the drawings or scheduled but the possibility of their presence can reasonably be inferred, the Contractor shall, in collaboration with the Engineer, ascertain whether any such services exist within the relevant section of the Site. The Contractor shall complete such an investigation well in advance of the start of construction work in the said section and he shall submit a report in good time to enable the Engineer to make whatever arrangements are necessary for the protection, removal or diversion of the services before any construction activities commences.

As soon as any underground service not shown on the drawings is discovered, it shall be deemed to be a known service and the Contractor will be held responsible for any subsequent damage to it. If such a service is damaged during the course of its discovery, the cost of making good such damage will be met by the Employer unless he establishes that the Contractor did not exercise reasonable diligence and that the damage was avoidable.

Where the authority concerned elects to carry out on its own account any alterations or protective measures, the Contractor shall co-operate with and allow such authority reasonable access and sufficient space and time to carry out the required work.

1.4.18 Signboards

Signboards shall be as per drawing. The signboards shall be placed at the project office and at main highway of the project town of the Contract, in English and Nepali, at least following information should be mentioned in each signboard:

(i) The name of the Project and section no.

(ii) The names and addresses of the Employer, the Contractor and the Engineer with contact number.

(iii) the name and short description of the Project

(iv) the amount of the Contract Price

(v) the starting and completion dates

They shall be of durable construction capable of withstanding the effects of the climate until the end of the Defects Liability Period.

The Contractor shall keep the signboards in good repair for the duration of the contract and shall remove them on completion of the Contract.

Besides these signboards the Contractor shall not, except with the written authority of the Engineer, exhibit or permit to be exhibited on the Site any other form of advertisement.

1.4.19 Site Roads, Loading and Turning Areas

The Contractor shall provide and maintain such access to the various sections of the Works as he requires for the proper execution of the work. Existing roads and bridges shall be upgraded for the construction transport purposes and site roads, loading and turning areas shall be so arranged as to minimize inconvenience to adjoining landowners or occupants and to the general public. The site roads shall be of gravel or equivalent material providing a hard surface for vehicles. Temporary roads, loading and turning areas shall be removed when they are no longer required and the location reinstated to the satisfaction of the Engineer, and damage to existing roads or bridges shall be repaired and reinstated to the satisfaction of the Engineer.

1.4.20 Site Drainage

The Contractor shall keep each Section of the Works well drained until the Engineer certifies that it is substantially complete and shall ensure that, so far as is practicable, all work is carried out in the dry. Site areas shall be kept well drained and free from standing water except where this is impracticable having regard to methods of Temporary Works properly adopted by the Contractor.

The Contractor shall provide, operate and maintain in sufficient quantity such pumping equipment, well points, pipes and other equipment as may be necessary to minimize damage, inconvenience and interference and shall construct, operate and maintain all temporary coffer-dams, sumps, ditches, drains and other temporary works as may be necessary to remove water from the Site while construction is in progress. Such Temporary Works and construction equipment shall not be removed without the approval of the Engineer.

Notwithstanding any approval by the Engineer of the Contractor's arrangements for the removal of water, the Contractor shall be responsible for the sufficiency thereof and for keeping the Works safe at all times and for making good at his own expense any damage to the Works.

The Contractor shall be responsible to keep the Site clear of water at whatever pump rate is found necessary.

The Contractor's site drainage facilities shall not cause pollution in any local watercourses, he shall be responsible for any legal action resulting from pollution events.

1.4.21 Cleaning-up of Site

Before application is made for the Employer to accept any substantially completed Section of the Works, all items shall be complete, ready to operate and in a clean condition. All trash, debris, unused building materials and temporary facilities shall have been removed from the Site. Tools and construction equipment not needed during the subsequent Defects Liability Period for repair and adjustment shall not remain on the Site. The temporary walkways, parking areas and roadways shall be completely swept and broomed.

1.4.22 Measurement and Payment

No separate measurements and/or payment shall be made for all materials and works required under this Clause (1.4). All the cost associated with this Clause is deemed to be included in the item rates of the Bill of Quantities.

1.5 Provision of Temporary Facilities

1.5.1 Temporary Diversions of Utilities

If in the opinion of the Contractor it is necessary to make temporary diversions of services in connection with the Works, the Contractor shall arrange with the relevant authority for the construction of diversions.

The Contractor may at his own cost and subject to the approval of the authority concerned, make such temporary diversions as may facilitate the carrying out of the Works. These temporary diversions shall be reinstated to the full satisfaction of the Engineer and the relevant authority on completion of the Works.

1.5.2 Detours and Traffic Control

The Contractor shall program his work in such a way that, wherever the temporary closure of street sections to public thoroughfare cannot be avoided, the duration of traffic diversion can be kept as short as possible. No streets shall be closed and no detours shall be introduced and no traffic diverted until the Contractor's proposals have been approved by the Engineer and the appropriate Government authorities, such as the Roads Department.

Where work is to be carried out in public roads, the Contractor shall give notice to the Engineer sufficiently in advance of the date on which he wishes to commence such work.

The Contractor shall be responsible for obtaining the permission of the Engineer, Road Department and the Police for activities he intends to carry out in public roads. Two copies of the Contractor's proposals to the relevant authorities shall be submitted to the Engineer. One copy of all obtained approvals shall be submitted to the Engineer.

The Contractor's attention is drawn to the fact that processing of the documentation required by the local authorities prior to the cutting of existing public roads takes approximately 30 days. During the Monsoon period (June to August) no road cuttings are normally allowed.

Detours shall be selected in such a way that the inconvenience to the affected traffic as well as to the inhabitants of the affected areas is kept to a minimum.

The Contractor shall furnish, install and maintain at all times during the execution of the Works all necessary traffic signs, barricades, lights, signals and other traffic control devices, including flagging and other means of guiding traffic through the work zone. Traffic control shall be managed in accordance with prevailing rules and regulations, and with the approval and to the satisfaction of the Engineer.

All devices mentioned above shall be in conformity with the requirements of the Roads Department. All traffic signs and control devices to be furnished and installed by the Contractor shall be approved by the Engineer for their location, position, visibility, adequacy and manner of use under specific job conditions.

All traffic control devices necessary for the initial stage of construction shall be properly placed and operational before any construction is allowed to start. When work of a progressive nature is involved, the necessary signs shall be moved concurrently where they are needed.

If the Engineer determines that proper provisions for safe traffic control are not being provided or maintained, he may restrict construction operations affected by such defective signs or devices until such provisions are established or maintained, or may altogether order suspension of the Work until a proper traffic control is achieved. In case of serious or willful disregard by the Contractor of the safety of the public or his employees, the Engineer may take necessary steps to rectify the situation and deduct the cost thereof from monies due or becoming due to the Contractor. The Contractor shall be responsible for all resulting delays.

The Contractor shall designate or otherwise employ personnel to furnish continuous surveillance of the traffic control operations. The designated personnel shall be available day and night to respond to calls involving damage due to vandalism or traffic accidents.

At sections where traffic is in operation and when ordered by the Engineer, the movements of the Contractor's equipment from one place of work to another shall be subject to traffic control. During rush hours movement of larger vehicles, such as trucks, cranes, dumpers, etc. through main thoroughfare are not permitted by the police. Spillage resulting from hauling operations along or across the road way shall be removed immediately at the Contractor's expense.

The cost of detours and traffic control is deemed to be included in the rates for road reinstatement

1.5.3 Provision of Temporary Services

When the execution of the Works requires the temporary disconnection of existing public utilities, the Contractor shall provide the affected users with temporary services in at least the same standard as the original services.

For water supply he may install temporary lines or arrange for regular supply by tankers. The amount of water to be provided for the interruption period for a specific area shall be assessed by the Contractor. The Contractor shall submit to the Engineer, for its approval, the recommended volume of water to be provided.

When forced to disconnect existing sewers the Contractor shall install temporary pipes of adequate size to carry off sewage from any private sewer facilities cut off by construction work. Connections to temporary pipes shall be made immediately by the Contractor upon cutting off the existing facility. No sewage shall be allowed to flow from any severed facility upon the ground surface or into the trench excavation. Pipes used in temporary sewers may be plastic or approved flexible material.

When the Contractor is forced to disconnect power or telephone connections the relevant authority shall provide temporary connections at the Contractors expense.

Upon completion of work the Contractor shall replace all severed connections, with the assistance of the concerned authority where necessary, and restore to operating order the existing facilities.

No valve or other controls in public service facilities shall be operated by the Contractor without approval of the Engineer and the relevant authorities. All users affected by such operation shall be notified by the Contractor at least one hour before the operation and advised of the probable time when service will be restored.

1.5.4 Protection of Adjoining Property

1.5.4.1 Land

The Contractor shall control the movement of his crews and equipment on the working easement including access routes approved by the Engineer so as to minimize damage to crops and property and shall endeavor to avoid marring the lands. Ruts and scars shall be obliterated and damage to land shall be corrected and the land shall be restored as closely as possible to its original conditions before final taking-over of the Works.

The Contractor shall be responsible directly to the tenant / land owner for any excessive or avoidable damage to crops or lands resulting from his operations whether on lands adjacent to right-of-way or on approved access road and deductions will be made from payment due to the Contractor to cover the amount of such excessive or avoidable damage if adequate compensation is not paid by the Contractor, in the opinion of the Engineer.

1.5.4.2 Buildings and other Structures

The Contractor shall be responsible and take all measures in order to protect adjoining property including buildings, electrical and telephone poles, bridges and culverts, retaining walls, compound walls and fences, and other structures. Prior to the commencement of the activities, the Contractor shall assess the probability and extent of unavoidable damages, if any, to the building and properties and submit his assessment to the Engineer. The Engineer may make his own opinion and if required may order arrangements for protection or repair of such likely unavoidable damage in which event the Contractor shall complete the activities.

1.5.5 Reinstatement upon Completion

Temporary facilities shall be provided by the Contractor, only for as long as required after which he shall dismantle and remove the same from their place of use as speedily as possible. Re-usable components shall be safely stored by the Contractor in his yard.

The place of use shall be cleared and reinstated immediately to at least the condition existing before the temporary facilities were provided, and to the satisfaction of the Engineer.

1.5.6 Measurement and Payment

All temporary diversions of utilities and temporary services required for execution of the works shall be deemed to be included in other items of the BOQ and shall not be separately paid.

1.6 Coordination with Other Authorities

1.6.1 Statutory Services

As far as possible the Contractor shall acquaint himself with the actual location of all existing public utilities such as sewers, water mains, drains, cables for electricity, telephone lines, lighting poles, masts, etc., before commencing any activities likely to affect the existing utilities. The Contractor shall with the assistance of the Employer obtain such information directly from the responsible authorities as early as possible.

1.6.2 Notices, Permits

Well in advance of the programmed start of any work which may affect traffic or any existing utilities the Contractor shall give advance notice to the respective authority indicating the type, the exact location, the programmed starting time and the expected duration of the activities and shall provide whatever particulars may be required by the authorities to issue any required permits and make all necessary arrangements. The Employer will provide whatever assistance possible to the Contractor to facilitate the permit procedure which, however, will remain the sole responsibility of the Contractor.

1.6.3 Witnessing and Post-Construction Clearances

It is expected that the issue of these permits will be tied to the requirement that the work may only be carried out in the presence of authorized inspectors from the authorities concerned. Their job will be to witness and assess any damage or interference with their respective utility. Should such disturbances occur it will be at their discretion to authorize either the Contractor to correct them or to arrange for specialized repairs through their own personnel.

The Contractor shall be fully responsible for all costs whatever resulting from avoidable damages of or interference with other utilities.

As proof that the activities in question have been completed to the satisfaction of the authorities concerned the Contractor shall submit to the Engineer upon request official post-construction clearances issued by the respective authorities.

1.6.4 Measurement and Payment

No separate measurements and/or payments shall be made for all materials and works required under this Clause (Clause 1.6). All the cost associated with this clause is deemed to be included in the item rates of the Bill of Quantities.

1.7 Submissions by the Contractor

1.7.1 Pre-Construction Surveys and Setting Out

The Contractor shall verify all measurements and be responsible for their correctness. Any differences which may be found between actual measurements and the dimensions given in the Contract Documents shall be submitted to the Engineer, in writing, for consideration and directives before proceeding with the Works.

Site bench marks shall be accurately and safely established, maintained and removed upon completion of the Works, all to the satisfaction of the Engineer. The Engineer will indicate the position, co-ordinates and elevation of bench marks near the works, as shown on the Drawings.

The Contractor shall prepare a plan detailing the location of the bench marks and keep this up-to-date throughout the period of the Contract. Reproducible copies of the plan so prepared shall be supplied to the Engineer, as and when he may require.

The Engineer reserves the right to order levels, considered necessary for the full and proper supervision and measurement of the works, to be taken at any time.

Before the Works, or any part thereof, are commenced, the Contractor and the Engineer shall together make a complete survey, and take levels, of the Site and agree on the dimensions and elevations upon which setting out of the Works shall be based.

These levels shall be related to the bench marks and shall be plotted and drawn up by the Contractor. After agreement of the drawings, which shall be signed by the Engineer and the Contractor, these levels shall form the basis of setting out of the Works.
The Contractor shall submit the original of the drawings, and three copies, to the Engineer.

The Contractor shall be responsible for the true and proper setting out of the Works in relation to reference data given on the Drawings and shall accurately set out the positions, levels and dimensions of all parts of the Works. Any delay or loss resulting from errors in the setting out of the Works shall be the responsibility of the Contractor.

Setting out shall be reviewed by the Engineer before commencing the Works, but any approval shall, in no way, relieve the Contractor of his responsibility for the correct execution of the Work.

Setting out of the Works shall use methods and the necessary instruments described in BS 5606 "Code of Practice for Accuracy in Building". The Contractor shall maintain, in good working order at all times, the instruments provided by him for the setting out of the Works and shall make such instruments available to the Engineer as instructed for checking or taking measurements.

The Contractor shall provide all assistance which the Engineer may require for taking measurements of the Works, including labor, equipment and transportation.

1.7.2 Detailed Design of Temporary Works

The Contractor shall submit for approval full particulars, including drawings of any of the site installations and Temporary Works. If required the Contractor shall also submit calculations of the stresses, strains and deflections which will arise in false work or other Temporary Works and these calculations shall be accompanied by detailed Working Drawings to show the Contractor's proposals. Approval by the Engineer of the Contractor's proposals, calculations or drawings shall not relieve the Contractor of any of his duties or responsibilities under the Contract.

1.7.3 Working Drawings

The Drawings prepared by the Engineer, are called Engineer’s Drawings. They may be modified or added to as provided by the following clauses.

The proposals shown on the Engineer’s Drawings are based on information available prior to preparation of the Bid Documents. All levels indicated or proposed are based on survey information previously available but will need to be revised subject to the results of survey and site investigation carried out by the Contractor. Nevertheless, the Contractor shall follow such proposals in preparing his own proposals consistent with his own experience.

Working Drawings shall be submitted by the Contractor to the Engineer. Working Drawings shall include, but not be restricted to, pipeline plans and profiles, reinforcement detail drawings and bending schedules, shop drawings for structural steel and miscellaneous metal work, and drawings for other work for which the Engineer's approval is required.

It shall be the Contractor's own responsibility to prepare such Working Drawings as he may require for the proper setting out and construction of all structures and facilities. Work shall not commence on an individual structure or facilities until the relevant Working Drawings have been approved by the Engineer.

Within 28 days of the date of the Letter of Acceptance, the Contractor shall submit to the Engineer a Drawings Submittal Schedule for the Working Drawings listing the anticipated dates upon which they will be submitted for approval by the Engineer. The submission dates shall be spaced at reasonable intervals to allow at least 21 days for the Engineer to duly check and to either approve them or to request changes or modifications, as the case may be.

All dimensions shall be in metric units and each drawing shall be properly identified by a drawing head and a numbering code in the form prescribed by the Engineer upon commencement of the Works. ISO or DIN standard size sheets shall be used.

Drawings shall be scaled at A1 size, and plotted at A1 size and A3 size.

Prior to submittal, the Contractor shall also check the drawings prepared by his Subcontractors for accuracy and completeness, especially that the relation to adjoining work is accurately shown.

The Contractor shall submit 3 (three) copies of all drawings for approval.

Any changes or modifications to the Working Drawings that the Engineer considers necessary shall be made by the Contractor promptly and the drawings resubmitted for approval.

Approval of Working Drawings will be given by the Engineer in the form of a stamp "RELEASED FOR CONSTRUCTION" together with the date and the authorized signature. Only those Working Drawings carrying the signed and dated stamp shall be used for execution.

Copies of all such approved Working Drawings together with one unreduced transparency shall be supplied to the Engineer by the Contractor immediately after approval. The cost of preparing and providing all Working Drawings shall be included in the Contract Rates.

Should it be found at any time after approval has been given by the Engineer to a Working Drawing submitted by the Contractor that the said Working Drawing does not comply with the terms and conditions of the Contract or that the details do not agree with the Working Drawings previously approved, such alterations and additions as may be deemed necessary by the Engineer shall be made therein by the Contractor and the work carried out accordingly without entitling the Contractor to extra payment on account thereof, except where such alternations and additions are to be made in direct consequence of written order by the Engineer to vary the Works.

No examination by the Engineer of any document submitted by the Contractor or of the Contractor's Working Drawings, nor the approval expressed by the Engineer in regard thereto, either with or without modification, shall absolve the Contractor from any liability imposed upon him by any provision of the Contract. Notwithstanding the Engineer's approval of the Working Drawings the Contractor shall be responsible for any dimensional or other errors.

1.7.4 As-Built Drawings and GIS Data Creation

1.7.4.1 As-Built Drawings

Such approved Working Drawings as have been selected by the Engineer shall be correctly modified for inclusion in the As-Built Drawings incorporating such variations to the Works as have been ordered and executed. Such drawings shall show the actual arrangement of all structures and items of equipment installed under the Contract. The Contractor shall submit 1 (one) reproducible copy and 3 (three) prints of all As-Built Drawings clearly named as such to the Engineer for approval before applying for the Taking-Over Certificate for the respective Section of the Works.

In the as built drawings, for the major structures, the GPS control points should be always enlisted in the drawings. GPS for mat should be in MUTM projection (84 or 87) or WGS84 format (lat, lon).

After approval of the As Built Drawing the Contractor shall supply an electronic copy of the drawing in together with a licensed copy of the drafting software (at least AUTOCAD 2007). The software shall become the property of the Employer and shall be used to view the As Built Drawings.

During the course of the Works, the Contractor shall maintain a fully detailed record of all changes from the approval to facilitate easy and accurate preparation of the As-Built Drawing.

Irrespective of the other contractual prerequisites no Section of the Works will be considered substantially completed until the respective As-Built Drawings have been approved by the Engineer.

1.7.4.2 GIS Data Creation

In parallel with the preparation of as-built drawings, the Contractor shall produce GIS data of the constructed works. The contractor conduct all necessary survey work, and shall ensure that vertical and horizontal measurements shall be captured at an accuracy

of +/- 0.1m at a 95% confidence level, using the most suitable and cost-effective field data collection technology and methodology. All horizontal and vertical survey measurements will be referenced to the present GIS georeference based on MUTM projection with relevant meridian (84 or 87).

In case of pipe line or any linear installation or construction stretching more than 100 m, the Contractor will survey the three-dimensional position (x,y,z) of all point and line assets constructed under this project, (e.g., pipelines, approach road, longer span bridge crossing, etc.). In case of point installation or construction, the Contractor will survey the three- dimensional position (x,y,z) of all point assets constructed under this project, (e.g., small bridge crossings, manholes, chambers, valves, meters, hydrants, plugs, reducers, and tees). Nodes shall be created to clearly delineate different pipe sections in terms of material and/or diameter and to allow for future development of a hydraulic model in the GIS platform. Nodes shall also require a three-dimensional position, and through this, the position of the ends of a pipeline segment shall be defined. Point and line data should be consistent with the attributes of the existing GIS system, if any. However, the Engineer and the Employer may require the Contractor, at no additional cost, to create new attributes to include non-survey data, e.g., valve model, name of the manufacturer, images or plans, etc. Prior to the field survey, the Contractor shall submit to the Engineer, for approval, the GIS design in terms of themes, feature types and attributes.

The Contractor shall develop a checklist of QC checks for each type of deliverable and will be responsible for ensuring that these QC checks are performed. The Contractor shall assign a GIS quality officer to manage the quality review process. This officer shall be independent of the capture and production teams.

GIS data for the project will be delivered in an ESRI ArcGIS compliant file geo-database.

1.7.5 Construction Programme and Progress of Works

1.7.5.1 Construction Programme

In amplification of the requirements of the Conditions of Contract, the program shall be in the form of a Critical Path Method (CPM) Diagram showing, sequences, dependencies, durations and dates for execution of all major items following the sub-divisions in the Bills of Quantities for the execution of the Works within the periods stated in the Contract. It shall be supported by:

a) Data of the construction methods
b) Equipment Utilization Schedule
c) Manpower Utilization Schedule
d) Subcontracting Schedule
e) Mobilization/Demobilization Schedule

The CPM diagram incorporating the above mentioned schedules shall be prepared using Microsoft Project, or similar approved project management software, and shall be presented in hard copy and electronic form to the Engineer.

In carrying out the Works due attention shall be paid to all measures which can reasonably be taken in order to diminish the inconvenience which the work may cause to services and access to property.

1.7.5.2 Updating, Monitoring and Progress Reporting

The Contractor shall monitor the progress of the Works including information provided by his Sub-contractors and suppliers, as necessary, for purpose of network planning, scheduling and updating and shall confirm the actual progress on each current activity shown on applicable CPM networks. The CPM networks shall form part of the Monthly Progress Report and shall indicate changes of schedule, if any in network activity duration and start/finish imposed dates. It shall also be provided in electronic form.

The Contractor shall prepare written explanatory notes on the particular activities which are overrunning or going to overrun against the Master Schedule. If any such overrunning work is on the critical path, the Contractor shall state what corrective actions will be taken by him to bring it back on the schedule.

1.7.5.3 Detailed Fortnightly Programme

The contractor shall submit at the end of each working week a detailed bar chart program for the next fortnight. The program shall identify where further drawings or instructions are to be issued by the Engineer to avoid disruption to the progress of the Works.

1.7.5.4 Progress Reports

The Contractor shall furnish the Engineer with 5 copies of Progress Reports at regular monthly intervals in a form agreed with the Engineer, containing the following information:

f) Physical progress for the report month and estimated progress for the next month;
g) CPM networks and explanatory notices as described in Clause 1.7.5.2;
h) Updated S-curves for physical progress at different sections of the Works

i) Progress on Quality Control and Quality testing Plan

j) List of activities and obligations completed and planned for next month

k) Any report which may be specifically requested by the Employer and/or the Engineer.

These monthly progress reports shall be submitted not later than 7 days after the end of the reporting month.

1.7.6 Operation and Maintenance Manual

The contractor will submit an operation and maintenance manual, providing details of all the plant /mechanical facilities (valves, meters, etc.) he supplies and give details of recommended maintenance intervals and procedures.

1.7.7 Record / Progress Photographs

The Contractor shall arrange each month at least 12 Nos. of photographs to be taken by a professional photographer as Record Photographs and shall provide the electronic files and 6 color prints each on glossy paper unmounted and of a size not less than 210 mm x 297 mm (A4) in transparent plastic pockets contained in hard cover album. Each print shall contain upon its back the date and description of the view taken. The Contractor shall ensure that no use is made of any negative or print without permission from the Employer.

Out of these Record Photographs the Contractor shall select 6 characteristic ones as Progress Photographs, copies shall be made of these to be attached to the Progress Reports.

1.7.8 Measurement and Payment

Unless otherwise provided in the BoQ, no separate measurements and/or payment shall be made for all materials and works required under this Clause (Clause 1.7). All the cost associated under this clause is deemed to be included in the item rates of the Bill of Quantities.

1.8 Quality Control

1.8.1 Quality Control Plan and Procedures

The Contractor shall be responsible for establishing and maintaining procedures for quality control that will ensure that all aspects of the Works comply with the requirements of the Contract.

As soon as reasonably practicable prior to the commencement of Works the Contractor shall submit for approval a Quality Control Plan giving detailed proposals for control of quality of all aspects of work on the Site and at suppliers' workshops.

The Quality Control Plan shall include the following:

a) a list of the Contractor's staff engaged in quality control

b) a list of any outside testing agencies employed by the Contractor for work in connection with quality control

c) where a testing laboratory is to be established on Site under the Contract, a list of major items of equipment and a layout of the laboratory, together details of the tests which will be carried out there

d) a list of manufactured items and materials, obtained by the Contractor for the Works, which require inspection at the suppliers' premises, and the proposed procedures for ensuring quality control

e) a list of materials and operations to be inspected by the Contractor at the various stages of construction work on Site, together with inspection procedures, test types and frequencies

f) Sample of proposed quality control records, testing and reporting forms.

Unless the Engineer permits otherwise, the approved Quality Control Plan shall be followed throughout the construction of the Works. Any approval by the Engineer of the Contractor's plan and procedures shall not relieve the Contractor of his obligation to ensure that the Works comply with the requirements of the Contract.

The Contractor shall appoint a suitably qualified member of his staff to be responsible for all aspects of quality control and to maintain effective liaison with the Engineer.

Quality Assurance Plan (QAP) and third party inspection:

Before procurement of materials like SS pipes, DI pipes, DI fittings, CI Valves, submersible pumps, electrical panels, etc. Contractor shall have to submit manufacturer's Quality Assurance plan (QAP) for review and approval of Engineer. QAP shall contain the quality control measures and quality checks/reviews at various stages of material production and shall comply as per latest international standards/codes of practice.

Such approved QAP shall be followed by Third party inspecting agencies at factory premises. No relaxation in QAP shall be done and followed either by the contractor or TPI agency without amendment to approved QAP by engineer. All such third party inspections and test results to be submitted as TPI tests reports in neat booklet FORM. After procurement

Following QAP norms, Contractor shall submit such TPI test reports along with interim payment BILLS claiming supply of items. No materials will be accepted for payment without necessary third-party INSPECTION.

1.8.2 Sampling and Testing

The Contractor shall provide for the approval of the Engineer, samples of all construction materials and manufactured items required for the Permanent Works. All samples selected by the Engineer shall be removed from Site. All approved samples shall be stored by the Contractor in a sample room or in a location approved by the Engineer, for the duration of the Contract, and any materials or manufactured items subsequently delivered to Site for incorporation in the Permanent Works shall be of a quality at least equal to the approved sample. The approved samples may only be disposed of with the Engineers approval.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Engineer. Samples for testing will generally be selected by the Engineer from materials to be utilized in the project and all tests will be under the supervision of, and as directed by, and at such points as may be convenient to the Engineer.

Material requiring testing shall be furnished in sufficient time before intended use so as to allow for testing. No materials represented by tests may be used prior to receipt of written approval of said materials.

The Contractor shall give the Engineer at least 14 days' notice in writing of the date on which any of the materials will be ready for testing or inspection at the suppliers' premises or at a laboratory approved by the Engineer and unless the Engineer shall attend at the appointed place and time the test may proceed in his absence. The Contractor shall in any case submit to the Engineer within 7 (seven) days after every test such number of certified copies of the test readings as the Engineer may require.

Approval by the Engineer as to the placing of orders for materials or as to samples or tests shall not prejudice any of the Engineer's powers under the Contract.

The provisions of this Clause shall also apply to materials supplied under any nominated subcontract.

After all construction at each Section is completed and before applying for taking-over, the Contractor shall perform field tests as called for in the Specifications. The Contractor shall demonstrate to the Engineer the proper operation of the facilities and the satisfactory performance of the individual components. Any improper operation of the system or any improper or faulty construction shall be repaired or corrected to the satisfaction of the Engineer. The Contractor shall make such changes, adjustments or replacement of equipment as may be required to make the same comply with the Specifications, or replace any defective parts or materials.

In addition to any special provision made herein as to sampling and testing materials by particular methods, samples of materials and workmanship proposed to be employed in the execution of the Works may be called for at any time by the Engineer and these shall be furnished without delay by the Contractor at his own cost. Approved samples will be retained. The Engineer will be at liberty to reject all materials and workmanship that are not equal or better in quality and character than such approved samples.

The tests required for quality control shall include but not be limited to:

a) tests conducted at the premises of the Contractor, Subcontractor, manufacturer or supplier which are normally or customarily carried out at such premises for the items or materials being supplied for the Works
b) tests which are normally or customarily conducted on the items or materials being supplied for the Works by the Contractor, Subcontractor, supplier or manufacturer but which have to be conducted at an approved laboratory because the necessary testing facilities are not available on the premises of the Contractor, Sub-Contractor, supplier and manufacturer
c) tests on locally obtained materials or items either on the Site or at an approved laboratory for the purpose of obtaining the approval of the Engineer to the classification, use and compliance with the Specifications of such items or materials
d) routine quality control tests conducted by the Contractor to ensure compliance with the Specifications
e) regular testing of concrete and other materials as specified in the relevant Chapters of the Technical Specifications
f) Standard shop and Site acceptance tests, including trial assemblies, of Plant.

1.8.3 Inspection and Acceptance

The Engineer will not inspect any item of fabricated or finished work until such time as the Contractor shall have forwarded to the Engineer the approved Working Drawings covering the items to be inspected, together with four copies of the respective orders.

Manufactured items and materials delivered to the Site shall be inspected by the Contractor on arrival. Any defects shall be notified to the Engineer. Minor defects to surface finishes and the like in manufactured items shall be made good in an approved manner to the satisfaction of the Engineer. Items with more serious defects shall be returned to the Contractors for correction or replacement as appropriate.

1.8.4 Materials/Plant Certificates

Where certificates are required by the Specifications or relevant Reference Standard, the original and one copy of each such certificate shall be provided by the Contractor.

Certificates shall be clearly identified by serial or reference number and shall include information required by the relevant Reference Standard or Specification Clause.

The timing for submittal of certificates shall be as follows:

a) manufacturer's and Contractor's test certificates shall be submitted as soon as the tests have been completed and in any case not less than 7 calendar days prior to the time that the materials represented by such certificates are needed for incorporation into the Permanent Works

b) Certificates of tests carried out during the construction or on completion of parts of the Permanent Works shall be submitted within 7 days of the completion of the test.

No materials, articles or items of fabricated or finished work to be supplied by the Contractor or Subcontractors which have been inspected and tested by the Engineer or the inspecting Engineer shall be dispatched unless a Passing Certificate has been requested by the Contractor from the Engineer and subsequently been issued by the Engineer to the effect that the same are approved. Neither the Contractor nor Sub-Contractors shall make use of any materials or articles ordered by them for the purpose of fabrication until a Passing Certificate covering the said materials and articles shall have been issued by the Engineer or inspecting Engineer.

1.8.5 Site Records

Daily records of on-site testing and inspection shall be kept on forms of approved format. Test results shall be certified by the responsible member of the Contractor's staff. All test certificates and inspection records (including any from Contractors or other outside testing agencies) shall be clearly identified with the appropriate part of the Works to which they refer, and they shall be submitted to the Engineer together with the respective Passing Certificate.

Once each month, or at such other intervals as the Engineer may require, the Contractor shall submit in an approved form a summary of all quality control inspections and tests performed at Site and elsewhere in the intervening period.

Test results shall be summarized in tabular form or graphically or both in a way that best illustrates the trends, specific results, and specification requirements. Where the tests show that the specified requirements were not achieved, the report shall describe the action that was taken.

Each report shall also contain a forecast of quality control work likely to be carried out during the period to be covered by the succeeding report.

The Contractor shall keep detailed and up-to-date inventories in an approved form of goods and materials already approved by the Engineer for which Passing Certificates have been issued as well as of all other goods and materials subject to quality control which are on order, delivered, found faulty, lost during the work or found to be surplus to requirements. The Engineer shall have access to these records at all times.

1.8.6 Daily Logbook

The Contractor shall keep a Daily Logbook at each location where major construction activities are taking place. This Daily Logbook shall be in a form approved by the Engineer and shall contain, but not be limited to, the following major items of information:

a) Name of Contractor and Package No.

b) date

c) weather conditions (max./min. temperature, hours and intensity of rainfall, cloudy, sunny, windy)

d) work carried out during the day per Section (description, quantities)

e) major equipment used per section (on contractual work, on extra work ordered, approximate operating time on either)

f) strength of labour force per Section (on contractual work, on extra work ordered, hours worked on either)

g) Delays (cause, effects such as idle time etc.)

h) Unusual events (earthquakes, floods, fires, storms, accidents, strikes, agitation, rallies etc.)

i) visitors at Site

j) availability of required construction materials at site

Each daily log shall be signed by the responsible Site Manager of the Contractor and "noted" by the Engineer.

1.8.7 Operation and Maintenance for 1 year

After the installation of the pumps and the successful commencement, the contractor should operate the plant for at least 1 year. The electrical cost of the pump operation and electrical power consumption shall be recorded as per NEA format and should be reported in the log book.

Also for the disinfection of the treated water, the bleaching powder added should be reported in the logbook. The concentrations of the bleaching powder for chlorination is given in section 3.3.3.4.11.

This log book record of power consumption and chlorination will be used for the reimbursement for the contractor during first year of operation.

Personnel that should be employed for the one year maintenance of the system should be at least two assistant pump operator who will act as guard also for their pump station, one water supply and sanitation technician who will also act as plant operator and plumber for the system, and one general guard for the system.

Within a month after the start of the pipe laying works, the Contractor shall train the WUSC staff identified by the Employer who will be responsible for the operation and maintenance of the distribution system. The training shall include but not be limited to, cutting pipes of all diameters, installation of polyethylene sleeves, tape wrapping of pipes and fittings, repair of coatings, jointing of pipes of all diameters with all types of joint, including electro fusion joints, installation of valves and fittings and maintenance of valves and fittings.

Training shall be done for twelve (12) persons, and consist of at least 7 days of classroom-type training and a suitable period of field training to demonstrate and train the personnel of the Employer. The training personnel and program, and training materials shall be submitted prior for the approval of the Engineer.

1.8.8 Measurement and Payment

Unless otherwise provided in the BOQ, no separate measurements and/or payment shall be made for all materials and works required under this clause (Clause 1.8). All the cost associated under this clause is deemed to be included in the item rates of the Bill of Quantities.

1.9 Standards, Codes and Abbreviations

1.9.1 Reference Standards and Codes

The Works shall be carried out in accordance with the relevant quality standards, test procedures, or codes of practice, collectively referred to as Reference Standards, listed in the relevant parts of the Specifications. The applicable issue of any Reference Standard shall, unless otherwise stated in the Specification, be the issue current at the date two months preceding the date for submission of the Bids for the contract. The Contractor shall familiarize himself fully with the requirements of such standards. If no standard is indicated then the relevant ISO Standard or, in the absence of such standard, the relevant Indian Standards shall apply, or others, if so approved.

The Contractor shall obtain and keep on Site at least one copy of each approved Reference Standard and each Reference Standard referred to in the Specifications, and will make these accessible to the Engineer at any time upon request.

The Contractor shall obtain the Reference Standards from the addresses given below:

ISO	International Organization for STANDARDIZATION, Rue de Varembe, Geneva, Switzerland
DIN	Deutsche Industry Norm (German Industry Standard) from Deutsche Normenausschuss, Beuth- Vertrieb, P.O. Box 1045, W-1000, Berlin 30, Federal Republic of Germany
BSI	British Standards Institution, 389 Chiswick High Road, London W4 4BR, England
AASHTO	American Association of State Highway and Transportation Officials, Suite 341 National Press Building, Washington, D.C. 2004, U.S.A.
ACI	American Concrete Institute, P.O. Box 4754, Redford Station, Detroit, MI 48219, U.S.A. AISC American Institute of Steel Construction, 101 Park Avenue, New York, NY 10017, U.S.A. ASTM American Society for Testing and Materials, 2501 Race St., Philadelphia, PA 19103, U.S.A. AWS American Welding Society, Inc., 2501 N.W. 7th St., Miami, FL 33125, U.S.A.
AWWA	American Water Works Association, 6666 West Quincy Ave. Denver, Colorado 80235, U.S.A. IS Indian Standards, Manak Bhawan - 9, Bahadur Shah Jafar Marg, New Delhi, 11002
SIS	Swedish Standards
NS	Nepal Standards, Nepal Bureau of Standards and Metrology, Balaju, Kathmandu, Nepal

1.9.2 Metric Units

S.I. units of measurement shall be used throughout the Contract. All information and data originating in another system shall be transferred by the Contractor into the S.I. system.

1.9.3 Abbreviations

ACI	=	American Concrete Institute
AC	=	asbestos cement; alternating current
AASHTO	=	American Association of State Highway and Transportation Officials
ASTM	=	American Society for Testing and Materials
BOQ	=	Bill of Quantities, Schedule of Quantities
BS	=	British Standard
CBR	=	California Bearing Ratio
cm	=	centimeter
cm2/g	=	square centimeter per gram
CP	=	chromium plated
d	=	day(s)
dia	=	diameter
DIN	=	Deutsche Industry Norm (German Standard)
DN	=	diameter nominal (=ND)
GON	=	The Government of Nepal
g/cm3	=	gram per cubic centimeter
g/m2	=	gram per square meter
h	=	hour
ha	=	hectare
HDPE	=	high density polyethelene
GON	=	Government of Nepal
HP	=	horse power
IDA	=	International Development Association
IS	=	Indian Standard
ISO	=	International Standard Organization
kg	=	kilogram
kg/cm3	=	kilogram per cubic centimeter
kg/cm2	=	kilogram per square centimeter
km	=	kilometer
kN	=	kilo newton
kVA	=	kilo volt ampere
l	=	liter
m	=	meter
m2	=	square meter
m3	=	cubic meter
mg/l	=	milligram per liter
min	=	minute
mm	=	millimeter
m/min	=	meter per minute
m3/d	=	cubic meter per day
m3/min	=	cubic meter per minute
m/s	=	meter per second
mm/s	=	millimeter per second
N	=	Newton
ND	=	nominal diameter (=DN)
NEA	=	Nepal Electricity Authority
nm	=	nanometer

N/mm2	=	Newton per square millimeter
NS	=	Nepalese Standard
NWSC	=	Nepal Water Supply Corporation
OMC	=	Optimum moisture content
OPC	=	Ordinary Portland Cement
Pa	=	Pascal (1N/m2)
PC	=	personal computer
PCC	=	Plain Cement Concrete
PD	=	Permissible Deviation
PE	=	Polyethylene
pH	=	hydrogen ion concentration (acidity)
PI	=	Plasticity Index
ppm	=	parts per million
PVC	=	Poly Vinyl Chloride
RC or RCC	=	reinforced concrete
r/min	=	revolution per minute
s	=	second
SI	=	System International d'Unités
Si	=	silicon
SRPC	=	Sulphate Resisting Portland Cement
T	=	temperature
t	=	metric ton
uPVC	=	unplasticised polyvinyl chloride
V	=	Volt
W	=	Watt
WC	=	Water Closet
oC	=	degree centigrade
"	=	inch
%	=	percent
4WD	=	four wheel drive
<	=	smaller/less than
>	=	larger/more than

1.9.4 Measurement and Payment

No separate measurement and payment will be made for items provided under Clause 1.9, the cost of which shall be deemed to be included in the rates of the BOQ.

1.10 Securities and Insurance

1.10.1 Performance Security

The Contractor shall provide Performance Security in the required amount and currencies from an approved bank/financial institutions in accordance with relevant clause of the Conditions of Contract.

1.10.2 Insurance of Works and Contractor's Equipment

The Contractor shall also insure all his equipment against damages and losses with an approved insurance agency/institution as stipulated in relevant clause of the Conditions of Contract.

Insurance of Contractors Workmen And Employees

The Contractor shall insure all his employees and workmen against such liability as stipulated in Condition of Contract Clause 13 and submit the policy document to the Engineer within stipulated date.

1.10.3 Third Party Insurance Policy

The Contractor shall obtain a Third Party Insurance Policy as stipulated in the Conditions of Contract from an approved insurance agency/institution in the form acceptable to the Employer.

1.10.4 Insurance of Employer's Personnel

The Contractor shall insure all nominated personnel of the Employer including the Engineer's personnel against such liability as stipulated in the Conditions of Contract and submit the policy document to the Engineer within stipulated date.Measurement and Payment

Only the cost of providing Insurance Policies as described above shall be paid to the Contractor amount against submission of required insurance policies with the appropriate payment receipts, in the form acceptable to the Employer, and made provision in the BOQ.

1.10.5 Other Provisional Items

All provisional items in the schedule shall be carried out at the discretion of the Engineer, and shall form part of the contract. In case, the provisional items are carried out by the Contractor, the rates shall be settled as for extra items as stated in the conditions of contract.

1.11 Items Supplied by the Employer

Items supplied by the Employer, if any, are described in Appendix a of Particular Technical Specification.

2 CIVIL ENGINEERING WORK

2.1 Site Clearance

2.1.1 Scope

This specification covers the removal of vegetation, boulders or concrete block of size up to 0.2 m^3, surface obstructions, and the demolition and removal of structures and their basements (if any) not directly associated with or incidental to any excavation.

2.1.2 Interpretations

2.1.2.1 Supporting Specifications

This specification contains stipulations that are generally and particularly applicable to site clearance

a) 1 General

b) 2.2 Earthworks, as applicable

2.1.2.2 Application

This specification contains stipulations that are generally and particularly applicable to site clearance.

2.1.2.3 Definitions

For the purpose of this specification the following definitions shall apply:

Cleared surface - The natural surface of the ground after clearing of surface vegetation has been completed.

Designated area - An area the position of which in relation to the work to be carried out is shown on the drawing or is described in the specification and is therefore known to the Contractor at the time of Bidding.

Finished level - The level of the finished earthworks as shown on the drawings or stated in the project specification.

Grubbing - The operation of digging out the roots of vegetation.

Original ground level - The level of the surface of an area before the commencement of clearing.

2.1.3 Materials

Material obtained from clearing and grubbing and from the demolition of structures shall be disposed of in tipping areas or other suitable places indicated by the Engineer and shall be covered with soil or gravel. Where no such place is indicated by the Engineer, the Contractor shall make his own arrangements for the provision of a suitable place. Such disposal places shall be subject to Environmental Mitigation Plan and approved by the engineer.

The Contractor shall not clear the Site of or damage any living tree having a girth more than 0.5 m (measured 1 m above the ground level) situated on the parts of the Site not subsequently to be occupied by the Works. All trunks and branches of cleared trees shall be stripped of secondary branches, sawn into transportable lengths and stacked at designated areas. Such timber shall be the property of the Employer and shall remain the property of the Employer.

Fencing wire shall be neatly wound into rolls or coils and all such wire, together with all fence posts and other re-usable material from walls, etc., shall be stacked at designated areas.

2.1.4 Construction Equipment

The Contractor shall provide saws for cutting of trees and branches as ordered, and plant that is suitable for grubbing roots and for digging out and removing other obstructions on the Site.

2.1.5 Construction and Workmanship

2.1.5.1 Areas to be Cleared and Grubbed

Prior to the start of any work, the Contractor should lay-out the right-of-way, working areas, clearing, and pavement cuts to insure a proper recognition and protection of the adjacent properties.

All lay-out work must be approved by the Engineer before any demolition, rehabilitation or construction begins.

The Contractor shall clear the parts of the Site subsequently to be occupied by the Works and shall maintain them clear of vegetation. Areas cleared shall include but not be limited to, portions of the Site where excavations are to be carried out and embankments and structures constructed, however, the Contractor shall not commence clearing and grubbing until the Engineer has designated, in writing and in detail, the exact areas to be cleared or grubbed and the time at which the work is to be started.

The Contractor shall ensure that the general shape, profile, and levels of the area are not materially altered during clearing and grubbing operations.

In order to avoid re-clearing or to control dust or erosion the Contractor may have to clear and grub at the latest practicable stage of construction.

2.1.5.2 Cutting of Trees

The Contractor shall take the necessary precautions to prevent injury to persons and animals and damage to structures and other private and public property. Where necessary, trees shall be cut in sections from the top downwards.

No tree shall be cut down until the Engineer has given written authorization for such work to commence. If possible,

trees shall be felled in such a manner as to allow removal of the root together with the trunk.

The Contractor shall be responsible for the disposal of cut trees. Prior to disposal, the Contractor shall identify the method of disposal and location of disposal sites if applicable, both of which shall be approved by the Engineer.

Individual trees indicated and marked by the Engineer as trees to be preserved shall be left standing and uninjured. An amount of NRs 100,000/- shall be deducted from monies due to the Contractor as a penalty in respect of every such tree that is damaged or removed unnecessarily or without the authorization of the Engineer.

2.1.5.3 Clearing

Clearing shall consist of:

a) the removal of all trees and bushes (complete with roots), other vegetation, rubbish, fences, and all other material that may interfere with the construction of the Works
b) the disposal of all materials resulting from the clearing
c) The removal of all rocks and boulders of size up to 0.2 m3 that are lying on the surface to be cleared or exposed during the clearing operation.
d) where fences have to take down, the sorting, coiling, and stacking of the material, and
e) The removal and stacking of other re-usable materials.

The moving of a certain amount of soil or gravel may be inherent in or unavoidable during the process of clearing. No extra payment will be made for the removal of such soil or gravel.

2.1.5.4 Grubbing

All stumps and roots larger than 75 mm in diameter shall be removed to a depth of at least 600 mm below original ground level. Where a road bed or other area has to be compacted, all stumps and roots included matted roots shall be removed to a depth of at least 200 mm below the cleared surface. The removal of stumps and roots shall be done in such a manner that the topsoil is least disturbed. Cavities resulting from grubbing shall be backfilled with approved material and compacted to a density at least equal to that of the surrounding ground.

2.1.5.5 Re-clearing of Vegetation

If during the contract period vegetation should again grow on any portion of the Site, or other areas that have been cleared in accordance with this specification, the Engineer may, if he considers it necessary, order that such area(s) be re-cleared.

Such re-clearing shall include the removal and disposal of grass, shrubs, and other vegetation, as in the first clearing operation.

2.1.5.6 Dismantling

Before moving equipment onto the Site and commencing operations the Contractor shall establish to the Engineer's satisfaction that the method of demolition proposed by the Contractor is such that he can keep any nuisance arising from dust, noise, and vibration to an acceptable level and ensure the safety of structures adjacent to those to be demolished.

The materials obtained from dismantling shall become the property of the Contractor. Serviceable materials shall be stacked neatly in such a manner as to avoid deterioration at site or at other places. Non-serviceable materials shall be disposed off by the Contractor without causing any inconvenience.

Dismantling of reinforced concrete structures shall be carried out using approved methods and in accordance with any safety regulations of the local municipality/VDC or relevant thereto. The Contractor should note that a Building Permit may be required for demolition work.

All rubbish shall be cleared off the site and the Ground let clean and clear and rubbish and non-serviceable materials shall be carted away in a manner acceptable to the local municipality up to a distance of 10kms as per the direction of the Engineer.

Underground structures shall be broken out to a depth of 1meter below original ground level. Sumps, pits, chambers and the like shall be properly cleaned out and filled with clean demolition hard-core, excluding any wood, plastic, sheet metal, loose reinforcement steel and the like.

The top surface of hardcore material shall be blinded with clean sand to a minimum thickness of 200mm. Where directed by the Engineer, a reinforced concrete raft slab shall be cast over sumps, pits, etc. after filling.

The area shall be spread with approved fill material and graded to original levels, or such other levels as the Engineer may direct.

Dismantling of walls, tanks, plates inside building to be rehabilitated will be performed with the required care, without damaging the stability of the structure.

Where required or directed by the Engineer, the existing structure will be temporary reinforced to assure the stability. The Contractor will submit for the Engineer's approval the methods applied for demolishing and the proposed temporary safety measures. The Engineer's approval shall not relieve the Contractor of any of his responsibilities under the Contract.

2.1.5.7 Measurement and Payment

The items scheduled for clearance and demolition will be classified according to the nature of the materials involved and the methods of their disposal.

Only those areas designated to be cleared as indicated in BOQ will be measured for payment. The area of surfaced roads, structures, and paved areas falling within such designated areas will be deducted from such measurements.

2.2 Earthworks

2.2.1 Scope

This specification covers earthworks carried out with light or heavy equipment or by hand, for general excavations, terracing, landscaping etc. It covers the requirements for site-works, excavations for foundations for reservoirs, buildings, bridges and general structures and reinstatement of surfaces.

2.2.1.1 Interpretations

2.2.1.2 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

a) 1 General
b) 2.1 Site Clearance
c) 3.1 Pipe Trenches, as applicable

2.2.1.3 Application

This specification contains Clauses that are generally applicable to earthworks. Interpretations, additions, and variations of this specification (if any) are set out in the Particular Specification.

2.2.1.4 Definitions

For the purpose of this specification the following definitions shall apply:

Backfill - Approved material placed in an excavation after specified operations have been performed and compacted to specified density.

Borrow - Material obtained from various sources such as borrow pits.

Borrow pit - An excavation made for the purpose of procurement of material.

Bulk Excavation – An excavation made from original ground level to reduced site or platform level.

Catch water drain - An open drain and/or berm intended to intercept water and to lead it to suitable discharge points.

Excavation - An excavation, to accommodate a structure or pipeline, made below the original ground level or reduced site/platform level as appropriate.

Over break - Excavation carried out in excess of the designated profile.

Pass - In regard to compaction, a movement of an approved compacting machine from one end of the layer being compacted to the other end.

Specified density - The ratio of field density to laboratory-determined modified AASHTO maximum density.

Spoil - Unsuitable or excess material removed to waste dumping sites or reclaimatiosites.

Stockpile - A pile of material that has been selected, loaded, transported and unloaded in a heap outside the confines of a borrow pit or of an excavation that forms part of the Works.

Suitable material - That material which is acceptable in accordance with the Contract for use in the Works and which is capable of being compacted, in the manner specified, to form a stable fill having side slopes as indicated on the Drawings.

Top Soil - The top layer of soil shall containing organic components that can support vegetation.

Unsuitable material - Unsuitable material shall mean other than suitable material and shall include:

f) material from swamps, marshes or bogs;
g) organic and perishable material;
h) material susceptible to spontaneous combustion;
i) Clay of liquid limit exceeding 80 and/or plasticity index exceeding 55.

2.2.2 Materials

2.2.2.1 Classification for Excavation Purposes

The Engineer will decide on the classification of the materials, which will be based on inspections and criteria given below.

The excavation of material will be classified as follows:

j) Normal excavation. Material that can be efficiently (i.e. in a manner that can reasonably be expected of an experienced contractor, having regard to the production achieved) removed or loaded, with normal mechanical means.

k) Rock excavation. Rock is defined as all materials which, in the opinion of the Engineer, require blasting, or the use of metal wedges and sledge hammers, or the use of compressed air drilling for its removal, and which cannot be extracted by ripping with a tractor of at least 110 kW with a single rear mounted heavy duty ripper.

2.2.2.2 Classification for Placing Purposes

l) Material for embankments, terraces, etc. Such materials shall, generally, have a CBR of at least 3% (compacted at OMC), a PI not exceeding 18, and a maximum dimension of 300 mm, unless otherwise specified in the Technical Specifications.

m) Material for backfill or fill against structures. Material placed as backfill or as fill within 500 mm of structures shall comply with requirements specified under a) above except that it shall not contain more than 10% rock or hard fragments retained on a sieve of nominal aperture size 50 mm.

n) Stone used for rock fill, gabions and stone pitching shall be hard, tough, sound, and clean and derived from a source approved by the Engineer.

2.2.2.3 Selection

Topsoil, if required for later use on the Site, as well as any other material excavated that is suitable for backfilling or for filling against the finished structures, shall be selected and stockpiled in the vicinity of the structures. Topsoil shall be stockpiled in a manner to prevent its deterioration.

The use of top soil shall be restricted to surface layers in positions not subject to loading pavements or structures.

No excavated suitable material other than surplus to requirements of the Contract shall be removed from the Site except on the direction or with the permission of the Engineer. Should the Contractor be permitted to remove suitable material from the Site to suit his operational procedure, then he shall make good at his own expense any consequent deficit of filling arising there from.

If any suitable material excavated from within the Site is, with the permission of the Engineer, taken by the Contractor for purposes other than the forming of embankments and other areas of fill, sufficient suitable filling material to occupy after full compaction, a volume corresponding to that which the excavated material occupied shall, unless otherwise directed by the Engineer, be provided by the Contractor from his own resources.

Suitable material surplus to the total requirements of the Works and all unsuitable material shall, unless the Engineer permits otherwise, be run to spoil in tips provided by the Contractor.

Where the excavation reveals a combination of suitable and unsuitable materials the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the suitable materials are excavated separately for use in the Works without contamination by the unsuitable materials.

Any material that is below the finished level of an excavation and that the Engineer considers to be unsuitable, shall be excavated and disposed of as directed. The resultant space shall be refilled with backfill and compacted as specified

2.2.2.4 Explosives and Blasting

No explosives of any kind shall be used by the Contractor without the prior consent of the Engineer in writing.

The Contractor shall at all times maintain full liaison with and inform well in advance, and obtain such permission as is required from, all Government authorities, public bodies and private parties whatsoever concerned or affected, or likely to be concerned or affected by blasting operations.

The Contractor shall comply with all relevant ordinances, instructions and regulations which the Government, or other person or persons having due authority, may issue from time to time regarding the handling, transportation, storage and use of explosives.

The Contractor shall store explosives in a licensed store or magazine provided with a separate compartment for detonators. Explosives shall be handled only by currently licensed shot firers. The Contractor shall ensure that there is no unauthorized issue or improper use of explosives brought on the Site.

Explosives shall be used in the quantities and manner recommended by the manufacturers. The written permission of the Engineer shall be obtained for each and every location or series of locations where the Contractor wishes to use more than 10 kg of explosives in one blast. Such permission shall not in any way relieve the Contractor of his liabilities under the Contract.

When blasting is carried out, the Contractor shall ensure, by adherence to proper safety distances and by the use of heavy blasting mats where necessary to prevent the dispersal of material, that no damage is caused to persons or

Property on or off Site. Special care shall be taken when blasting to ensure that individual explosions are reduced to such a size as to preclude damage to any buildings or structures. Blasting will not be permitted within 400 meters of any building or structure.

Before the beginning of the defects liability period the Contractor shall account to the satisfaction of the Engineer for all explosives brought on to the Site during the continuance of the Contract and the Contractor shall immediately remove all unused explosives from the Site on completion of the Works or from time to time by the Engineer.

2.2.2.5 Gabions

Gabions shall consist of steel wire mesh crates. The steel wire shall be mild steel wire complying with IS 280-1962. The standard size of mesh size shall be 100 x 120 mm hexagonal shape with 10 SWG thickness mesh wire, 10 SWG thick binding and connecting wire and 7 SWG thick selvedge wire. The weight of deposition of zinc shall be minimum of 250 gm. per square meter equivalent for all the gauges of wire specified. The height of boxes shall be maximum of 1.0 m and diaphragms shall be provided at 1.0 m interval. Maximum size of gabion box will be limited to 3.0 m x 1.0 m x 1.0 m.

2.2.3 Construction Equipment

Equipment shall be suitable for obtaining the end result required under the conditions applicable to the Site.

Compaction equipment used for applying the dynamic load, controlling the moisture content, and grading or mixing, shall be capable of achieving the compaction specified with the material available.

Any vehicle or item of equipment provided by the Contractor for the transport of materials shall conform to the requirements of the applicable road traffic ordinance if the vehicle or equipment is required to operate on any public road, street, or area that has been surfaced.

Where any of the Contractor's operations or the movement of any of the Contractor's vehicles or equipment has caused damage to the surface of any area normally open to the public, the Contractor shall repair such surface as a matter of urgency, and at his own expense.

The Contractor shall provide and use, where applicable, equipment that is suitable for the detection and location of underground service pipes and cables.

Construction traffic shall not use the surface of the bottom of mass excavations unless the excavation is in rock or the Contractor maintains the level of the bottom surface at least 30 cm from formation level. Any damage to the formation arising from such use of the surface shall be made good by the Contractor at his own expense, with material having the same characteristics as the material which has been damaged.

2.2.4 Construction and Workmanship

2.2.4.1 Precautions

2.2.4.1.1 Safety and safeguarding

Every excavation that is accessible to the public shall be adequately protected by barriers or fences, provided with lighting at night and watched to ensure that barricades and lights are effective at all times. Reference shall be made to Clause 1.4.16 of this specification.

The Contractor shall suitably safeguard excavations if the depth of an excavation or the nature of the material excavated renders the sides of the excavation liable to movement that might endanger the Works or the workmen engaged on the excavation.

This safeguarding may consist of supports by timber or sheeting adequately strutted and braced, or, if approved by the Engineer, by a reduction of the slope of the excavated face or faces so that any danger to the Works or the said workmen is eliminated.

The Contractor shall make good any fall of earth or rock due to insufficient safeguarding at his own expense, as directed and by approved means.

Without relieving the Contractor in any way of his responsibility, the Engineer may order additional lateral support for, or the sloping or reduction of the slope of, the sides of any excavation. During the progress of each excavation, the Contractor shall report to the Engineer the presence of bedding planes inclined towards the excavation, seepage water and any other feature that may affect the stability of the excavation, as soon as the presence of such feature or features is known. All timbering and sheeting shall be removed from the excavation at the completion of the work, unless the written permission of the Engineer allowing any portion to remain is obtained.

Should blasting be necessary, the Contractor shall obtain the permission from the Engineer and the local authority well in advance and in writing and shall take every precaution to protect the Works and persons, animals and property in the vicinity of the Site. The Contractor will be held responsible for any injury or damage caused by any blasting operations

And shall, at his own expense, make good such damage. A copy of the blasting permit(s) issued to the Contractor to cover the purchase, storage, and handling of explosives, shall be handed over to the Engineer.

When blasting to specified profiles, the Contractor shall so arrange the holes and charges that the resulting exposed surfaces are as sound and stable as the nature of the material permits. The Contractor shall make good at his own expense any additional excavation necessitated by the shattering of rock in excess of a 150mm over break allowance.

2.2.4.1.2 Existing services

The Engineer's Drawings as well as the Contractor's working drawings show positions of existing underground services based on the best information available.

The Contractor shall, before commencing work in any particular area, verify the position of all underground services and all other obstacles and existing construction on the Site.

The Contractor shall have equipment required for the detection and location of underground services available on the Site and in an operable condition for as long as is necessary to detect and locate such services and, if so ordered, he shall excavate by hand to expose such services in areas and in a manner and at a time agreed upon with the Engineer.

The Contractor shall advise the Engineer at least 7 days in advance of the actual date on which he proposes to excavate near any service. He shall not use mechanical equipment to excavate within 3 m of the assumed position of any service and shall, if necessary, expose the service by means of hand excavation carried out under proper supervision. When so ordered, the Contractor shall backfill such observation trenches with approved material to the compaction density ordered.

Once a service is exposed the Contractor shall take all measures necessary for the support and protection of the service.

Where a service is damaged because of the Contractor's negligence, he shall inform the Engineer and the authority concerned make good such damage or bear the cost of the repairs, as applicable

2.2.4.1.3 Storm water and groundwater

The Contractor's responsibility will include the provision of adequate protection against erosion and flooding by storm water, flow from springs, and seepage, and to include provision for repair, at his expense, of any damage to the Works that may arise as a result of the inadequacy of the protection provided by him.

2.2.4.1.4 Nuisance

Wherever dust from the activities, haul roads, borrow pits or road deviations becomes a nuisance to the public the Contractor shall, when so ordered by the Engineer, apply sufficient water or take other measures to lay the dust, oil shall not be used.

All excavated material shall be so deposited as not to interfere with or endanger the Works, other property, or traffic. The Engineer may order the Contractor to remove, at his expense, any material that the Engineer considers liable to endanger or to interfere with the Works, private property, traffic, or pedestrians, and to place such material at some other approved location.

2.2.4.1.5 Roads

The Contractor shall reinstate and maintain the surfaces of all roadways through which trenches or other excavations have been made. Should any subsidence occur at the location of such trench or excavation, the Contractor shall immediately restore the road surface to its correct level. Where immediate restoration is impracticable, the Contractor shall provide adequate protection. The Contractor shall follow the Standard Specification for Roads & Bridges, 2001, published by the Department of Roads and its requirement to fulfill the above works.

2.2.4.1.6 Traffic control

Where work affects the operation or safety of public road traffic, the Contractor shall, comply with the requirements of the Clause 1.5.2 of the Specification.

2.2.4.2 Methods and Procedures

2.2.4.2.1 Site preparation

Before carrying out any work at any location, the location shall be inspected where necessary together with the Engineer.

The Contractor shall request in writing such inspections where in his opinion the situation shown in the Drawings has changed and/or is different from actual conditions.

After clearing, the location shall be surveyed in conjunction with the Engineer's representative to establish original ground levels, and these agreed ground levels shall form the basis for the calculation of quantities of any subsequent excavation and filling.

Should work commence in the absence of this joint survey, the Engineer's statement shall be final.

Prior to the start of excavation proper, if and as scheduled, all areas in which excavation is to take place or that are to be covered by banks, structures etc., shall be cleared as specified or directed by the Engineer.

Where so ordered, the Contractor shall remove and conserve the topsoil for later use in a manner approved by the Engineer. The Contractor will not be required to remove topsoil from any area in which the average depth of topsoil is less than 150 mm.

The Contractor is responsible for the transfer of line and grade from control points established by the Engineer. The preservation of stakes or other line and grade references provided by the Engineer is the responsibility of the Contractor.

The Contractor's method for setting the line and grade for the activities shall be approved by the Engineer.

2.2.4.2.2 Excavation

Excavation shall be carried out to the depth indicated or to such greater depths as may be required by the Engineer to ensure a satisfactory foundation.

Except where otherwise specified, shown on the Drawings, ordered or dictated by the requirements for safeguarding, excavation shall be so carried out and so trimmed to the outline of the concrete work shown on the Drawings that the excavated surfaces will act as forms for the concrete works. Such surfaces as well as the bottom of excavations shall be cleaned by hand, air or other effective means to remove all loose, soft or otherwise unsuitable material and as required by the Engineer.

Should the Contractor excavate to dimensions in excess of those stipulated or permitted, he shall fill in the excess at his own expense in the manner specified or approved by the Engineer. Excavated surfaces that will remain permanently exposed shall be finished off in a neat and workmanlike manner and shall be graded to provide adequate drainage.

When the Contractor is required by the Engineer to open up borrow pits, he shall maintain them so that they do not become a danger to persons and livestock. On completion of borrowing, the sides of the pits, if not filled with unused material, shall be graded 1V:2H, or as the Engineer may direct. The Contractor shall not spoil, stockpile, or waste any material without approval. He shall dispose of surplus and unsuitable material in areas designated by him and approved by the Engineer. Spoil heaps shall be flattened to present a neat level or graded surface with no danger of erosion.

All excavations in driveways, gardens and the like, private and/or enclosed lands, and premises shall be made by hand unless the consent of the owner to the use of (small) mechanical plant has been obtained by the Contractor.

The Contractor shall not sell any materials arising from excavations, demolitions and the like carried out on the Site unless permission is obtained from the Engineer.

2.2.4.2.2.1 Excavation of Foundation Pits & Trenches

Excavations shall be taken out to the least dimensions required to accommodate the several parts of the Works and shall provide any working space necessary for their excavation.

Excavations shall be carried out in such lengths, widths and depth at one time and in the sequence as approved by the Engineer and in such manner as to avoid any damage to the ground and adjacent property.

Excavations shall be timbered, sheeted and piled or otherwise supported to the extent necessary to support the surrounding ground and to ensure the safety of the Works and adjacent structures. Alternatively where specifically permitted they may be suitably battered.

Unless otherwise required by the Contract no timber or other supports shall be left in excavations without consent of the Engineer.

All proposed measures for the shoring and supporting of excavations or trenches shall be to the approval of the Engineer. Calculations showing the adequacy of any temporary works shall when required be submitted to the Engineer for approval.

2.2.4.2.2.2 Excavations to be Kept Free of Water

The Contractor shall provide and maintain and operate dewatering or other pumping equipment, and shall construct such drains, sumps and catch waters as may be necessary to remove water from the excavations or to prevent its entrance thereto. Water in the excavations shall be dealt with in such manner as will prevent the surfaces on or against which foundations or other work will be constructed from any deterioration of their natural condition, or from such condition as improved by work executed under the Contract.

The arrangement made for dewatering the ground, diverting water or removing water entering the excavations shall be to the satisfaction of the Engineer. Arrangements for removing water shall ensure that the dewatering of excavations can continue during the placing of concrete or execution of any other activities which could be adversely affected by water in or entering excavations. (The Contractor shall ensure that disposal of water does not create a nuisance or cause damage).

Precautions shall be taken especially when ground dewatering equipment is used, to ensure that the lowering of the ground water table in the vicinity of excavations or the removal of fine particles of soil from the ground surrounding the excavations causes no damage to sources of water supply, the adjoining Works or property, or the ground consolidated previously by others.

The Contractor shall take all necessary precautions to ensure the stability of any of the Works against floating or displacement during construction due to high sub-soil water level, flood or other causes.

The method of disposal of drainage water from dewatering operations shall be to the approval of the Engineer and the Employer. Drainage water shall be caught where necessary in holding lagoons which shall be constructed by the Contractor for the purpose or piped to approve disposal points as directed. The Contractor shall obtain all necessary approvals and No Objection Certificates for his disposal method.

Crossings of existing road corridors in disposal systems for drainage water from dewatering systems shall be laid as permanent structures to an acceptable standard of construction. Depth of cover to drainage pipes shall not be less than 1.5 Meters. Pipes shall be PVC or reinforced concrete with appropriate joints. Pipes shall be laid, bedded and backfilled to the approval of the Engineer.

Applications for approval for disposal of drainage water shall be made to the Engineer and Employer in the form of Method Statements giving the following information:

a) Routes, diameters, depths and materials of proposed pipelines.
b) Design of proposed holding lagoons.
c) Proposed daily average, and maximum pumping/discharge rates.
d) Effect on any existing disposal systems proposed to be used.
e) Any other information required by the Engineer or Employer.

2.2.4.2.2.3 Foundation Levels and Preparation of Foundations

Formation levels shall be at the levels shown in the Drawings or at such other levels as may be directed.

When approaching foundation levels in excavations in material other than rock, the final trimming to these levels, whether for actual foundations or for any blinding concrete required by the Contract shall not take place until placing of the blinding concrete or of concrete in the foundation is about to commence.

In the event of the Contractor requiring trimming the foundations in advance of readiness to place concrete, the trimmed foundations shall be protected against the ingress of moisture or the evaporation of soil moisture.

In the case where blinding concrete is required by the Contract no trimming of side faces of excavations shall be carried out for 24 hours after the placing thereof.

Where foundations are in rock, as the excavations approach finished level, the Contractor may be directed to continue excavating without the use of explosives or with limited use thereof by shallow holes and light charges. The final trimming of the foundations shall be executed without explosives by approved hand tools.

Immediately before placing concrete against rock surface, all loose and soft material shall be removed from surface by the use of stiff brooms, hammers, picks and air/water jets. Before the placing of concrete all water shall be removed from depressions and the Contractor shall take all measures necessary to keep all rock faces, against which concrete is to be deposited, dry and properly drained.

2.2.4.2.2.4 Protection of Slopes during Contract Period

The Contractor shall be responsible for the protection of slopes formed during the initial earthmoving stage, from subsequent erosion or damage throughout the period of the Contract, caused either by natural means or as a result of subsequent construction operations, or by construction traffic or any traffic.

The form of protection to be used shall be to the approval of the Engineer. During or after the initial earthmoving, the Contractor shall submit his proposals for the protection of the formed slopes. No subsequent construction activity will be permitted until the approved form of slope protection has been carried out.

The permanent form of protection of slopes shall be as described elsewhere in the Specification.

2.2.4.2.2.5 Placing and compaction

Where approved material from excavations is insufficient to form designated embankments, terraces etc., the Contractor shall, unless otherwise ordered, obtain the additional material, as directed, from borrow pits at locations approved by the Engineer.

2.2.4.2.2.6 Fill in embankments terraces etc.

The fill material shall be free from vegetable matter and shall contain no debris or deleterious matter. The embankment area shall be stripped, grubbed, and cleared prior to placing of embankment fill. The level shall be taken after the stripping and grubbing to arrive at the actual height of fill involved. Nothing extra shall be paid for stripping grubbing etc. Work shall be in good workmanlike manner.

The material of each embankment shall be deposited in layers of thickness, before compaction, not exceeding 300 mm. The material shall be spread to form a layer that is of approximately uniform thickness, and graded over the whole area of the embankment. Each layer shall be compacted at OMC to a density of at least 90 % of modified AASHTO maximum density in the case of cohesive soil or 98 % in the case of non-cohesive soil, unless indicated otherwise on the Drawings.

Should the material be too wet, owing to rain or any other cause, it shall be harrowed and allow to dry out to the correct moisture content before compaction is undertaken. The Contractor shall ensure that storm water will at all times be discharged uniformly over the full area of each embankment or through specially prepared and protected drainage ditches to prevent scouring of the slopes. Where it is necessary to use clay or clayey material in embankments, such material shall be placed not less than 1 m and not more than 5 m below the finished surface.

Where hand-compacting is employed in no case shall the number of men filling-in be more than half the number of men compacting.

Watering-in of backfill will not be allowed, except in some special cases, and if directed or approved by the Engineer.

The Contractor shall be responsible for the suitability of all embankment materials under the Contract until final acceptance of the work. The Contractor shall replace any portions which have become displaced due to carelessness and negligence on his part or to damage resulting from natural causes not attributable, in the opinion of the Engineer, to unavoidable movements of the ground up to which the embankment is made.

2.2.4.2.2.7 Backfilling and Filling

Where backfilling or filling around or against structures has been authorized by the Engineer, such filling shall be placed, and shall be compacted approximately simultaneously on both sides of the structure to minimize unequal loading. All excavations shall be carefully refilled with approved material in layers of thickness not exceeding 200 mm. Each layer shall be compacted, using power rammers or vibrating plate compactors, to a density equal or better than that of the adjoining undisturbed material. Each layer shall be completed before the next is added. Except with the consent of the Engineer, filling shall not be deposited in water.

Timber sheeting and other excavation supports shall be carefully removed as the filling proceeds except where they are required by the Contract, or directed by the Engineer to be left in position, but removal of such supports will not relieve the Contractor of his responsibilities for the stability of the Works.

No filling shall take place around any structure until the Engineer's approval to backfill has been obtained and no backfilling shall take place around sumps, tanks or any other water retaining structures until the structure has been tested and a certificate of compliance with the specified test issued

2.2.4.2.3 Rubble Masonry, Stone Paving & Pitching

In rubble masonry walls the joints shall be broken vertically and staggered bond stones shall be provided to the full wall thickness. More than one meter high wall shall not be allowed and constructed at a time. Each stone shall be 150 mm to 250 mm high, 200 mm to 300 mm long and 100 mm to 150 mm wide and the whole masonry work shall be well bonded by cement mortar as mentioned in the Drawings. The faces of all stones showing externally shall be rough hammer dressed to a convex surface. The mortar joints shall be 15 to 20 mm thick. Finished rubble masonry works shall be wetted by water and prevented from drying out for at least seven days after construction.

Stone paving shall be pitched by hand and set in places in such a manner as to secure the greatest possible compactness and solidity; the smaller interstices shall be filled in with stone chips firmly wedged in with hammers. Rubble for paving is to be carefully bedded and grouted in cement mortar (1:3) to form an even surface.

Stone pitching shall be laid on a filter layer of gravel. The stones shall be pitched by hand to provide a dense uniform surface with even joints.

2.2.4.2.4 Gabion works

Gabion crates shall be filled with large stones with minimum voids between the stones.

2.2.4.2.5 Landscaping

On completion of earthworks to the finished level, the whole surface shall be graded, shaped and compacted to final grades and levels. The surface shall be lightly watered as the Engineer may direct.

If ordered by the Engineer, topsoil shall be placed on level and slightly graded areas and shall be lightly compacted by tamping, and trimmed neatly to required lines, grades, and levels. The final thickness of topsoil after compaction shall be at least 200 mm.

If ordered by the Engineer, grass or other vegetation shall be planted after top soiling has been completed. Such planted areas shall be neatly trimmed and well-watered, and the Contractor shall ensure that planted areas are not permitted to dry out. Any grass or vegetation planted that fails to grow shall be replaced by the Contractor, at his expense.

All land drains, like irrigation channels, culverts, etc. which have been severed during excavation work shall be carefully reinstated by the Contractor at his cost in either similar or approved equivalent material or construction.

Particular attention shall be paid to the support of reinstated drains in filled ground.

2.2.5 Tolerances

2.2.5.1 Positions, dimensions, levels, etc.

The work shall be finished to and within the limits (permissible deviation = PD) given below:

a) Excavations
   - (i) position on plan, i.e. PD in plan of any point measured from nearest grid line: ±35 mm
   - (ii) dimensions on plan, i.e. PD from the designed dimensions: -10 to +50 mm
   - (iii) foundation level, i.e. PD in level of surface of excavation trimmed to receive blinding concrete: ±50 mm
   - (iv) Level (other than foundation level), i.e. PD from designed levels with reference to nearest transferred bench-mark: ±15 mm

b) Embankments, terraces, etc.
   - (i) position of top edge, i.e. PD from designated position of any point, measured from nearest grid line: ±300 mm
   - (ii) alignment of top edge, i.e. PD from a line joining any two points 30 m apart on top edge of embankment: ±100 mm
   - (iii) finished levels, i.e. PD from designated levels with reference to nearest transferred bench-mark: ± 50 mm
   - (iv) slopes of top surfaces, i.e. PD from rate of fall: ± 5 % i.e. if fall 10% tolerance 9.5 to 10.5%

2.2.5.2 Moisture content and density

The permissible deviations (PD) shall be as given below:

a) OMC in field during compaction: +1% and -2%

b) specified density: +(no top limit) and -0

2.2.6 Testing and Acceptance

To determine founding conditions or for other purposes, the Engineer may require the Contractor to drill, auger or excavate bore holes in advance of the start of construction. When so requested by the Engineer, the Contractor shall provide labour, tools, machinery and equipment for sinking such exploratory holes and for refilling them. Such operations will be paid as day work.

The Contractor shall carry out sufficient tests to satisfy himself about the consistency of material placed in embankments and as backfill, and submit a test report to the Engineer.

The Engineer may carry out check tests as he deems necessary, at any depth or at any layer. Where these tests reveal that the material used does not comply with the applicable requirements of the specification, or that the compaction specified has not been attained, the Contractor shall rectify the work to the satisfaction of the Engineer.

2.2.7 2.2.8 Measurement and Payment

Rates for excavation shall cover the cost of excavating, forming excavated material embankments, terraces, shoring and supporting excavations, protection of structures, provision for existing services, dealing with storm and ground water, protection of slopes, and the cost of disposal of any surplus and unsuitable material to a tip identified by the Contractor and approved by the Engineer.

The Contractor shall be responsible for making all arrangements for the disposal of surplus excavated material up to a distance upto10kms at no extra cost. The cost for all lift, disposal including transportation shall be included in unit rate of excavation.

Rates for excavation shall cover the cost of excavating and proper placing of material for re-use. Excavation shall be restricted to limits of excavation as provided in drawings.

Rates for filling shall cover the cost of the provision of suitable material from any lead distance, placing in layers, and compacting as specified. Filling quantity will be restricted to quantity excavated till limits of excavation only. Extra excavations beyond limits of excavation, as shown in drawings, to be filled up with suitable material as directed by engineer at contractor's cost.

The Contractor shall be responsible for making all arrangements for the disposal of surplus filling material up to a distance up to 1 km at no extra cost. The cost for all lift, disposal including transportation shall be included in unit rate of filling.

Rates for landscaping shall include trimming the earthworks to final grades and levels, disposal of surplus materials, planting and seeding, reinstatement of land drains.

Excavations which are required to be backfilled will be measured as if taken out with vertical sides regardless of whether they have been taken out with sloping sides. They will be measured from the net plan of the finished concrete footing, foundation, building or concrete structure except that, in the case of conical-bottomed tanks or other such structures, the volume will be measured from the finished outline of the concrete as shown on the drawings.

Fill is measured as the volume between ground levels before and after the filling and the rate will include forming embankments, terraces, etc.

Landscaping is measured as the area over which finishing is required; it shall exclude areas covered by structures, roads and pavements.

2.3 Cement Concrete

2.3.1 Scope

This specification covers the requirements for plain and reinforced concrete, either cast-in-situ or precast, for civil engineering and building construction applicable to this project.

2.3.1.1 Interpretations

2.3.1.2 Supporting specifications

The following specifications shall, inter alia, form part of and be read in conjunction with this specification:

a) 1 Item of General Application

b) 2.2 Earthworks, as applicable

2.3.1.3 Application

This specification contains clauses that are generally applicable to concrete and structural precast concrete work.

2.3.1.4 Definitions

For the purpose of this specification the following definitions shall apply:

a) General

Adverse weather. Cold weather, or weather in which the ambient temperature is above 25°C, or the relative humidity is low, or the wind velocity is high, or weather in which any combination of the latter three conditions occurs, and which tends to impair the quality of fresh or hardened concrete or otherwise causes concrete to have abnormal properties.

Approved laboratory - A laboratory suitably equipped and staffed for purposes of concrete testing and as such approved by the Engineer.

Cold weather - Weather conditions in which the ambient temperature is 5°C or less.

Concrete cover - The thickness of concrete between the face of the concrete and the outside of reinforcing steel nearest this face as cast.

Cool weather - Weather conditions in which the ambient temperature is higher than 5°C but not higher than 15°C.

Fixture - An item such as a bolt, anchorage, bearing, or the like that is cast or grouted into concrete.

Formwork - Temporary work that is required to support and shape the concrete for a structure.

Hot weather - Weather conditions in which the ambient temperature is higher than 25°C.

Normal weather - Weather conditions in which the ambient temperature is higher than 15°C and less than 25°C.

b) Quality

Class of concrete - See grade of concrete.

Consistency - The extent, as measured by the slump test, to which fresh concrete resists flow or deformation.

Designed Mix – A mix specified by its required performance in terms of strength.

Grade of concrete - An identification number for the concrete, the number being numerically equal to the characteristic compressive strength at 28 d expressed in MPa.

Prescribed mix - Concrete for which the Engineer has prescribed the mix proportions.

Ready-mixed concrete - Concrete complying with the relevant requirements of the specification and delivered to the Site in a plastic state.

Target slump - The average value for the slump of concrete aimed at ensuring compliance with the slump required in terms of the specification.

Workability - The property of fresh concrete that determines the ease with which it can be placed and compacted without segregation of the constituent materials.

c) Strength

Characteristic compressive strength - See specified strength.

Specified strength - The required concrete strength (or the strength corresponding to the required concrete grade) stated on the Drawings or in the Technical Specification and which in all cases represents the strength below which not more than 5 % of valid 28 d test results obtained on cubes of concrete of the same grade can be expected to fall.

Designed Mix - The mix shall be designed to produce the grade of concrete having the required workability and a characteristic strength

Target strength - An average value of the strength of concrete that is higher than the characteristic strength and is aimed at to ensure that the characteristic strength is attained. (Note: If the standard deviation can be determined, the value of the target strength is at least equal to the specified strength plus 1.64 times the standard deviation of valid 28 d test results.)

Valid test result – The average result obtained from the testing of cubes of concrete as defined in IS: 4634-1968 or equivalent BS 5328 Part 4.

d) Joints

The location of joints is controlled by design requirements and construction limitations. Joints shown on the Engineer's Drawings are "designated construction joints" and are required for design requirements and cover "movement joints", "contraction joints" and "expansion joints". The Engineer may, at the request of the Contractor, give his consent to further joints before the casting of concrete to suit the Contractor's method of construction. These shall be defined as "construction joints". In the event that the placing of concrete has to be halted due to equipment failure, inclement weather, movement of shutters or some other event, which are not the Employer's risk, which requires the halting of concreting, and "unforeseen construction joint" shall be formed. Where they are to the Employer's risk they shall be defined as "unforeseen designated joints"

2.3.1.5 Abbreviations

For the purpose of this specification, the abbreviation for reinforced concrete shall be RCC and the abbreviation for plain concrete shall be PCC.

2.3.2 Materials

2.3.2.1 Approval of materials

The Contractor shall supply in good time to the Engineer for his approval, samples of the aggregates and, if so ordered, of the water, that he proposes to use for the concrete and shall furnish evidence that the water and aggregates comply with the requirements of the Contract. Evidence shall be in the form of a statement from an approved laboratory of the results of tests, or an authoritative report or record of previous experience.

2.3.2.2 Cement

Unless otherwise specified the cement used in the Works shall be rapid hardening cement confirming to IS 8041-1990 or high strength ordinary Portland cement (OPC) complying with IS 8112-1989 or related equivalent BS and Nepalese Standards. The use of high-alumina cement (IS-6452-1972) or supersulphated cement (IS 6909-1990) will not be allowed.

The Contractor shall require the manufacturer to provide a certificate for each consignment of cement received at the Site. The Contractor shall maintain a record available for inspection by the Engineer of the locations of concrete from each consignment.

Within eight weeks of the award of the Contract a report on proposed cement sources shall be submitted to the Engineer. The report shall propose primary and secondary sources of supply and shall give each manufacturer's full analysis of chemical composition and physical properties.

The report on cement sources shall be submitted at least four weeks in advance of the commencement of work on trial concrete mixes.

The Contractor shall supply samples of cement, when requested by the Engineer both from any store on Site and the place of manufacture.

If required by the Engineer the Contractor shall ascertain whether the alkali content of cement is greater than 0.6% calculated as Na2O + 0.658 K2O. For alkali contents greater than 0.6% the Engineer may require tests in accordance with BS EN 196 to determine the alkali content of the cement.

The Contractor shall conduct preliminary and works tests as required by the Engineer to determine fineness, compressive strength (mortar cube) at 7 days and 28 days, initial and final setting time and soundness of the cement, as described in IS/BS/NS.

Separate storage facilities shall be provided on the Site for each type of cement used. Cement shall be fresh when delivered to Site and the consignments shall be used in the order of their delivery. The Contractor shall mark the date of delivery on each consignment and each consignment shall be stored separately in such manner as to be easily accessible and identifiable. No cement in bags or other container shall be used unless these and the manufacturer's seals are intact at the time of mixing. If the cement is delivered in bags it shall be stored under cover and on elevated floors that provide proper protection against moisture and other factors that may promote deterioration. Bulk cement may be used providing it is stored in approved weather-proof silos or similar containers provided that the cement drawn for use is measured by mass and not by volume.

The Contractor shall not use cement, which has hardened into lumps, but subject to removal of the lumps by screening, the Engineer may allow such cement to be used in non-structural concrete mixes.

2.3.2.3 Water

The water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Portable water shall be generally considered satisfactory for mixing concrete. The quality of water shall correspond to IS: 456-2000 (Clause 5.4).

Regular tests of the water shall be made by the Contractor during construction of the Works as instructed by the Engineer. The water shall be sampled at the point of discharge into the mix. The Contractor shall supply two copies of each test result to the Engineer.

2.3.2.4 Aggregates

Aggregate shall consist of naturally occurring (crushed or uncrushed) stones, gravel and sand or combination thereof. They shall be hard, strong, dense, durable, clear and free from veins and adherent coating; free from injurious amounts of disintegrated pieces, alkali, vegetable matter and other deleterious substances. As far as possible, flaky, scoriaceous and elongated pieces should be avoided.

Aggregates shall not contain any harmful material described in Clause 3.21, IS: 383-1970, such as pyrites, coal, lignite, mica, shall or similar laminated material, clay, alkali, soft fragments, sea shells and organic impurities in such quantity as to affect the strength or durability of the concrete. Aggregates to be used for reinforced concrete shall not contain any material liable to attach the steel reinforcement. The maximum quantity of deleterious materials shall not exceed the limits set in Clause 3.21, IS: 383-1970.

The contractors should supply samples of the aggregates for the purpose of making preliminary tests for concrete. Method of sampling of aggregate or concrete shall be as per IS: 2430-1986 and method of test for aggregate for concrete shall be as per IS: 2386.

Graded or Single-Sized Coarse Aggregates shall be supplied in the nominal sizes as per clause 4.1 and 4.2 of IS: 383- 1970. The proportion of sizes and shapes of the aggregates shall be determined by the method described in IS: 2386 (Part I) -1963.

The grading of fine aggregates for concreting shall be within the limits given in Clause 4.3 of IS: 383-1970 and shall be described as fine aggregates with grading zones of I, II, III, and IV.

Immediately after commencement of the Works, the Contractor shall supply samples of proposed aggregates and also carry out preliminary testing on proposed aggregates for compliance with the Specification. The results of such tests shall be to the satisfaction of the Engineer before the Engineer will give approval to the source of aggregates proposed by the Contractor. Alternatively, and subject to the approval of the Engineer, the Contractor may submit certified results of tests on the aggregate carried out by an independent laboratory for the Engineer's approval of the source of aggregate.

During the performance of the Contract, the Contractor shall supply samples of aggregates when required by the Engineer for testing. The method of sampling shall be done in accordance with IS: 2430-1986. The amount of material required for each test shall be as specified in the relevant method of test given in IS: 2386 (Part I) -1963 to IS: 2386 (Part VIII) -1963.

All the tests shall be carried out as described in IS: 2386 (Part I) -1963 to IS: 2386 (Part VIII) -1963. When tests are necessary for combined aggregates, the aggregates shall be separated into two fractions, one finer than 4.75 mm IS Sieve and the other coarser than 4.75 mm IS Sieve. Appropriate tests shall be made on samples from each component, the former being tested as fine aggregate and the latter as coarse aggregate.

The contractor shall provide samples or perform any tests as required by the engineer and shall allow access to and provide attendance to enable the engineer to inspect and sample the sources of all materials in quarries, pits, river beds or other sources.

Any rejected aggregate shall be promptly removed from Site within 24 hours.

2.3.2.5 All-In-Aggregates (Combined Aggregates)

If the combined aggregates are available, they do not have to be separated into fine and coarse aggregates but necessary adjustments can be made (with the instructions of the engineer) in the grading by the addition of Single-Sized aggregates. The grading of combined aggregates shall be done in accordance with Table 5 of IS 383 -1970. (Clause 4.44),

2.3.2.6 Admixtures

Admixtures shall not be used in any way in trying to replace any quantity of cement and shall conform to IS: 9103 -1999. Admixtures shall not be used in any concrete without the approval of the Engineer. Admixtures may require tests to be made before they are used. To facilitate approval, the Contractor shall provide the following information:

- the trade name of the admixture, its source, and the manufacturer's recommended method of use
- typical dosage rates and possible detrimental effects of under-dosage and over-dosage
- whether compounds (such as those containing chloride in any form as an active ingredient) likely to cause corrosion of the reinforcing steel or deterioration of the concrete are present, and, if so, the chloride content (expressed as chloride ions or as anhydrous chloride) by mass of admixture
- The average expected air content of freshly mixed concrete containing an admixture which causes air to be entrained when used at the manufacturer's recommended rate of dosage.

If the use of air-entraining agent is permitted by the Engineer, test measurements shall be carried out on Site by the Contractor, as and when required by the Engineer, to determine

a) the percentage of air entrained in the concrete, and
b) The density of concrete.

The Contractor shall provide equipment to permit measurement of entrained air at such frequencies as are required by the Engineer.

2.3.2.7 Reinforcement

This work shall consist of the supply of all reinforcing bars and fabric of the type, shape, size, and grade required for concrete structures and placing them in accordance with this specification, as shown on the drawings or as directed by the engineer.

The contractor shall supply the reinforcing steel necessary for the completion of the work. The reinforcing steel shall be any of the following if not mentioned on the drawings:

- Mild steel and medium tensile steel bars conforming to IS: 432 (Part I) -1982 or equivalent of Nepalese Standard.
- Hot-rolled deformed bars conforming to IS: 1139 -1966 or equivalent of Nepalese Standard.
- Cold-twisted bars conforming to IS: 1786 - 2008.
- The modulus of elasticity of steel shall be taken as 200 KN/sq.m.

If the contractor can produce a manufacturer's certificate which can be identified with the reinforcing steel by numbers or identification marks, it shall be accepted as evidence that the steel complies with the relevant specification. If the contractor cannot produce such certificates and if the engineer requires tests to be performed to satisfy himself that the steel complies with this specification, then the contractor shall supply a certificate of compliance with this specification or send for testing one test piece in each size of reinforcing steel with each batch of steel delivered to the site at least three weeks before the steel is due to be incorporated in the works. In case of each test piece that fails, the steel represented by such test pieces shall be rejected.

All hard drawn steel wire fabric shall confirm to IS: 1566-1982 and rolled steel made from structural steel shall confirm to BIS: 226-1975.

Steel reinforcement shall be protected at all times from injury. It shall be stacked in racks above the ground and shall at all times kept clear of mud. Reinforcement steel which is free from dirt, detrimental scale, paint, oil, loose rust or other foreign substance can only be placed in the work.

2.3.2.8 Storage capacity

The storage capacity provided and the amount of material stored (whether cement, aggregates, steel, or water) shall be sufficient to ensure that no interruption to the progress of the work is occasioned by lack of materials.

2.3.2.9 Deteriorated material

Material that has deteriorated, or that has been contaminated or otherwise damaged, shall not be used in the concrete. Such material shall be removed from the Site without delay.

2.3.2.10 Water stops

The Contractor shall supply and fix Water stops in all joints in members which are to be water-retaining and where shown on the Drawings.

Water stops built into joints shall be made of PVC, rubber, GI Sheet or similar approved material. They shall be obtained from manufactures approved by the Engineer and shall be stored, fixed and jointed in accordance with the manufacture's instruction. They shall be fabricated into the longest practicable units complete with angles and junctions at the

Manufacture's works and shall be made continuous throughout the structure below highest water level and where shown on the Drawings. The number of joints in the Water stop made on Site shall be kept to a minimum.

Where water stop joints are vulcanized or welded on site, jointing shall be performed strictly in accordance with the supplier's instructions and recommendations. The tensile strength of the spliced water stop at a factory-made splice shall be at least 90% of the water stop's tensile strength. The tensile strength of a water stops spliced at the site shall be 80% of the original strength of the water stop.

The Contractor shall supply the manufacturer's test certificates for each consignment of Water stops delivered to Site and shall, in addition, supply to the Engineer sufficient of each type and consignment for confirmatory tests to be carried out in accordance with the appropriate standard test procedure, if ordered.

2.3.2.11 Joint filler

Unless otherwise specified in the Contract, the joint filler shall be of expanded polystyrene, resin or bituminous bonded cork, or similar type (e.g. "FL excel"). The filler shall be obtained from a manufacturer approved by the Engineer and shall be stored and fixed in accordance with the manufacturer's instructions. The Contractor shall supply the manufacturer's certificate for each consignment of joint filler delivered to Site and shall, in addition, supply to the Engineer sufficient of each consignment for confirmatory tests to be carried out in accordance with the appropriate standard test procedure, if ordered.

2.3.2.12 Joint sealant

Unless otherwise shown on the drawings or ordered by the Engineer, an elastomeric two-part polysulphide or polyurethane sealer shall be used. Such joint sealers and the requisite priming materials shall be obtained only from manufacturers that have been approved by the Engineer. They shall be stored in accordance with the manufacturer's instructions and recommendations

The Contractor shall supply the manufacturer's test certificate for each consignment of each type of joint sealer delivered to Site and shall, in addition, supply to the Engineer sufficient of each type and consignment for confirmatory tests to be carried out in accordance with the appropriate test procedure, if ordered.

2.3.2.13 Waterproof Membrane

Unless and otherwise mentioned elsewhere, the waterproof membrane shall be combination of heavy polythene film and a thick self-adhesive rubber/bitumen compound of 1.5 mm thickness or alternatively a 1.5 mm butyl rubber membrane. A compatible solar protection material shall be used at the exposed perimeter of the membrane. Such waterproof membranes, solar protection material, and the requisite priming materials shall be obtained only from manufacturers which have been approved by the Engineer. They shall be stored in accordance with the manufacturer's instructions and recommendations.

The Contractor shall supply the manufacturer's test certificate for each consignment of waterproof membrane materials.

2.3.2.14 Concrete Curing Compound

Concrete curing compound for structures shall be a liquid resin or wax resin base membrane curing compound of a proprietary brand and shall contain a fugitive dye.

Test certificates, prepared by an approved testing laboratory, shall be supplied by the Contractor to show that the performance of the curing compound complies with the curing efficiency.

2.3.2.15 Premixed Grout

The grout used to secure holding down bolts or to fill under structural steelwork shall be premixed and with properties applicable to the application. All premixed grout shall be kept in conditions recommended by the manufacturer and shall not be used after the expiry date.

2.3.2.16 Bituminous Paint

Bituminous paint shall comply with BS 3416 or equivalent IS Standard, Type II for materials in contact with raw or treated water and Type I for all other cases as per BS.

2.3.3 Construction Equipment

2.3.3.1 General

All Construction Equipment shall be maintained in good working order at all times during concrete work.

2.3.3.2 Mixing equipment

The type and capacity of mixing machines shall be such that the rate of output of concrete is suitable for the rate of concreting. Each machine shall be capable of producing a uniform distribution of the ingredients throughout the batch and shall comply with the specification to which the manufacturer claims it has been manufactured. Worn or bend blades

And paddles shall be replaced. The inner surfaces of the mixer shall be clean and free from hardened concrete. The mixers used shall be specially suited to the production of low slump concrete.

2.3.3.3 Vibrators

Vibrators shall be capable of fully compacting each layer of concrete. At least one standby vibrator shall be available at all times during concreting for every three vibrators necessary to maintain the rate of placing.

Vibrating equipment used for the production of precast elements, whether in the form of a vibrating table, an external vibrator attached to the mould, or an immersion vibrator, shall have the frequency that is suitable for the compaction of low slump concrete.

The concrete that is to be compacted by vibration should appear anything from earth dry to slightly glistening. The mix should have the appearance of lacking in fines.

Segregation is likely to take place when the concrete is tipped into the formwork and this should be avoided. The concrete mix should not contain surplus water and sand which will develop segregation under influence of vibrator compaction. The distribution of new concrete should be uniform for the whole section and the surface kept horizontal for the whole section all the time thus ensuring the movement of concrete is downward only. Vibrators shall not be used as a spreading or distributing agent.

The vibrators shall be of rotary out of balance immersion type or the electro-magnetic type and operate at a frequency of not less than 4,000 cycles per minute. The vibration shall be of such a power input as to produce an acceleration of 1 to 3 m/sec in the mass of the compacted concrete. The vibrators shall be provided for continuous operation.

Internal vibrators shall be disposed within the mix, when placed, so as to maintain the whole of the concrete under treatment in adequate state of agitation such that de-aeration and effective compaction may be achieved at a rate commensurate with the supply of concrete from the mixers. Insertion of vibrators at about 450 mm center is considered sufficient.

Vibration shall continue during the whole period occupied by placing the concrete, the vibration being adjusted so that the center of vibration approximates to center of the mass being compacted at the time of placing. The concrete should not be over vibrated and the period of insertion of internal vibration should be about 15 seconds at any point.

The concrete shall be considered fully compacted when the mortar fills the spaces between the coarse aggregate so as to form a glistening and even surface except for slight irregularities where the coarse aggregate breaks this smooth surface. When this condition has been attained the vibrators shall be withdrawn slowly.

The vibrator must not be placed against the steel or the formwork. The minimum distance shall be 8 mm. The compactor must be placed in such a position that formwork, reinforcement, and recently laid concrete may be subjected to the minimum amount of vibration.

2.3.3.4 Formwork

Formwork shall be so designed and constructed that the concrete can be properly placed and compacted and that, subject to the tolerances specified, the required shapes, finishes, positions, levels, and dimensions shown on the drawings are maintained. The formwork and joints shall be capable of resisting the dead load, including the pressure exerted by the wet concrete, wind forces, and all other superimposed loads and forces. If not otherwise directed, forms shall be made of timber where practicable.

The types of ties used and their position shall be such that the required finish is achieved and will not be marred by subsequent corrosion of the ties.

Unless otherwise shown or directed, formwork shall be such that exterior corners of finished concrete are provided with 25-mm chamfers and re-entrant corners without fillets.

2.3.3.5 Scaffolding and ladders

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required at his own cost.

2.3.3.6 Casting beds and moulds

All casting beds for precast concrete shall be properly aligned and levelled. Adequate weather protection shall be provided should this be necessary to achieve the standards specified below.

2.3.3.7 Construction Equipment for handling, lifting, and stacking

The Contractor shall provide adequate equipment for handling, lifting, and stacking precast units that they do not become discolored and are protected from permanent damage due to stresses induced during handling or stacking or due to the use of slings, chains, and hooks.

2.3.4 Construction and Workmanship

2.3.4.1 Reinforcement

Reinforcement Bars shall be straightened to eliminate any bends or kinks developed during delivery to the site. Bars shall be cut into the length and hooked and bent in accordance with the drawings. Bars shall not be straightened or bent in any way that may be injurious to the material.

Unless otherwise stated reinforcement shall be Fe 415 high strength deformed steel bar confirming to IS 1786 or equivalent to NS 191-2046.

Bent bar reinforcement shall be cold bent to the shapes shown on the drawings. Bending of bars shall confirm to IS: 2502-1963.

After cutting and bending, the bars shall be bundled or stocked according to their respective marks as shown in the bending schedule.

All steel reinforcement shall be accurately placed in the positions shown in the drawings and firmly held during placing and setting of the concrete.

Bars shall be held in position be wiring at all intersections with annealed wire not less than 1.25 mm diameter (preferably 16 gauge).

Distances from the forms shall be maintained by precast mortar blocks, plastic tipped metal chairs, metal hangers, plastic chairs, or other approved devices. Metal supports and tie wires which extend to the surface of the concrete shall not be permitted. Stirrups and distribution bars shall pass around the main bars and shall be securely wired thereto.

Layers of bars shall be separated by precast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stones or brick, metal pipe and wooden blocks shall not be permitted.

In case concrete blocks are used, they shall be cured by immersion in water for at least 7 days until 24 hours before the blocks are to be used.

Reinforcement in any member shall be placed and then inspected and approved by the engineer before the placing of the concrete begins. Concrete placed in violation of this provision shall be rejected and removal may be required.

Substitutions of different size bars will not be permitted unless written application, stating special reasons, is made at least 4 weeks before the reinforcing steel is to be placed. Such permission will not be guaranteed and will be subject to the approval of the engineer. Such permission may, however, be granted if the structure is not adversely affected and no additional payment will be made on account of these alterations.

All reinforcement shall be furnished in the full lengths indicated on the drawings and bar bending schedules. Splicing of bars except where shown on the drawing will not be permitted without the written approval of the engineer.

2.3.4.2 Splicing of Reinforcement

Splicing of reinforcing bars shall be either by lapping, or mechanical butt splicing at the option of the Contractor. Bars in excess of 44 mm diameter shall not be spliced by lapping. The location of splices, except where shown on the Drawings, shall be determined by the Contractor based upon using available commercial lengths where practicable. Unless otherwise shown on the Drawings or approved by the Engineer, splices in adjacent reinforcing bars shall be staggered. The minimum distance between staggered splices for reinforcing bars 25 mm diameter or smaller shall be the length required for a lapped splice in the bar. The minimum distance between the staggered butt splices for reinforcing bars 44 mm and larger shall be 1500 mm. Completed welded butt splices and mechanical butt splices shall develop not less than 90 percent of the specified minimum ultimate tensile strength of the un-splice reinforcing bar. Acceptance of welded butt splices and mechanical butt splices of approved design shall be based on qualification tests performed prior to making splices to be used in the work upon job control tests made during the progress of the work. Such tests shall consist of the fabrication and testing by the Contractor of sample splices and shall include testing satisfactory to the Engineer on all or any splices. Acceptable sample splices shall conform to the splicing requirements in this Clause. Splices made by lapping shall consist of placing the reinforcing bars in contact and wiring them together in such a manner as to maintain the alignment of the bars and to provide the minimum specified clearances. The length of lapped splices shall be as shown in Table 2-1 unless otherwise specified in the Drawing or ordered by the Engineer.

Table 2-1: LENGTH OF LAPPED SPLICES FOR REINFORCING BARS

Type of Bar	Diameter of Bar	Length of Lapped Splice in Diameter
Mild Steel Fe-250	Up to 32 mm	50 diameter of smaller bar
Tor Steel Fe-415	25mm or Less	55 diameter of Smaller Bar
Tor Steel Fe-415	More than 25 mm	55 diameter of Smaller bar
Steel >Fe-415	More than 25 mm	60 diameter of Smaller bar

2.3.4.3 Placing of Reinforcement

Reinforcement shall be placed in position as given on the detailed design drawing and shall be secured at that position. In case of delay occurring between fixing of reinforcement and concreting, it shall be checked prior to concreting.

All bars are to be lapped for at least fifty five (55) diameters except where otherwise shown on the plan or indicated in the reinforcement bar schedule. The lea distance between parallel bars is to be 25 mm or one diameter whichever is greater. The positions of the laps are to be staggered throughout unless shown otherwise.

2.3.4.4 Cover of the Reinforcement

Unless otherwise shown on the drawings or directed by the Engineer, reinforcement shall have concrete cover and the thickness of such cover shall be:

- At each end of the reinforcing bars not less than 25 mm nor less than twice the diameter of such bar;
- For a longitudinal reinforcing bar in a column not less than 40 mm nor less than the diameter of such bar. In case of columns of minimum dimension of 200 mm or under, whose reinforcing bars do not exceed 12 mm, a cover of 25 mm shall be used;
- For longitudinal reinforcing bar in a beam not less than 25 mm nor less than the diameter of such bar;
- For tensile, compressive, shear or other reinforcement in a slab, not less than the diameter of such bar;
- For any other reinforcement, not less than 15 mm, nor less than the diameter of such bar.
- For reinforced concrete members immersed in water, concrete cover over reinforcement shall be minimum 50 mm.
- The maximum cover for reinforcement shall not be more than 75 mm.

Unless otherwise specified by the engineer, tolerances for placing of reinforcement shall be within the following tolerances:

a) For effective depth 200 mm or less + (-) 10 mm
b) For effective depth more than 200 mm + (-) 15 mm

The cover shall in no case be reduced by more than one third of the specified cover or 5 mm whichever is less.

2.3.4.5 Formwork

Formwork will be classified in accordance with the surface conditions required on the finished concrete, as shown on the drawings or as directed. Such finishes will be as follows:

- Class F1 Rough. No treatment of the surface of the concrete will be required after the striking of the formwork. The finish of the concrete need not be more accurate than Degree of Accuracy U3 as defined in terms of Clause 2.3.6.14.
- Class F2 Smooth. Imperfections such as small fins, bulges, irregularities, surface honeycombing, and slight surface discolorations shall be made good and repaired by approved methods. The finish of the concrete shall be accurate to Degree of Accuracy U2 as defined in terms of Clause 2.3.6.14
- Class F3 Special. Special finishes shall be as indicated on the drawings and BOQ.

If no Class of Finishes is specified in the BOQ or Technical Drawing, Class of finishes Class F2 shall apply. Forms shall

be erected with joints tight enough to prevent leakage of cement mortar.

Surfaces of forms (regardless of the material of which they are made) that are to be in contact with fresh (wet) concrete shall be treated with a coat of non-staining mineral oil or other approved material, or, in the case of timber forms, by thorough wetting of the surfaces with water, so as to ensure easy release and prevent adhesion of the formwork during stripping.

Before re-use, all formwork shall be reconditioned, and all form surfaces that are to be in contact with the concrete shall be thoroughly cleaned.

Where necessary for the proper placing of the concrete, temporary openings for cleaning, inspection, or placing and compaction purposes shall be provided and, subsequently, so closed as to provide the finish specified and to conform to the applicable tolerances specified.

Formwork shall not be removed before the concrete has attained sufficient strength to support its own weight and any loads that may be imposed on it. The Engineer's approval shall be obtained before formwork is removed. As a guide, the formwork shall remain in place, after placing of the concrete, as follows:

a) Concrete cast with OPC or SRPC, in hot or normal weather
   (i) Beam sides, walls, and unloaded columns 1 d
   (ii) Slabs with props left underneath 4 d

(iii) Beam soffits with props left under 7 d

(iv) Slab props, including cantilevers 10 d

(v) Beam props, including cantilevers 14 d

b) Concrete cast with OPC [illegible] PPC in cold weather

(i) Beam sides, walls and lightly loaded columns 1.5 d

(ii) Slabs with props left underneath 7 d

(iii) Beam soffits with props left under12 d

(iv) Slab props, including cantilevers 17 d

(v) Beam props, including cantilevers 21 d

In cool weather, stripping times shall be determined by interpolation between the periods specified for normal and cold weather.

If the Contractor can prove to the satisfaction of the Engineer that a period shorter than the appropriate minimum given above is sufficient to enable the concrete to comply with its requirements, the formwork may be removed after such shorter period.

Formwork shall be removed carefully so that shock and damage to the concrete are avoided.

Notwithstanding the provisions above, the Contractor shall be responsible for making good any damage to the concrete arising from the removal of formwork and its supports.

2.3.4.6 Holes, chases, and fixing blocks

No holes or chases, other than those shown on the drawings or approved by the Engineer, shall be cut or otherwise formed in the concrete. The manner of attaching fixtures to be embedded in the concrete shall be subject to approval by the Engineer.

Boxes for forming holes shall be constructed so as to be easily removable without damaging the concrete during removal. They shall be properly vented to permit the escape of entrapped air and shall be capable of being sealed, subsequently, to prevent the loss of grout.

2.3.4.7 Pipes and conduits

No pipes or conduits, other than those shown on the drawings or approved by the Engineer, shall be permanently embedded in the concrete.

2.3.5 Concrete

2.3.5.1 Quality

Concrete shall comply with the requirements for a designed mix to in Accordance to Clauses 5.1, 5.2.1, 8.2.1, 14.1.1, 35.1 of IS:456 - 2000 or relevant BS Standard (BS 8110 and BS 8007).

The Contractor shall determine to the approval of the Engineer the actual proportions of ingredients for each class of concrete to be used in the Permanent Works.

The concrete shall meet the requirements given in the Table 2-2 the designation of the concrete mix, letter M refers to the mix and the number to the specified characteri4stic compressive strength of 15 cm cube at 28 days and is expressed in N/sq. m.

Table 2-2: GRADES OF CONCRETE

(In Accordance to Clauses 5.1, 5.2.1, 8.2.1, 14.1.1, 35.1 of IS: 456-2000)

Grade Designation	Specified Characteristic Compressive Strength at 28 days (N/sq. mm.)
M10	10
M15	15
M20	20
M25	25
M30	30

2.3.5.2 Grades of Concrete

Grades of concrete to be used shall be as specified in the drawings or as directed by the engineer. In any case Grade of Concrete is not mentioned in drawing, grades of concrete lower than M15 shall not be used in reinforced concrete.

2.3.5.3 Mix Proportion

The mix proportions shall be selected to ensure that the workability of the fresh concrete is suitable for the conditions of handling and placing, so that after compaction it surrounds all reinforcements and completely fills the formwork. When concrete is hardened, it shall have the required strength, durability, and surface finish.

The determination of the proportions of cement, aggregates, and water to attain the required strengths shall be made as follows:

- by designing the concrete mix;
- By adopting nominal concrete mix.

Design mix concrete shall be preferred to the nominal concrete mix. If design mix concrete cannot be used for any reason on the work for grades of M20 or lower, nominal mixes may be used with the permission of the engineer.

2.3.5.4 Design Mix Concrete

The mix shall be designed to produce the grade of concrete having the required workability and a characteristic strength not less than the appropriate values given in Table 2-2.

When the results of sufficient number of tests (at least 30) are not available, then depending upon the degree of quality control expected to be exercised at the site, the value of standard deviation of the compressive strength of concrete given in Table 2-3 can be adopted for guidance but only if approved by the engineer.

Table 2-3: SUGGESTED VALUES OF STANDARD DEVIATION

Grade of Concrete	**Standard Deviation for Different Degree of Control in N/sq. mm.**		
	Very Good	**Good**	**Fair**
M10	2.0	2.3	5.3
M15	2.5	3.5	4.5
M20	3.6	4.6	5.6
M25	4.3	5.3	6.3
M30	5.0	6.0	7.0

The target strength for mix design and the selection of the water cement ratio shall be done according to IS: 10262- 2009.

2.3.5.5 Selection of Water Content and Fine Aggregates Ratio

For the desired workability, the quantity of mixing water per unit volume of concrete and the ratio of fine aggregate to the total aggregate by absolute volume shall be estimated according to Table 2-4 depending upon the nominal maximum size and type of aggregates. The water content corresponds to the saturated surface dry aggregate.

Table 2-4: SAND AND WATER CONTENTS PER CUBIC METER FOR GRADES UPTO M35

Nominal Maximum Size of Aggregate per cubic meter (mm)	**Water Content of Total of Concrete (kg)**	**Sand as Percent Aggregate**
10	208	40
20	186	35
40	165	30

The water content corresponds to the saturated surface dry aggregate.

2.3.5.6 Nominal Mix Concrete

Nominal mix concrete may be used for concrete of grades M10, M15, and M20. The proportions of materials for nominal mix concrete shall be in accordance with Table 2-5.

Table 2-5 PROPORTIONS FOR NOMINAL MIX CONCRETE

Grades of Concrete	**Total Quantity of Dry Aggregate by mass per 50 kg of Cement (kgs)**	**Proportion of fine Aggregate to Coarse Aggregate by mass**	**Maximum Quantity of Water per 50 kg of Cement**
M10	480	Generally 1:2 but subject to an upper limit of 1:1.5 and a lower limit of 1:2.5	34
M15	350		32
M20	250		30

The proportions of fine to coarse aggregates should be adjusted from upper limit to lower limit progressively as the grading of fine aggregates becomes finer and the maximum size of coarse aggregates becomes larger.

The cement content of the mix specified in Table 2-5 for any nominal mix shall be proportionately increased if the quantity of water in a mix has to be increased to overcome the difficulties of placement and compaction, so that the water cement ratio as specified is not exceeded.

2.3.5.7 Mixing of Concrete

- Unless otherwise agreed by the Engineer concrete shall be mixed in a batch type mixer which shall comply with IS: 1791 -1985 or such other type as the Engineer may approve. When swing-type weight batchers are used they shall comply with IS: 2722-1964. Batch mixers will be tested and perform in accordance with IS: 4634-1968 or such other tests as the Engineer may require. Mixers which have been out of use for is mixed. Concrete shall not be mixed when the air temperature in the shade is

  Below 3°C (38°F) unless special precautions are taken which have been approved by the Engineer.

  During hot weather the Contractor shall ensure that the constituent materials are sufficiently cool to prevent the concrete from stiffening in the interval between its discharge from the mixer and its final position. Concrete shall be mixed for not less than 90 seconds nor more than 5 minutes from the time all constituents have been introduced into the mixer.

- Hand mixed concrete shall only be used when specified or authorized in writing by the Engineer. It shall be made in batches of not more than 0.25 cubic meters and shall be mixed on a water tight level platform. The proper amount of coarse aggregate shall be measured in measuring boxes and spread on the platform and the fine aggregate spread over this layer, the two layers being not more than 300 mm in total depth. On this mixture will be spread the dry cement and the whole mass turned not less than 2 times dry; then sufficient clean water shall be added, evenly distributed and the whole mass again turned not less than 3 times, not including placing in the carriers or forms.

- Ready mixed concrete batched off the site may be used only with the approval of the Engineer and shall comply with the requirements of IS: 4926 - 2003.

2.3.5.8 Control Over Production of Concrete

The Engineer shall be afforded all opportunity and facility to inspect the materials and manufacture of concrete and to take any samples or to make any tests. All such inspection, sampling and testing shall be carried out with the minimum of interference with the process of manufacture and delivery.

2.3.5.9 Batching of Concrete

- Weight Batching: In normal circumstances weight batching shall be used. The mass of cement supplied in a standard sack shall not be less than 50 kg. All cement taken from bulk storage containers and from partly used sacks shall be batched by mass with additional 2 % of mass required.

  Mixing water for each batch shall be measured. The amount of water measured shall be adjusted to allow for the moisture content of the aggregates.

  The mass of the aggregate of each size shall be determined and a correction made for the moisture content of the aggregates.

- Volume Batching: In special circumstances, and at the sole discretion of the Engineer, proportioning of materials by volume may be approved. If batching is by volume, the fine and the coarse aggregates shall be measured separately in suitable measuring boxes of known volume and of such capacity that the quantities of aggregates for each batch are suitable for direct transfer into the mixer. Bulking tests on the fine aggregate shall be conducted regularly and the results used for adjustment of the batch volume of the fine aggregate to give the true volume required.

2.3.5.10 Transportation and Placing of Concrete

No concrete shall be placed at any time without at least one day's notice being given to the engineer, and concrete shall be placed only in the presence of the engineer.

Before any concrete is placed, forms must be inspected to see if thoroughly clean, and all sawdust, shavings, nails, dirt and rubbish of any description must be removed from within the forms. Temporary openings shall be provided where necessary to facilitate cleaning and inspection immediately before depositing concrete.

Where concrete is to be placed on a rock foundation the surface shall be washed down with streams of water under sufficient pressure, and scarified with wire brush of by other effective means, to thoroughly cleanse the rock surface and to remove all dirt, gravel, scale, debris, rock fragments or other loose material. Where concrete is to be placed on other concrete including inclined and vertical surfaces, which has taken its final set, the forms shall be retightened and the concrete shall satisfactorily roughened with pick or other means if required, and shall be cleansed in a similar manner. All objectionable substance shall be removed from the surface of concrete at such times depending on weather conditions and rate of hardening, as the engineer may direct. When such area is cleansed and wetted, but free from surplus water, a wash of neat cement grout shall be scrubbed into the contact surface of the old concrete or rock with brooms and shall

Be thoroughly worked into all crevices and depressions. When required by the engineer, a coat of mortar shall be spread over the contact surfaces thus prepared, after which the concrete may be put in position and well rammed, and worked so as to make a thoroughly bonded and water-tight joint.

No concrete shall be placed in position until the reinforcement, forms and supports or the foundation, as the case may be, have been inspected and passed by the engineer.

Concrete shall be placed only in the presence of the engineer.

Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which prevent the separation or loss of ingredients. Mixing and transporting equipment shall be free from hardened concrete and foreign materials on the inner surface. The concrete shall be deposited in the forms are near as practicable in its final position to avoid re-handling. It shall be so deposited as to maintain until the completion of the unit, a plastic surface approximately horizontal. Forms for walls or other thin sections of a considerable height shall be provided with openings, or other thin sections of a considerable height shall be provided with openings, or other devices, that will permit the concrete to be placed in a manner that will avoid accumulation of hardened concrete on the forms or metal reinforcement. Under no circumstances shall concrete which has partly hardened be deposited in the work.

When concrete is conveyed by chutes, the plant shall be of such size and design as to ensure a practically continuous flow in the chute. The angle of the chute shall be such as to allow the concrete to flow without separation of the ingredients. The delivery end of the chute shall be as close as possible to the point of deposit. When the operation is intermittent, the spout shall discharge into the hopper. The chute shall be thoroughly flushed with water before and after each run; the water used for this purpose shall be discharged outside the forms.

Concrete shall be deposited continuously and as rapidly as practicable unit the unit of operation approved by the engineer is completed. Any concrete which has taken its initial set will be rejected and under no circumstances shall concrete remain longer than twenty (20) minutes after mixing before being used, or such other time as may be determined by the engineer, to suit the setting properties of the cement, the position in the work and the weather conditions at the time of placing.

Cement shall not be placed in running water. No concrete shall be placed in water without the permission of the engineer, and the method of depositing shall be such as to minimize loss of cement, and subject to his approval. Care shall be taken that no water interferes in any way with the proper placing of concrete, and the Contractor shall not allow water to rise in any concrete until in the opinion of the engineer it has set sufficiently. Water shall be removed from excavation before concrete is deposited unless otherwise directed by the engineer. Any flow of water into the excavation shall be diverted through proper side drains to a sump, or be removed by other approved methods which will avoid washing the freshly deposited concrete. Water vent pipes and drains used for constructional purposes shall be filled by grouting or otherwise after the concrete has thoroughly hardened. Springs encountered in the foundation shall be plugged, piped or otherwise satisfactorily disposed off.

Concrete shall be gently placed into position and is not to be poured from a greater height than 1200 mm into the forms unless suitable chutes are specially provided for. It is to be placed and punned in layers not thicker than 150 mm and the section of the works undertaken shall be such that the next layer of concrete 150 mm thick will be placed on top of the first within twenty (20) minutes of placing the first layer, or such time as to preclude any danger of disturbing the first layer once it has taken its initial set. It is to be well worked and consolidated around the reinforcement and embedded fixtures and into corners of forms by means of suitable tools in such a manner as to prevent the formation of any void spaces and to ensure the most thorough compacting to obtain density and water tightness. At the same time by spading just inside the face of the forms, a good smooth and regular face is to be ensured when the forms are stripped. Concrete is also to be assisted into place by tapping the outside of the forms opposite the newly-placed concrete.

All concrete shall be done in as large sections as possible without a break, to ensure a minimum number of joints. In mass work, the masses of concrete laid at different times shall break joints both horizontally and vertically. Whenever required, the work shall be so prosecuted that construction joints will occur only at designated places and when so directed, the Contractor shall complete by continuous depositing of concrete, sections of the work bounded by such joints. Joints not indicated on the plans shall be so designed and located to the approval of the engineer.

When placing of concrete is to be interrupted long enough for the concrete to take its final set, provision for bonding will be made by leaving the surface rough by the use of forms of such styles and dimensions as to properly form the concrete joints into steps, dovetails, grooves or other ordered shapes. In the case of walls, the bond is to be helped by the formation of a continuous tapered tongue or key whose base width shall be approximately one-third of the thickness of the wall, and whose height shall be 75 mm. No concrete shall be placed on old work, which has taken its initial set, unless work is at least three (3) days old.

In the case of floor slabs, construction joints transversely to the span shall be made at the center of the span unless directed otherwise by the engineer. Longitudinal construction joints shall be made where shown on the plan or as directed by the Engineer.

Columns are to be placed in accordance with the instructions above, but in certain cases for long columns the engineer may allow the use of a "Tremie" pipe. Columns shall be poured up to the underside of the haunches of beams. The haunches are to be formed and poured with the beam.

Beams and slabs shall be poured together so that there is no break between the two, unless the Drawings expressly show such a break.

At the discretion of the engineer, concreting operations may be suspended during excessively hot weather.

The Contractor shall not permit walking over or upon finished surfaces of concrete until sufficiently hardened or until at least three (3) days after placing. While setting, the concrete must not be disturbed or subjected to vibration or interference of any kind.

Should concreting be stopped for any reason, the work is to be left protected, and is to be cleaned down before operations are resumed.

At all times, great care shall be exercised to prevent injury to concrete surfaces and the Contractor may be required to clean same before the completion of the contract.

The Contractor is to note particularly that adequate numbers and the very best class of workmanship will be insisted on. This will necessitate especially the conformation with this specification with regard to the amount of water used in mixing, the thorough tamping while placing, and the through cleansing of all surfaces from laitance or other matter on which concrete is to be placed.

2.3.5.11 Compaction of Concrete

The Contractor shall regard the compaction of the concrete as work of fundamental importance and shall produce a watertight concrete of maximum density compatible with the approved mix. Unless otherwise specified by the engineer, concrete shall be compacted with the use of mechanical vibrators of the type complying IS: 2505 - 1992, IS: 2506-1985 and IS: 2514-1963.

Compaction shall be assisted by the use of mechanical vibrators of the immersion type, but shall not involve the vibration of reinforcement or shutters except that vibration of shutters may be allowed, with the approval of the Engineer. Vibrators shall be inserted at least to the full depth of the newly deposited concrete and then slowly withdrawn to prevent the formation of voids. The procedure shall be continuous with points of insertion 150 to 225 mm apart. The number and type of vibrators available for use during each period of concreting shall be to the approval of the Engineer, which will not be given if sufficient stand-by vibrators in good working order are not readily available. If concreting is in the dark, ample lighting shall be provided at the mixing stations and at every place where concrete is being deposited.

Compaction shall be carried out by mechanical vibration or (if approved) by spading, rodding, or forking.

Over-vibration resulting in segregation, surface laitance, or leakage, or any combination of these, shall not be permitted. The rate of concrete placing shall be commensurate with the available compaction equipment and only skilled operators shall be permitted to undertake compaction by vibration.

Concrete for precast elements shall be so placed in moulds and vibrated that concrete surfaces are smooth and even and all arrises are true and clean.

Where precast units having architectural finishes are required, the Contractor shall ensure that duplicate samples are submitted to and approved by the Engineer with regard to both colour and quality before full scale production is commenced. One sample will be retained by the Engineer and the other shall be retained by the Contractor at the place of manufacture. The Contractor shall not commence manufacture until acceptable samples have been lodged.

Vibration shall not be applied by way of reinforcement. Therefore contact with the reinforcements and all inserts shall be avoided as far as possible.

2.3.5.12 Construction Joints in Concrete

Concreting shall be carried out continuously up to the locations where joints are shown on the Contractor's working drawings or up to approved or directed locations. The method adopted for forming such joints and unforeseen joints shall be one of the following:

General Preparation: Joints when concrete is less than 24 h old. The surface of the concrete shall be water jetted to expose the aggregate.

Joints when concrete are more than 24 h but not more than 3 d old. The surface of the concrete shall be sandblasted or chipped with a light hammer to expose the aggregate.

Joints when concrete are more than 3 d old. The procedure specified in (b) below shall be followed. Preparation

before placing concrete:

- Joints when concrete are less than 24 h old. The surface of the concrete shall be swept clean and immediately before placing the concrete, wetted but without pools of water.
- Joints when concrete are more than 24 h but not more than 3 d old. The surface of the concrete shall be swept clean, and thoroughly wetted but without pools of water.
- Joints when concrete are more than 3 d old. The procedure specified in (b) above shall be followed, except that the old surface shall be kept continuously wet for at least 24 h before the new concrete is placed.

2.3.5.13 Curing and Protection of Concrete

The Contractor shall, until it has thoroughly hardened and for not less than 7 days, protect the concrete from the harmful effects of frosts, wind, sun, high or low temperature, variation or reversal of temperature gradient, premature loading, deflection or impact, and aggressive groundwater. The protruding steel shall be kept cool.

Unless otherwise approved by the Engineer, exposed concrete surfaces shall be kept continuously moist for not less than 7 days after casting in the case of Portland and sulphate resisting cement concretes. Immediately upon exposure, surfaces shall be covered with a thick layer of hessian or sand or other material as may be approved by the Engineer, which shall be in continuous contact with the concrete and kept wet to the satisfaction of the Engineer; the Contractor shall make special provision to the satisfaction of the Engineer for the supervision of wetting concrete which incorporates other authorised types of cement.

If curing membranes are proposed by the Contractor and approved by the Engineer, they shall be applied in conformity with the manufacturer's instructions. They shall be applied to unshuttered surfaces within one hour of concrete deposition and shall incorporate aluminum or other approved reflecting agent. Surfaces with applied curing membrane shall be shaded from the sun, unless otherwise approved.

Curing membranes shall not be applied to construction joints.

Concrete curing compound for structures shall be a liquid resin or wax resin base membrane curing compound of a proprietary brand and shall contain a fugitive dye.

Test certificates, prepared by an approved testing laboratory, shall be supplied by the Contractor to show that the compound complies with the curing efficiency.

2.3.5.14 Concrete surfaces

Surfaces of concrete not finished against forms or ground surfaces shall be finished to the following classes.

Type Ul - This finish is for surfaces where a superior finish is not required. It is also the first stage for finishes U2 and U3. The finishing operations shall consist of grading, tamping, and screening the concrete to produce a uniform, plain, or ridged surface.

Type U2 - This is a smooth matt finish such as may be achieved by a wood trowel, as required, inter alia, to receive mastic paving, block or tile paving bedded in mastic or screeds. Smoothing shall be done only after the concrete has hardened sufficiently, and may be by hand or machine. Care shall be taken that the concrete is worked no more than is necessary to produce a uniform surface free from marks.

Type U3 - This is a smooth steel-trowelled finish for surfaces of concrete pavings, tops of walls, copings and other members exposed to weathering or water, surfaces to receive thin flexible sheet, tile paving bedded in adhesive, and seatings for bearing plates and the like where the metal is in direct contact with the concrete. Trowelling shall not commence until the moisture film has disappeared and the concrete hardened sufficiently to prevent excess laitance from being worked to the surface. The surfaces shall be trowelled by hand or machine under firm pressure and left free from trowel marks.

If no Class of Finishes has been specified in the BOQ or Technical Drawing, Class of finishes U2 shall apply.

2.3.5.15 Watertight concrete

Each section of the Works that is required, to hold or exclude water shall be watertight, and special care, particularly at construction joints, shall be taken by the Contractor to ensure water tightness. Should any such section of the Works fail to pass the tests for water tightness as required as per the Technical Specification or as ordered, or show any sign of water leakage or penetration after being taken into use shall be repaired as per the instruction of the Engineer at the cost of the Contractor. If the problem persists, the structure shall be deemed defective and demolished and replaced with proper one.

2.3.5.16 Concrete in wet ground

The Contractor is to provide a dewatering system on own cost, which ensures when concrete is placed there is not surface water and the ground provides suitable working condition.

2.3.5.17 Grouting

Where it is required to grout holding down bolts, or to place grout under column bases or bedplates for equipment, the Contractor shall first prepare the relevant concrete surfaces by scrabbling and cleaning them. The grout shall consist of an approved premixed grout mixture of cement, sand, water, and admixture, and shall be so rammed into each HD-bolt pocket or under each base or bedplate (as applicable) that all voids and pockets are completely filled around the bolt or between the top of the concrete and the underside of the metalwork, and, in the case of a base or a bedplate, that the grout projects beyond the base or bedplate. After the void has been completely filled, the edges of the mortar grout shall

Be trimmed at an angle of 45^0 outward from the bottom edges of each base or bedplate and the trimmed edge wood-floated to a neat finish.

2.3.5.18 Concrete pumping

Where approved by the Engineer, the Contractor may use a suitable concrete pump for transporting the concrete from the batching equipment or transport vehicle to the point where it is to be deposited, in which case the specified mix proportions shall be adjusted and agreed with the Engineer at the time of submission of the relevant method statement. The concrete shall be fed directly from the batching equipment or transport vehicle into the hopper of the pump. Once concreting has commenced the rate of the flow and mixing must be such as to ensure continuous movement of the concrete in the pipe work, which shall have as few bends as possible. Frequent slump tests (e.g. in accordance with BS 1881) shall be carried out at the delivery end to ensure the consistency and workability at the point of placing. All equipment must be thoroughly cleaned at the end of each operation.

2.3.5.19 Defects

The concrete shall be homogeneous and free from honeycombing, interstices, and planes of weakness. If, after removal of the forms, the concrete shows any defect, the Contractor shall immediately report such defect to the Engineer, and he shall not carry out any patching or remedial work until authorized to do so by the Engineer.

After thorough inspection and investigation of the quality and strength of the defective work and after due consideration of the possible consequences of such defect, the Engineer will either specify the extent and method of repair or order the demolition and reconstruction of the whole of the defective work to the extent that he considers necessary.

The cost of all such investigation, repair, and remedial work and of any demolition and reconstruction of defective work shall be borne by the Contractor and all repair, remedial, and reconstruction work shall be executed to the satisfaction of the Engineer.

Finished concrete shall have a neat, smooth, even, and uniform finish free from any honeycombing. If the finish of any formed or floated concrete surface is, to the opinion of the Engineer, unsatisfactory and does not conform to that specified, the Contractor will be required, at his own expense, to rub down such surface while it is still green, or, alternatively, to grind it down with Carborundum or other suitable material when it has hardened or to take other approved measures to give the specified finish.

For precast elements, moulds shall be removed without any shock or vibration that might damage the concrete or have any other detrimental effect on the units and on their surfaces.

2.3.5.20 Handling and erection of precast units

The Contractor shall ensure that lugs, slots, holes, etc., provided for handling units and moving them from the point of manufacture to the place where they are erected, are adequate, and are so arranged that excessive stresses do not occur in any unit during handling, movement, or erection. Without the Contractor's responsibility being limited in any respect, the position of lifting and supporting points, the method of lifting, and the type of equipment and transport used shall be subject to approval by the Engineer.

The Contractor shall place indelible identity, location, and orientation marks on each unit, as and where necessary. Packing pieces shall

be such that they do not discolour or otherwise permanently damage the units.

Precast units shall be so stacked that the accumulation of trapped water and dirt is prevented, that, in the case of small units, deformation is minimized during the curing process, and that large units have complete freedom of movement during the curing process.

The method of assembly and erection agreed to with the Engineer shall be adhered to on the Site. Immediately after the unit is in position and before the lifting equipment is removed temporary supports or temporary connections between units shall be provided as necessary. The final structural connections shall be completed as soon as is practicable.

2.3.5.21 Joint Sealers

The Contractor shall construct recesses at all joints and on both faces of the concrete work except on the underside of ground slabs. The recesses shall be accurately formed to the lines and dimensions shown on the Drawings or as agreed with the Engineer.

The Contractor shall prepare the surfaces in the recess, prime if necessary and shall apply a joint sealer and fill or caulk the recess completely with it.

Joint sealing shall not be commenced without the approval of the Engineer. In reservoir joints the sealer shall be applied after the construction of the reservoir roof.

Sealants shall be installed in strict accordance with the manufacturer's instructions. De-bonding strip shall be used in conjunction with the sealers as indicated on the Drawings. The de-bonding strip shall be compatible with the joint sealer and shall be resistant to attack from the primer used to bond the sealer to the concrete.

Polysulphide and polyurethane sealers shall not abut bituminous sealers. Surfaces to receive polysulphide and polyurethane sealers shall be kept free from bituminous paints.

All sealers shall be appropriate for the prevailing climatic conditions.

2.3.5.22 Concrete for benching

Concrete for benching in manholes and similar structures shall consist of Grade M15 concrete unless otherwise specified. It shall be placed with low workability to the approximate shape required, and, while still green, shall be finished with not less than an average of 20 mm of cement screed to a steel trowelled finish and to the contours indicated on the drawings.

2.3.5.23 Records

The Contractor shall maintain written records that provide the following information:

- the date on which each section was concreted
- the position of the section within the Works
- the time taken to place the concrete
- the daily weather conditions
- the nature of samples taken and the dates they were taken
- the curing history
- the date of removal of formwork
- the grade of concrete

A written record of the concrete works shall be made each day by the Contractor and kept available for inspection by the Engineer. The diary shall contain notes and records of:

(a) The names of the Contractor's engineers who are responsible for the different phases of the concrete work, and also the names of their assistants.

(b) The temperatures of air, water, cement, aggregates and concrete, together with the air humidity and type of weather.

(c) Deliveries to the Site of concrete materials (quantity, brand of cement, etc.).

(d) Inspections carried out, tests performed, etc. and their results.

(e) Times of commencement and completion of different parts of the concrete works, and times of erection and striking of forms.

(f) Quantity of cement, fine and coarse aggregate and admixture used for each section of work, and the number and kind of test samples taken on these ingredients and water.

2.3.6 Tolerances

2.3.6.1 General

Permissible deviations (PD) appropriate to the degree of accuracy will be applied to linear dimensions, position, plumb (verticality), level, squareness, and bow.

Where precast units are to fit on between cast-in-situ concrete units, the tolerances applicable to the cast-in-situ concrete shall be compatible with the tolerances applicable to the precast units.

The Degree of Accuracy may be one of the following:

- Degree of Accuracy III for use where a high degree of accuracy is unnecessary, e.g. mass foundations, Finish classes F1 and U1.

- Degree of Accuracy II for what is normally considered "good work" Finishes F2 and U2.
- Degree of Accuracy I where the use of special, as opposed to normal, methods or materials (or both) is warranted, e.g. prefabricated units or where such are to fit in. Finishes class F3 and U3.

Deviations will be measured as set out below:

a) Any deviation from a flat plane surface will be measured as the maximum deviation of the surface from any straight line of length 3 m joining two points on the surface, determined by means of a straight-edge the ends of which are supported on identical blocks of suitable thickness placed over each of the points.

b) Any abrupt change in a continuous surface, including a local depression or peak in a floor or wall and any abrupt change caused by a joint in formwork will be measured as specified in (a) above.

c) Out-of-squareness of a corner or an opening or an element such as a column will be measured by taking the longer of two adjacent sides as the base line, and determining any departure from the perpendicular of the side at either end of the base line.

2.3.6.2 Permissible Deviations

If no Degree of Accuracy is specified in the BOQ or Technical Drawing or Technical Specification, Degree of Accuracy II shall apply.

The Permissible Deviations are:

- for the Degree of Accuracy III:
  - (i) reinforcement

    Spacing between two adjacent bars ± 25 mm location of ends of bars± 40 mm
    Cover to reinforcement- 0, + 20 mm
  - (ii) foundations

    position in plan from grid or center line± 50 mm linear dimension in plan cast against excav.± 60 mm linear dimension in plan cast against formw.± 30 mm level of underside of concrete - 40,+ 20 mm surface level- 30, +15 mm
  - (iii) elements above foundation

    Position in plan from grid or centre line± 25 mm linear dimensions± 30 mm
    Cross-section dimension- 10, + 20 mm
    Level of any element or component- 20, + 10 mm plumb, per meter of height5 mm
    plumb, maximum of any point, at any height70 mm out-of-squareness, for short sides <0.5 m ± 10 mm out-of-squareness, for short sides < 2.0 m± 20 mm out-of-squareness, for short sides < 4.0 m± 25 mm flatness of or abrupt changes in exp. surface 10 mm flatness of surface to be plastered15 mm
    abrupt changes in surfaces to be plastered 10 mm cover to reinforcement0 mm
    location in plan or elev. of HD-bolts± 5 mm constituents in the concrete mix± 5 %
- for the Degree of Accuracy II:
  - (i) reinforcement

    spacing between two adjacent bars± 20 mm location of ends of bars± 30 mm
    cover to reinforcement- 0,+ 15 mm
  - (ii) foundations

    position in plan from grid or centre line± 35 mm linear dimension in plan cast against excav.± 40 mm

linear dimension in plan cast against formw.± 20 mm level of underside of concrete- 30,+ 15 mm
surface level- 20,+ 10 mm

(iii) elements above foundation

position in plan from grid or centre line± 15 mm linear dimensions± 20 mm
cross-section dimension- 5, + 10 mm
level of any element or component- 15, + 5 mm plumb, per metre of height4 mm
plumb, maximum of any point, at any height50 mm out-of-squareness, for short sides <0.5 m± 5 mm out-of-squareness, for short sides <2.0 m± 15 mm out-of-squareness, for short sides <4.0 m± 20 mm flatness of or abrupt changes in exp. surface 5 mm flatness of surface to be plastered10 mm
abrupt changes in surfaces to be plastered 5 mm cover to reinforcement0 mm
location in plan or elev. of HD-bolts± 3 mm constituents in the concrete mix± 5 %

- for the Degree of Accuracy I:

(i) reinforcement

spacing between two adjacent bars± 15 mm location of ends of bars± 20 mm
cover to reinforcement- 0,+ 10 mm

(ii) foundations

position in plan from grid or centre line± 20 mm linear dimension in plan cast against excav.± 20 mm linear dimension in plan cast against formw.± 10 mm level of underside of concrete- 20,+ 10 mm
surface level- 10, + 5 mm

(iii) elements above foundation

position in plan from grid or centre line± 5 mm linear dimensions± 10 mm
cross-section dimension± 5 mm
level of any element or component- 10,+ 0 mm plumb, per metre of height2 mm
plumb, maximum of any point, at any height30 mm out-of-squareness, for short sides <0.5 m ± 3 mm out-of-squareness, for short sides <2.0 m± 10 mm out-of-squareness, for short sides <4.0 m± 15 mm flatness of or abrupt changes in exp. surface 30 mm flatness of surface to be plastered5 mm
abrupt changes in surfaces to be plastered3 mm cover to reinforcement0 mm
location in plan or elev. of HD-bolts± 1.5 mm constituents in the concrete mix± 5 %

- for precast beams the deviation from the intended line measured on a part of or on the overall length of the beam shall not exceed 3 mm for the length of up to 3 m, and for each additional meter in length a deviation of 1 mm will be allowed up to a maximum of 10 mm. In addition, the rate of deviation from the intended line shall not exceed 1:300.

2.3.7 Tests and Acceptance

2.3.7.1 Facilities and frequencies of sampling

For the purposes of taking samples and carrying out tests, the Engineer shall have free access to the Works and the Contractor shall provide all equipment required for the sampling (e.g. cones, moulds) as specified and render any assistance necessary. If so required, the Contractor shall provide storage and protection for such samples on the Site.

While concrete of a particular grade is being placed under the same conditions, sets of samples (each sample being sufficient for 3 cubes) shall be taken.

The sets of samples shall be taken as close as is practicable to the start of placing and at appropriate intervals thereafter, or from one particular batch and then from subsequent batches chosen at appropriate intervals.

At least one set of samples shall be taken from each day's casting and from at least every 90 m3 of concrete of each grade placed.

Only one sample shall be drawn from any one batch of concrete, and, except where otherwise ordered, no sample shall be taken of any grade until at least 3 batches of such grade have been mixed and discharged.

2.3.7.2 Testing

All testing shall be carried out in accordance with the relevant applicable standards or as directed by the Engineer.

The Contractor shall ensure that Site testing is carried out by a competent technician or by a person deemed by the Engineer to be sufficiently experienced.

The Contractor shall ensure that laboratory testing is carried out by a recognized testing institution or an approved laboratory or a firm approved by the Engineer.

Where early-strength testing is desired by the Contractor (e.g. for determination of the seven day strength), plans for such testing and interpretation of results shall be as agreed between the Contractor and the Engineer. As a general guide the seven day strength may be considered to be the 28 day strength divided by 1.4.

2.3.7.3 Acceptance criteria for designed mix concrete

Of the three cubes made from each sample of fresh concrete in accordance to IS: 516 -1959 or BS 1881, one will be crushed at 7 days and the other two at 28 days. The average of the two 28-day strengths will be taken as the test result. Compliance with the specified strength requirements shall always be judged on the 28-days' test results.

Concrete shall be considered to have failed to comply with the Specification:

(a) if a test result is less than the minimum specified in to IS: 516 -1959 or BS 5328 for that class of concrete, in which case the concrete which it represents shall be broken out and disposed of away from the Site by the Contractor unless at his sole discretion the Engineer approves otherwise .

(b) if the average of four consecutive test results for that class of concrete shall have failed to exceed the minimum mean of 4 as specified in to IS: 516-1959 or BS 5328 in which case no further concrete of that class shall be placed in the Permanent Works until the Contractor shall have discovered the cause of such failure and rectified it to the satisfaction of the Engineer.

If a mix fails to achieve the requirements for fresh concrete the batch shall be rejected and no further concrete of that class shall be placed in the Permanent Works until the cause of failure has been rectified.

If test results for strength of concrete of any class are consistently and significantly in excess of the target mean strength the Engineer may on the application of the Contractor agree to a reduction in the cement content in the mix for that class, provided the cement content is not lowered below the minimum specified for that class, nor the maximum water/cement ratio exceeded.

If, after evaluation of the test results an examination of the concrete in the structure is indicated, one or more of the procedures in the sequence given below may be adopted at the discretion of the Engineer to determine the acceptability or otherwise of concrete in particular sections of the structure:

a) An assessment of the stress level in the structure concerned in relation to the test result obtained

b) non-destructive testing, subject to similar concrete of proved acceptable quality being available in comparable members in the same construction as a reference (impact hammers and ultrasonic testing are two examples of such test techniques that may be used, provided the apparatus has been previously calibrated)

c) the testing of drilled cores in accordance with relevant applicable standards under terms and conditions agreed upon between the Engineer and the Contractor.

Where load tests are, in the opinion of the Engineer, unsuitable or impractical, and if an examination described above does not show the concrete strength to be acceptable, or if a portion of the structure fails to pass the test, the Contractor

shall, on the instructions and directions of the Engineer, either replace or strengthen by approved means: each section of the structure that failed or contains concrete that failed, as relevant; and any section, irrespective of strength, the functional purpose of which is affected by the a failed section or failed concrete.

The Contractor shall bear the cost of any replacement or strengthening referred to above as well as any other remedial measures that may be ordered to restore the durability of the concrete to that achievable by concrete of the strength required in terms of the specification.

2.3.7.4 Individual Load Tests on Precast Units

If so directed by the Engineer, the unit to be tested shall be supported at its designed points of support and loaded for 5 min with a load equal to the sum of the characteristic dead load plus 1.25 times the characteristic imposed load, and the deflection shall then be recorded. The maximum deflection measured after application of the load shall be checked for compliance with the applicable requirements of the relevant applicable standards.

The recovery shall be measured 5 min after the removal of the applied load and the load shall then be re-imposed. The percentage recovery after the second loading shall be at least equal to that determined after the first loading and at least 90 % of the deflection recorded during the second loading. At no time during the test shall there be, in the opinion of the Engineer and in the light of a reasonable interpretation of the relevant data, any sign of weakness or faulty construction in the unit under test.

If destructive tests for beam units are ordered, the unit to be tested shall be supported at its design points of support, and loaded to its ultimate design load. The unit shall not fail within 15 min after the application of the test load. A deflection exceeding 1/40 of the span shall be regarded as failure of the unit.

For units not amenable to the tests described above, details of the testing arrangements shall be agreed between the Engineer and the Contractor before such units are cast.

2.3.8 Measurement and Payment if not otherwise specified in the BOQ.

2.3.8.1 Formwork

Formwork will be measured as the net area of the face of the concrete. No deduction will be made for fillets and splays of size up to 100 x 100 mm or for openings of diameter up to 0.7 m or of area up to 0.5 m2.

Formwork in continuous lengths of narrow width of up to 300 mm will be measured by length, the width, or range of width being stated in the schedule.

Separate items will be scheduled

- for each class of finish required
- for the different angles of inclination of formwork as given below:
  - (i) horizontal: $>85^0$ up to 95^0
  - (ii) sloping: $>10^0$ up to 85^0
  - (iii) battered up to 10^0
  - (iv) vertical: 0^0
- for each type of structural element, such as walls, beams, slab, etc.
- for formwork to curved surfaces

No payment will be made for formwork used in forming designated and construction joints.

2.3.8.2 Reinforcement

Steel for reinforcement will be measured net by mass of all bars, including supporting steel detailed on the bending schedules. No allowance will be made for cutting, waste, spacer devices, or binding wire.

Welded mesh will be measured by area to be reinforced by means of mesh, no allowance being made for cutting, waste, laps, or deductions for end cover.

Steel offcuts resulting from the cutting and bending of reinforcing steel in accordance with the bending schedule shall be deemed to be the property of the Contractor.

2.3.8.3 Concrete

The volume or area of concrete, in which unit the payment is intended, will be computed from the measurements net to the dimensions shown on the drawings or to the dimensions cast, whichever is the smaller. Structural elements that are undersized will be measured for payment only if they are accepted by the Engineer.

No allowance will be made for concrete required to make up overbreak in soft excavation, but payment will be made for additional concrete or formwork, ordered in writing by the Engineer to replace unsuitable material or overbreak in hard rock or in intermediate excavation.

Sub-foundation carpets and blinding layers will be measured to the plan size of the concrete structure resting on it and the thickness shown on the drawings, and measured for the mean thickness as cast, provided that the Engineer is satisfied that the excavation has not at any point been taken deeper than necessary.

Separate items will be scheduled, as applicable, for each type and each grade of concrete, for each unit or element in the structure (where these would materially influence the pricing), such as

- slabs that are horizontal, sloping, conical or of different thickness
- concrete deposited under water
- small quantities each less than 0.20 m3 of formed surfaces, and
- different surface finishes, other than just striking-off and levelling. No

separate payment will be made for curing, sampling of testing.

2.3.8.4 Miscellaneous Items

Only designated joints shall be measured. Unless otherwise provided in the Contract, joints will be measured per linear m for joints in slabs and horizontal and vertical joints in walls. The rate shall include waterstops, formwork to form the joint, forming a recess for the joint sealer and application of the joint sealer.

Waterproof membrane and rubber gasket shall be measured as the plan area of the roof slab covered with the membrane. The rate shall include upstands at the perimeter and solar protection of the perimeter.

Bitumen painting is measured as the surface area covered by the painting.

2.4 Brickworks

2.4.1 Scope

This specification covers the general construction requirements for brickwork in general Masonry, Pavement, Drain Section, Manholes, Chambers, Buildings, Reinstatement Brickwork, Walls, and other brick related structures.

2.4.1.1 Interpretations

2.4.1.2 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

a) 1 General
b) 2.1 Site Clearance
c) 2.2 Earthworks
d) 2.3 Concrete Works, as applicable

2.4.1.3 Application

This specification contains clauses that are generally applicable to brickwork construction and associated work.

2.4.2 Materials

2.4.2.1 Bricks

Unless otherwise specified, burnt-clay bricks shall confirm to the requirement of IS: 1077-1992. Specification for common Burnt Clay Building Bricks, and shall be first class quality (Class `A').

Bricks should be obtained from an approved manufacturer and should be approved by the Engineer. The Contractor shall submit to the Engineer samples of the bricks that he intends using in the construction of the different sections of the Works. The samples of the bricks that are approved will be retained by the Engineer.

Bricks shall be free from defects affecting strength and durability. The amount and extent of manufacture cracks or cracks and chips due to handling shall not be to such a degree as to give an unsightly appearance to exposed brick surfaces and all face brick to be used on the Work shall match with the samples approved by the Engineer.

All bricks shall be machine made, of good quality brick earth and thoroughly burnt, and shall be of deep cherry red or copper color. The bricks when dried shall emit a clear ringing sound when struck together and shall not break when thrown on the ground or against other bricks from a height of 1 m. The bricks shall not absorb water more than one sixth of their weight after one hour of soaking by immersion in water. The bricks shall be wholly clean and free from flaws, cracks, and under-burnt lumps of any kind. They shall be uniform in size and regular in shape and have square, straight, and sharp edges and even surfaces.

Bricks shall be carefully handled at all stages in delivery, stockpiling, transportation on Site and construction to prevent breakage or surface damage. Bricks shall be carefully unloaded by hand and shall not be dumped or thrown. They shall be stocked in regular layers even as they are unloaded. The supply of bricks shall be arranged so that at least one weeks requirement of bricks are available at the site at any time.

2.4.2.2 Hollow concrete blocks

The hollow concrete blocks for masonry works shall be machine made and thoroughly compacted in the moulds by external form vibrators or vibrating tables.

Unless otherwise specified in drawing and BOQ, the hollow concrete blocks shall be made of 1 part of cement, to 4 parts of well graded fine and coarse aggregates mechanically mixed into a very dense and dry consistency with very low water cement ratio.

The hollow concrete blocks shall comply with NS 119-2042 and shall have following physical properties.

a)	Compressive Strength	70 kg/cm2
b)	Drying Shrinkage	0.04%
c)	Moisture Movement	0.03%
d)	Water absorption	240 kg/m3
e)	Moisture content	40%

2.4.2.3 Cement for mortar

Cement for masonry mortar and grout shall be ordinary Portland cement in accordance with the requirements of Clause 2.3.3.2. All cement for mortar for exposed face work shall be of a uniform color as approved by the Engineer.

2.4.2.4 Sand for mortar

Sand (fine aggregate) for masonry mortar and grout shall be in accordance with the requirements of IS 460-1962. For exposed face work shall be of a uniform color as approved by the Engineer. The particle size grading of sand for use in mortars for masonry work shall be within the limits specified in Table 2.4.

Table 2.4: Requirement of Grading of Sands for Masonry Work

IS Sieve Designation (IS 460-1962)	Percentage of Weight Passing IS Sieve
4.75mm	100
2.36 mm	90-100
1.18 mm	70-100
600 Micron	40-100
300 micron	5-70
150 Micron	0-15

Sand shall be clean pit sand and shall be free from clay and other impurities and, if so directed, shall be properly screened and washed.

2.4.2.5 Water for mortar

The water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that maybe deleterious to concrete or steel. Portable water shall be generally considered satisfactory for mixing of mortars. The quality of water shall correspond to IS: 456 - 2000 (Clause 5.4).

2.4.2.6 Construction Equipment

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required.

The type and capacity of mixing machines shall be such that the rate of output of mortar is suitable for the rate of brickwork. Each machine shall be capable of producing a uniform distribution of the ingredients throughout the batch and shall comply with the specification to which the manufacturer claims it has been manufactured. Worn or bend blades and paddles shall be replaced. The inner surfaces of the mixer shall be clean and free from hardened mortars. The mixers used shall be specially suited to the production of low slump mortars.

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required at his own cost.

2.4.3 Construction and Workmanship

2.4.3.1 Mortar

Cement and sand shall be mixed in specified proportions given on the drawings or BOQ. Cement shall be proportioned only by weight, by taking its unit weight as 1440 kg per cubic meter and the sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added and the mortar mixed to produce workable consistency.

Necessary tests to determine compressive strength of the mortar, for consistency of the mortar and its water retentivity shall be carried out in accordance with IS: 2250 -1981. The frequency of testing shall be one cube for every 2 cubic meter of mortar prepared subject to a minimum of 3 cubes for a day's work.

2.4.3.2 Workability of mortar

The mortar shall be of a readily workable consistency with only enough water to obtain a plastic condition suitable for troweling.

2.4.3.3 Workability of grout

Grout shall be of pourable consistency with a slump of 120 mm when tested in accordance with the standard slump test for mortar and grout.

2.4.3.4 Cement mortar mixing and using period

All cementing material and aggregates shall be mixed for a minimum of 2 min in a mechanical batch mixer. Only so much water shall be added as is compatible with convenience in using the mortar. If mortar begins to stiffen from evaporation or absorption of a part of the mixing water, the mortar shall be re-tempered by adding water and remixed. All mortar and grout shall be used within 2.5 h of the initial mixing and no mortar or grout shall be used after it has begun to set.

2.4.3.5 Mixing of mortar

The mixing shall be done intimately in a mechanical mixer unless hand-mixing is specifically permitted by the Engineer. If hand-mixing is done, the operation shall be carried out on a clean watertight platform, and cement and sand shall be first

mixed dry in the required proportion to obtain a uniform color and then the mortar shall be mixed for at least two minutes after addition of water.

In case of cement mortar, that has stiffened because of evaporation of water, it shall re-tempered by adding water as frequently as needed to restore the requisite consistency, but this retempering shall be permitted only within thirty minutes from the time of addition of water at the time of initial mixing.

Necessary tests to determine compressive strength of the mortar, for consistency of the mortar and its water retentivity shall be carried out in accordance with IS: 2250. The frequency of testing shall be one cube for every 2 cubic meter of mortar prepared subject to a minimum of 3 cubes for a day's work.

2.4.3.6 Brick laying

All brickwork shall be placed only after the foundation surfaces have been prepared to the satisfaction of the Engineer.

Bricks shall be well soaked in water for a minimum of 3 h immediately before being laid or as required so that the rate of absorption when laid does not exceed acceptable limits approved by the Engineer. The method of wetting shall be such that each brick shall be nearly saturated but the surface appears dry when laid.

Bricks shall be laid in running bond with head joints in each course centered over the bricks in the course below and shall be plumb, level & true to line with full head and bed joints. The ends of brick shall be buttered with sufficient mortar to fill the head joints.

Joints in brickwork shall be uniform and generally 10 mm thick for horizontal and 6 mm wide for vertical joints. Joints shall be tooled to produce a dense V-shaped joint or as otherwise ordered by the Engineer or shown on the drawings. Defective joints shall be cut out and repointed with mortar as directed by the Engineer.

The color and texture of all exposed mortar joints shall be subject to the approval of the Engineer and shall be kept uniform throughout the particular contract by strict adherence to the approved mixes and samples.

Extreme care shall be taken to prevent any concrete, grout, or mortar from staining the face of masonry. If any grout or mortar does contact the face it shall be immediately removed and the surface cleaned with clean water. Masonry work shall be protected against staining, tops of walls shall be covered with waterproof coverings as required, and when work is interrupted.

All walls shall, to the extent possible and as practicable, be built up at the same time. In no case shall any walls be advanced more than 1.5 m above another. If it is necessary to stop off a horizontal run of masonry, the end shall be stepped or as otherwise approved by the Engineer.

Where mortar on joints has partially or totally set, the exposed surface shall be cleaned and thoroughly wetted so as to obtain the best possible bond with the new work. All loose masonry and mortar shall be removed prior to the commencement of the work.

Brickwork shall be taken up truly plumb and each set of four bricklayers shall be provided with a plumb bob and straight edge.

Bricks on the 'fair face' shall be the best available, care being taken that they are not chipped or stained as work proceeds. Bricks shall be laid so as to give a perfectly flat face as tested with a straight edge, and no chipping or rubbing back will be permitted to remedy bad laying.

In the event of fair faced brickwork not being finished with struck joints whilst the mortar is still damp, pointing may be carried out with the approval of the Engineer. In this case all joints shall be raked out to a depth of 20 mm, cleaned free from all loose material and any putlogs filled in. The area to be pointed shall then be thoroughly soaked before pointing takes place, the mortar used being to the satisfaction of the Engineer.

Care shall be taken to keep all brickwork free from mud splashing, mortar, bitumen droppings, etc., and it shall be well cleaned down before being handed over.

If, after the completion of brickwork construction, any of it is found to be out of alignment or level or otherwise not conforming with the permissible deviations specified or otherwise defective, it shall be removed and replaced or repaired by the Contractor, at his own expense, and to the satisfaction of the Engineer.

2.4.3.7 Half brick thick wall and Curtain Walls

Two bars of 6 mm diameter shall be used longitudinally at every 5th course of half brick thick wall brick work. The first reinforcement shall be placed on the top of the bottommost course. The bars shall be fully embedded in the mortar and the ends shall be properly bonded in the vertical joints of brick work or to the main wall as directed by the Engineer. Laps for the reinforcement shall be provided of minimum length of 45 times the diameter of bar.

Top and ends of full height partition walls (half brick or single brick) shall be securely fastened to beams, slabs, columns, and walls, as applicable, with pre-fixed metal fasteners or holdfasts spaced not greater than 75cm apart unless otherwise

indicated. Clearance between top and ends of partition wall and beams, slabs, columns, and walls shall be caulked as indicated or as directed by the Engineer to form a closed continuous joint.

2.4.3.8 Exposed Brick Work

- The exposed brick work shall be specially selected for uniformity of size, color, and shape. All faces of the bricks shall be truly plane and rectangular all corners exactly 900 and all bricks identical in size. There shall be no cracks or flaws in the bricks. The finished surface shall give a uniform and pleasant appearance. The exposed brick work shall have 8 mm deep recessed pointing at joints.
- The brick walls for exposed brick work shall be of composite bricks with selected bricks for exposed face and routing bricks for inner face. This shall be done in a proper way to ensure proper bond. Mortar, etc. shall be the same as specified for brick work.
- All exposed brick work, at the final completion or when it is so directed by the Engineer shall be rubbed with carborundum stone, washed down, cleaned, in extreme cases, a 5% solution of neurotic acid may be used for cleaning of exposed brick work, but it shall be proceeded and followed by a copious bath of fresh, clean water.
- Exposed faces of brick masonry shall be kept moist for 10 d after laying

2.4.3.9 Brick manholes / Chambers

Brick walls for manholes or chambers shall be constructed in an approved bond comprising header and stretcher courses with the fair face on the inside. No false headers shall be built in and only whole bricks shall be used except where closures are required to form bond.

Joints shall be flushed up solid at every course throughout the whole width of each course, which shall be laid on a solid bed of mortar of thickness not exceeding 10 mm, and, if plaster is required, the joints shall be raked out to form a key as the work proceeds for the extent of the area to be plastered.

The walls of a manhole, if so required in terms of the Drawings shall be plastered internally and steel-trowelled to a smooth and true surface free of sharp edges and corners. The thickness of plaster shall be not less than 12.5 mm and not more than 15 mm. All salient angles and arises shall be slightly rounded, and all internal angles shall be finished true, square, and smooth.

2.4.3.10 HONEY COMB BRICK WORK

The honeycomb brick work shall be done with specified class of brick, laid in specified mortar. All joints and edges shall be struck flush to give an even surface. The thickness of the brick honeycomb work shall be half-brick only, unless otherwise specified.

Openings shall be equal and alternate with half brick laid with a bearing of 2 cm on either side.

2.4.3.11 Brick Work in Arches

The detailed specifications for brick work mentioned in earlier sub clauses of 2.4.3 shall apply, in so far as these are applicable. Arch work shall include masonry for both gauged as well as plain arches. In gauged arches, cut or moulded bricks shall be used. In plain arches, uncut bricks shall be used.

Brick forming skew-backs shall be dressed or cut so as to give proper radial bearing to the end voussiors. Defects in dressing of bricks shall not be covered by extravagant use of mortar, nor shall the use of chips or bats etc. be permitted.

2.4.3.12 Brick Pavement

The brickwork in paving shall be laid in 1:4 cement mortar and be made with machine made bricks, and shall be laid to the specified slopes, levels, dimensions, pattern, and bonds as shown in the drawing or as directed by the Engineer.

The widths of mortar joints shall not exceed 12 mm and shall be fully packed with mortar. The brick pavement shall be laid over a layer of mortar of 12 mm thickness, and shall not be disturbed at least for 7 d after it has been laid and shall be kept wet for at least 10 days.

2.4.3.13 Brick Soling

All the excavated materials shall be cleaned out properly and the base shall be rammed properly before the soling work is proceeded. Foundation shall be checked so that it is in exact line and dimensions.

Unless specified elsewhere or otherwise directed, dry brick soling in foundations and under flooring shall be laid flat or edge over a compacted surface as required, and be made of machine made bricks as specified above. The dry brick soling shall be laid over a cushion of sand of 25 mm thickness unless otherwise shown on the drawings or directed by the Engineer. All joints shall be completely filled with fine sand.

2.4.4 Tolerances

The dimensions of brickwork walls and structures such as manholes shall conform to the tolerances laid down for concrete structures (as per Clause 2.3.7), as applicable, or as directed by the Engineer.

2.4.5 Measurement and Payment

All Brickwork (half or full brick) will be measured as the net volume, for the different types and thickness applicable. No deductions will be made for openings of area up to 0.1 m2.

Unless and otherwise mentioned in BOQ, Brick soling and Brick pavement works will be measured as the net area.

In case of honey combed wall, the length, width and height shall be measured correct to a cm. Volume of wall shall be calculated in cubic metres correct to two places of decimal. Honeycomb openings shall not be deducted.

2.5 Stone Masonry Works

2.5.1 Scope

This specification covers the general construction requirements for Stone masonry Work, Stone Pitching work, reinstate of Stone Work, Walls and other stone masonry related works.

2.5.1.1 Interpretations

2.5.1.2 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

a) 1 General
b) 2.1 Site Clearance
c) 2.2 Earthworks
d) 2.3 Concrete Works, as applicable

2.5.1.3 Application

This specification contains clauses that are generally applicable to stonework construction and associated work.

2.5.2 Materials

2.5.2.1 Stone

Building stones to be used in the masonry shall be granite, quartize, gneiss laterite or any other type of good stones that may be specified in the item. In the absence of mention of a special type in the item or the special provision, good granite, quartize or gneiss stones in that order available and known to be satisfactory in use, in view shall be used. The stone shall stand weathering well and when immersed in water for 24 hours shall not absorb water more than 5 percent of its dry weight, when tested according to IS:1124-1974. The stone of the required quality shall be obtained from the quarries approved by the Engineer. All stones shall generally be freshly quarried.

Rubble stones for hearting shall be of approved quality, sound, hard, dense and durable, free from segregation, seams, srams, cracks, weathered- portion and other structural defects or imperfections tending to affect their soundness and strength. Stones shall be freshly quarried with sharp edges and clean faces. They shall be free from rounded, worn or weathered surfaces or skin or coating which prevents the adherence of mortar. Size and shape of stones shall be as per requirements of each item.

Stones to be used as headers, pin headers, quoin, copings etc. shall comply with the requirements of facing and hearting stones as may be relevant and shall further comply with the requirements of size and shape stipulated under the relevant item.

Samples of the stone intended for use in the work shall be submitted for the Engineer's prior approval. Mortar: Mortar

shall comply with IS 2250-1965 Code of Practice for Preparation and Use of Masonry Mortars.

2.5.2.2 Cement for mortar

Cement for masonry mortar shall be ordinary Portland cement in accordance with the requirements of Clause 2.3.3.2. All cement for mortar for exposed face work shall be of a uniform colour as approved by the Engineer.

2.5.2.3 Sand for mortar

Sand shall be in accordance with the Clause 2.4.3.4.

2.5.2.4 Water for mortar

The water used for mixing and curing shall be according to Clause 2.4.3.5.

2.5.2.5 Construction Equipment

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required. The type and capacity of mixing machines shall be such that the rate of output of mortar is suitable for the rate of stone masonry work and should be as per the Clause 2.4.3.6.

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required at his own cost.

2.5.3 General Construction and Workmanship

The dressing of stone shall be as specified for individual type of masonry work and it shall also conform to the general requirements for dressing of stone covered in IS: 1129 - 1972. Other specific requirements are covered separately with respect to particular types of rubble stone work.

Stones shall be sufficiently wetted before laying to prevent absorption of water from mortar. The bed which is to receive the stones shall be cleaned, wetted, and covered with layer of fresh mortar. All stones shall be laid full in mortar both in bed and in vertical joints and settled carefully in place with a wooden mallet immediately on placement so that it is solidly bedded in mortar before the has set. Clean ships and spalls shall be pressed into the mortar joints and beds wherever necessary, to avoid thick beds or joints of mortar. Whenever foundation masonry is laid directly on rock, the face stones of the first course shall be dressed to fit into the rock snugly when pressed down in the mortar bed lying over the rock. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faces completely covered with mortar.

Courses of the masonry shall ordinarily be predetermined. They shall generally be of the same height. Where there is variation in the height of courses, larger courses shall be placed at lower levels, with height of courses decreasing gradually towards the top.

Vertical joints shall be staggered as far as possible.

All necessary chases for joggles, dowels and cramps shall be formed in the stones beforehand.

Sufficient transverse bond shall be provided by the use of bond stones extending from the front to the back of the masonry. In case of thick walls bond stones shall overlap each other in their arrangement.

Bell shaped bond stones or headers shall not be used.

At all angular junctions stones at each alternate course shall be well bonded into the respective course of the adjacent wall.

All connected masonry in structure shall be carried up at one uniform level throughout as far as possible, but when breaks, are unavoidable, the masonry shall be raked in sufficient long steps to facilitate jointing of new work with old. The stepping of ranking shall not be more than 45° with the horizontal. Wing walls, abutments are piers, etc., shall be carried up truly plumb or to the specified batter.

Face work and hearing shall be brought up evenly. The top of each course, however, shall not be leveled up by use of flat chips.

2.5.4 Random Rubble Masonry (Un-coursed and Coursed)

2.5.4.1 Dressing:

Stone shall be hammer dressed on the face, the sides, and beds to enable it to come in proximity with the neighboring stone. The bushing on the face shall not be more than 4 cm on exposed face.

2.5.4.2 Insertion of Chips

Chips and spalls of stone may be used wherever necessary to avoid thick mortar beds or joints and it shall also be ensured that no hollow spaces are left anywhere in the masonry. The chips shall not be used below hearting stones to bring these upto the level of face stones. Use of chips shall be restricted to filling of interstices between the adjacent stones in hearting and they shall not exceed 20 percent of the quantity of stone masonry.

2.5.4.3 Hearting Stones:

The hearting or interior filling of wall face shall consist of rubble stones not less than 15 cm in any direction, carefully laid, hammered down with a wooden mallet into position, and solidly bedded in mortar. The hearting should be laid nearly level with facing and backing.

2.5.4.4 Bond Stones

Through bond stones shall be provided in masonry upto 60 cm thickness and in case of masonry above 60 cm thickness, a set of two or more stones overlapping each other at least by 15 cm shall be provided in a line from face to back. In case of highly absorbent types of stones (porous limestone and sandstones, etc.) the bond stone shall extend only about two-third into the wall, as through stones in such cases may give rise to penetration of dampness and, therefore, for all thicknesses of such masonry a set of two or more bond stones overlapping each other by at least 15 cm shall be provided. One bond stone or a set of bond stones shall be provided for every 0.50 square metres of the masonry surface.

2.5.4.5 Quoin Stone

Quoin stone, i.e., the stone specially selected and neatly dressed for forming an internal angle in masonry work, shall not be less than 0.03 cubic meters in volume.

2.5.4.6 Plum Stone

The plum stones are selected long stones embedded vertically in the interior of masonry to form a bond between successive courses and shall be provided at about 90 cm intervals.

2.5.4.7 Wet Foundation

In wet foundation, or other situation where water is met with the work space shall be kept free of water by the Contractor while the masonry is in progress and until the Engineer consider the mortar has sufficiently set. Dewatering shall be carried out in such a way as not to injure the concrete or masonry in any way. Dewatering shall also be done when required for taking/checking measurements, approved foundations etc. Dewatering shall be included in the rate of masonry unless separate provision is made in the contract.

2.5.4.8 Laying

The masonry shall be laid to lines, levels, curves, and shapes shown in the drawing. Fixtures, plugs, frames etc. if any shall be built in at places shown on the drawing or directed by the Engineer while laying the masonry and not later by removing the stones already laid.

- Stones in the hearting shall be laid on their broadest face which gives better opportunity to fill the space between stones.
- Stratified stones must be laid on their natural beds. All bed joints shall be normal to the pressure upon them.
- In weathered walls, the beds of stone and the plane of course should be at right angles to the latter.
- The courses of masonry shall ordinarily be predetermined. They shall generally be of the same height. Where there is to be variation in height of courses, larger courses are to be placed at the lower levels, the height of courses decreasing gradually towards the top of the wall, unless to architectural requirements.
- The stones shall be wetted before laying in mortar. Each mason shall be supplied by the Contractor with a vessel full of water and a tumbler for wetting stones, care being taken not to spill any water on green masonry. The bed which is to receive the stone shall be cleaned, wetted and covered with layer of fresh mortar. All stones shall be laid full in mortar both in place with a wooden mallet immediately on placement and solidly bedded in mortar before it has set. Clean chips and spalls, carefully selected to fit in the spaces shall be wedged into the mortar joints and beds wherever necessary to avoid thick beds or joints of mortar. When the foundation masonry is laid directly on rock the face stones of the first course shall be dressed to fit into the rock snugly when pressed down in the mortar bedding over the rock. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faces completely covered with mortar. If a portion of masonry is dismantled, every stone must be found with mortar adhering fast to all its embedded surfaces and there shall be no hollows. This will be one of the tests in deciding if the masonry is good or bad if need arises. Where hollows or other defects are suspected a stone here there may be removed for confirmation. If these are confirmed such portion shall be dismantled and rebuilt at the cost of the Contractor.
- Face work and hearting shall be brought up evenly but the top of each course shall not be leveled up by use of flat chips.
- In case any stone already set in mortar is disturbed or the joint broken, the stone shall be taken out without disturbing the adjoining stones and joints, the mortar thoroughly cleaned from the joints and the stone reset in fresh mortar. Attempts must never be made to slide one stone over another already laid.
- Shaping and dressing shall be done before the stone is laid in the work. No dressing and hammering which will loosen the masonry shall be permitted after it is once placed.
- There shall be an adequate collection of stones and spalls within easy reach of the mason to enable proper selection of stones for individual location while laying. The stones shall be continuously replenished.
- Bond
- To give sufficient lateral bond, a stone in any course shall break joint with the stone in the course below or above about half the height of the course and generally not less than 7.5 cms.
- To give sufficient transverse bond, the prescribed number of headers shall extend from front to back of thin walls up to a width of 60 cms or prescribed number of lines of overlapping headers from face to back of walls over 60 cms thick. Over laps shall be 15 cms at each end. To ensure provision of full number of headers of the required size, they shall be kept at specified intervals in each course in advance of starting masonry and then embedded in mortar. Their position in each course shall be staggered, so that each will be near about the middle of the two in the courses below and above. Their faces shall be marked with a distinguishing sign to identify them.
- To bond work at all angle junctions of walls, the stones at each alternate course shall be so carried into each of the respective walls as to join the work thoroughly. Quoin shall be laid header and stretch wise when seen on each side of the wall.

- When new work has to be started on the old or one completed a long while ago or in the previous working season, the surface shall be roughened and cleaned satisfactorily without disturbing the masonry before laying the new. It shall be wetted before laying the bedding mortar.
- Where practicable the whole of the masonry in any structure shall be carried upto a uniform level throughout. But where breaks are unavoidable in carrying up the work continuously in horizontal courses, sufficiently long step shall be left to join the courses to be laid later. All junctions of walls shall be formed at the time the walls are being built; cross-walls should be carefully bonded into the main walls.
- The practice of building two thin faces tied with occasional through-stones and filling up middle with dry packing and putting mortar on top must be strictly guarded against putting dry chips in the joints of stones before filling them with mortar shall not be allowed.
- For ensuring good bond masonry shall be left uneven at the top of each course.
- The face stones shall be laid absolutely without any pinnings on the exposed faces. In each course the headers or lines of headers as the case may be, shall be kept in position at specified intervals and with specified laps where such laps are required before the masonry of the layer is commenced to ensure that they are being laid properly and in required numbers and intervals. They shall be embedded in mortar as masonry in that layer progresses.
- Joints: No face joints shall exceed 8 mm in thickness. Stones shall be arranged to break joint as much as possible and long vertical lines of jointing shall be avoided.
- Striking Joints: The face joints should be properly struck while the mortar is fresh. Joints which cannot be struck at the time of laying, shall be prepared for it by raking joints to a depth of not less than 6 mm when the mortar is fresh. These joints should be properly cleaned of loose particles, wetted thoroughly and filled with good fresh cement mortar 1:3 and finished off by being troweled smooth.
- Rate of raising masonry: The rate of raising random rubble masonry brought up in uniform levels may be limited to a height of 60 cm per day in cement mortar. No fresh course shall be laid over masonry previously laid within 4 hours of its laying for cement mortar.

2.5.4.9 Items to Include in the unit rate

- Masonry built in any position to any height or depth and to lines, levels, curves and batters, shown on drawing as ordered by the Engineer with headers, quoin etc. including striking joints and curing, cutting, grooves holes etc. for fixing frames, fixtures etc. are also included in the rate.
- Erecting and removing all scaffolding, ladders and use of plant required for execution of the item, safety of the labour and inspection of the work including compensation for any injury, damage etc.
- Watering to allow construction in the dry and proper setting of masonry unless separately provided in the contract.
- Clearing the site round the masonry and back filling so as to restore it to the original condition.
- All labour, use of tools, materials and other items incidental to satisfactory completion of the item.
- Curing of the work and protection of fresh work from dust, rain etc.

2.5.4.10 Joints

The face joints shall not be more than 20 mm thick, but shall be sufficiently thick to prevent stone-to-stone contact and shall be completely filled with mortar.

2.5.5 Dry Rubble Masonry for Retaining structures

This work shall conform to Clause 2.5.5 of Random Masonry (Un-coursed) except that:

a) the masonry shall be dry without mortar;

b) the spaces between large stones shall be filled with spalls at tightly as possible; and

c) the foundations shall be excavated at right angles to the face batter and not horizontally. The beds of the stones shall be laid at right angles to the face better.

2.5.6 Dry Stone Pitching/Dry Rubble masonry

Stone Pitching/Dry Rubble masonry shall be constructed generally to the requirements of un-coursed random rubble masonry as specified in elsewhere in this document but with the omission of mortar. All stones shall be carefully shaped to obtain as close as fit as possible at all beds and joints, any interstices between the stones being fitted with selected stone spalls. The exposed tops or cropping of dry rubble structures shall be formed as described in the Contract.

Activities involved will be supply of stones, dressed bond stone, cement, sand, water, tools, machine, preparation of mortar, placing and joining stones dry/with mortar, control, and removal of water, curing, collection, & testing of specimens etc. complete.

2.5.7 Stone Soling Work Blinding in Floor

The ground or earth shall be thoroughly consolidated with a 25 mm layer of coarse sand so that there is no loose pockets left anywhere in the whole area. Over such consolidated surface a layer of stone soling shall be made. Care should be taken that all stones are placed vertically. No smaller stones than 150 mm shall be provided for such work. The stone shall be thoroughly rammed as closely packed in position and interstices blinded with course sand, if necessary, so that a solid hard core of desired thickness is formed in position.

2.5.8 Measurement and Payment

Unless and otherwise mentioned in BOQ, measurement shall be made to cubic meters of any type of masonry made in accordance with authorial dimensions.

Stone soling works will be measured as the net volume. Stone

pitching works will be measured as the net area.

2.6 Cement Plaster Works

2.6.1 Scope

This specification covers the general construction requirements for finishing works in any structure on exterior and interior surfaces including bed and side slopes, specified surfaces of stone pitching, brick wall, stone walls, reinstate work, and other surfaces.

2.6.1.1 Interpretations

2.6.1.2 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

a) 1 General
b) 2.2 Earthworks, as applicable
c) 2.3 Concrete Works
d) 2.4 Brickwork
e) 2.5 Stonework

2.6.1.3 Application

This specification contains clauses that are generally applicable to finishing work and associated work.

2.6.2 Materials

2.6.2.1 Cement

Cement for finish work shall be ordinary Portland cement in accordance with the requirements of Clause 2.3.3.2. All cement for mortar for exposed face work shall be of a uniform color as approved by the Engineer.

2.6.2.2 Sand

The particle size grading of sand for plaster work for internal as well as external walls and ceiling as analyzed by the method described in IS: 2386 (Part I) -1963 shall be as specified in Table 2-7. Where the grading falls outside the limits of the grading zones of sieves other than 600 micron IS Sieve by a total amount not exceeding 5 percent, it shall be regarded as falling within the grading. This tolerance shall not be applied to percentage passing the 600 micron IS Sieve or to percentage passing any other sieve size on the finer limit. The various sizes of particles of which the sand is composed shall be uniformly distributed throughout the mass. The required grading may often be obtained by screening and or by blending together either natural sands or crushed stone screening which are by themselves unsuitable grading.

Table 2-7: GRADING OF SAND FOR FINISHING WORK

(Clause 4.1 of IS: 2386 -1963)

IS Sieve Designation (IS 460-1962)	Percentage of Weight Passing IS Sieve
10.0mm	100
4.75mm	95-100
2.36 mm	95-100
1.18 mm	90-100
600 Micron	80-100
300 micron	20-65
150 Micron	0-50

Notes:

1 For crushed stone sands, the permissible limit on 150 micron IS Sieve is increased to 20 percent. This does not affect the 5 percent allowance permitted in 4.1 applying to other Sieve sizes.

2.6.2.3 Water for mortar

The water used for mixing and curing shall be according to Clause 2.4.3.5.

2.6.2.4 Scaffolding and ladders

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required at his own cost.

2.6.2.5 Care of Tools and Accessories

All tools shall be cleaned by scraping and washing at the end each day's work, or after use with different materials. Metal tools shall be cleaned and greased after each operation. The tools shall be examined and thoroughly cleaned before

plastering is begun. Cleanliness is particularly important with cement plasters, where contamination with set material may seriously affect the performance as well as reduce the effective life of the tools.

2.6.2.6 Plastering

The surface to be plastered shall be brushed clean. Mortar joints of brick masonry or concrete walls to be plastered shall be raked to a depth of approximately 12mm, and the surface brushed down with a stiff brush and thoroughly wetted. The surface shall be free of all dust, loose materials, grease, etc.

Before starting plasterwork, the contractor shall prepare a sample panel of plastering of a size at least 1 m^2 for the approval of the Engineer. The sample shall be prepared in an area designated by the Engineer. The Contractor shall obtain approval before starting work and preserve the approved sample intact until all plastering is completed.

Plaster shall be applied in two coats. The thickness of the first coat shall be just sufficient to fill all unevenness of the surface. The first coat shall be applied with even, firm pressure to ensure good bond, shall be cross scratched and shall be moist cured. After the first coat has properly cured, and been allowed to dry thoroughly, the surface shall be dampened before applying the finish coat. The finish coat shall be steel trowel finished to a smooth, even, burnished surface, completely free from defects or trowel marks.

Unless specified elsewhere or otherwise directed, the thickness of plaster in total shall not be less than 12.5 mm. Wall plastering shall be started from top and work down to the floor. Ceiling plastering shall be completed before starting the wall plastering. To ensure uniform thickness and vertical plaster face, plumb guider strips may be applied as required.

If required to achieve the smooth, burnished finish, the surface shall be finished with lime putty of just sufficient thickness to fill in uneven surface or defects due to coarse sand in the plaster mix. Lime mortar finish shall be applied immediately after the finish has set sufficiently firm.

In order to obtain additional strength at external angled corners, the corners shall be dusted with cement during the steel trowel finishing of the finish coat.

Care shall be taken to ensure that finished plaster surfaces shall be plumb, square, straight, and true to line. All arises and corners shall be straight, clean, and sharp.

2.6.3 Preparation of Plaster

2.6.3.1 Proportioning

The material used in the preparation of plastering mixes may be measured by volume using gauge boxes.

Cement shall be measured by weight. For the purpose of proportioning one cubic meter of cement shall be taken to weight 1,440 kg approximately.

2.6.3.2 Quantity of Water

For general cement plaster work with 1:3 proportion the quantity of water required is about 70 percent by weight of cement. This may, however, vary depending on the following factors, and adjustment shall be done as explained in IS: 2250-1981.

- The nature and condition of the fine aggregate.
- The temperature and humidity at the time of working;
- Richness of the mix, namely, whether rich or leaner than 1:3;
- The varying quantities of lime in composite mortars; and
- The use of admixtures added for improving the workability.

2.6.3.3 Mixing

Cement and sand shall be mixed dry in the required proportions to obtain a uniform colour. Water shall then be added to get the required consistency for the plaster.

Cement lime plaster shall be used within two hours after the addition of water to cement provided it is kept agitated or turned over at intervals of at least 20 min. Cement plasters shall be used within half an hour after the addition of water. Any mortar or plaster which is partially set shall be rejected and removed forthwith from the site.

Mixing may be done either manually or mechanically. "Hand mixing" shall be carried out on a clean, water tight platform. During mixing, the mortar shall be heed back and forth for 10 to 15 min after the water is added. In "machine mixing" the mixer shall run at least 5 min after placing all the ingredients in the drum.

Machine mixing is preferable to hand mixing for all mortars.

2.6.4 General Precaution in Plastering

2.6.4.1 Cleanliness and Protection of Existing Work

Cleanliness is essential in carrying out plaster work. Adequate protection shall be given to all existing work and fittings which are liable to be damaged, not only in the course of plastering operation, but also in the approaches thereto by covering up with boards, dust sheets, etc, as necessary.

2.6.4.2 Cleaning off on Completion

On completion, all work affected by plastering operations shall be left clean. Special care is necessary when removing set plaster from glass to avoid damaging its surface.

2.6.4.3 Suction Adjustment

The careful adjustment of suction is very necessary for good plastering, and may be done either by wetting the backing suitably if it is dry, or by sprinkling with a cement-mix as in the case of a concrete surface with low suction. Without the aid of suction, plaster would creep and slide down due to its own weight. On the other hand, high rate of suction withdraws all moisture from the plaster and makes it weak porous and friable. Too much water makes it impossible to keep the mortar in position till it sets. A failure in bond due to excessive water leads to further failure as the pocket formed may hold water and break up the plaster when the water freezes; or if the water is salt laden, the same results will be produced on evaporation by crystal formation.

The wall shall not be soaked but only damped evenly before applying the plaster. If the surface becomes dry in spots, such areas shall be moistened again to restore uniform suction. A for-spray is recommended for this work.

2.6.4.4 Adjustment of Working to the Setting Properties of Plaster

Cement plasters contain materials which set when brought into contact with water, and the fullest use of their strength producing properties is not made unless the mix is applied before the setting process has started. If retampering of such mixes is carried out after the set has commenced an inevitable loss in strength and efficiency will result.

The commencement of the set is accompanied by a noticeable stiffening of the mix. It is essential, therefore, that mixes shall be used as soon as possible after water has been added and that working periods recommended in this code shall not be exceeded.

2.6.4.5 Control of Cracking

This is normally a structural problem, but the plaster will be able to reduce the effects of structural cracking by making a trowel cut between adjacent surfaces.

2.6.4.6 Maintenance of Proper Time Intervals

Shrinkage, partly irreversible, occurs on drying, causing stresses to be set up both in the applied coat and in the undercoat or background, and in order to avoid break down of adhesion between successive coats, it is very important that the drying shrinkage of the first coat should be materially complete before a subsequent coat is applied. The rate of drying will vary widely with conditions of temperature, humidity, and ventilation. Proper time interval serves to diminish the possibility of efflorescent salts finding their way to the final plaster surface, and also of the drying and naturing shrinkage (map crazing) of the undercoat reaching the finished plaster surface over a period of time. The surface then shall be allowed to set for at least a day or two depending upon the weather (one day in summer and two days in winter). During this period the surface of this coat shall be kept damp and shall not be allowed to dry.

2.6.5 Preliminary Programming of Work

All materials necessary for plastering shall be kept readily available at the site. An adequate supply of water suitable for mixing the plaster and for curing purposes shall be available.

In building operations, such as construction of brick and block walls, the encasement of steel walls, columns and beams with concrete, etc, requiring plastering shall be so programmed that they are sufficiently matured to receive the plaster without subsequent damage to plaster or decoration. Careful programming and avoidance of last minute alterations in the design or in the sequence of work can avoid serious damage to the plaster finish. Where such alterations are unavoidable the permanent decoration shall be postponed.

Plastering operations shall not be started until all necessary fixing, such as door and window frames, mantle pieces are completed and all pipes and conducts to be embedded in the wall or plaster are installed.

A preliminary inspection shall be made to ensure that the surfaces are in a suitable condition for plastering, particularly as regards their planeness and dryness. If dubbing out is necessary, it should be done in advance, so that an adequate time interval may be permitted before the application of the first undercoat. Plastering operations shall be so scheduled as to allow sufficient interval between undercoats and finishing coats.

2.6.6 Sequence of operations

The surfaces to be plastered shall first be prepared as indicated in the sub-section "General precaution of plastering".

When the preparation has been done, arrangements may be made for a constant supply of plastering material prepared as described in 2.6.4. The plaster coat is then applied to the plastering surfaces.

Sometimes, ends of scaffolding BALLIES have to be housed in the wall which is being treated with plaster. In such cases after the BALLIES are taken out, the hole or holes left in the wall shall be filled up with brick and mortar, and the patch plastered up true, even and smooth in conformity with the rest of the wall, so that no sign of any patch work shows out.

Where corners and edges have to be rounded off, such rounding off shall be completed along with the plaster finishing to prevent any joint marks showing out later.

2.6.7 Special Finishing Textures

Various types of special textures for rendered surfaces may be obtained by using special tools for the application of the final coat. The special finishes shall be applied in accordance with the details given in IS: 2402-1963.

2.6.8 Trueness of Plaster System

The finished plaster surface shall not show any deviation more than 4 mm when checked with a straight edge of 2 m length placed against the surface.

2.6.9 Curing

To develop maximum strength and density in the plaster, it is necessary to cure cement plasters properly. The plaster coat shall be kept damp continuously for a maximum period of 7 days. Moistening shall commence as soon as the plaster has hardened sufficiently and is not susceptible to injury. The water shall be applied by using a fine fog-spray. Soaking of wall shall be avoided and only as much water as can be readily absorbed shall be used. Excessive evaporation on the sunny or windward sides of buildings in hot dry weather may be prevented by hanging mattings or gunny bags on the outside of the plaster and keeping them wet.

After the completion of the finishing coat, the plaster shall be kept wet for at least seven days, and shall be protected during that period from extremes of temperature and weather.

2.6.10 Approval by the Engineer of plaster work

All plaster work shall be subject to approval of the Engineer, and work failing to meet the requirements of the specifications or not being to the satisfaction of the Engineer shall be removed and reapplied at the Contractor's expense.

2.6.11 Inspection and Diagnosis –Applicable Only if the Engineer Deems it Necessary

It is essential to determine the cause of any defects of plaster work before any attempt is made to remedy or repair them and unless the cause is properly dealt with, the majority of defects will continue to recur after repair. The interpretation of defects of plasterwork and the determination of their causes can only be done by approaching the subject in a systematic and logical manner.

Since it is the final plaster finish which claims the attention of the casual observer, it is a common error to blame only the plastering materials or workmanship for all defects. Actually, these, although perhaps the most important, are not the only factors that may influence the final result.

Every defect in a plastering is more or less connected with the whole history and treatment of the background. Consideration shall be given not only to the plastering material used and to the quality of workmanship, but also the climatic conditions prior to, during and after the plastering process, and to the correct choice of the plastering system.

Detailed consideration has already been made in Clause 2.6.4 and 2.6.5 or several factors in this connection such as:

a) the possible causes for lack of bond between successive coats of plaster and between the first undercoat and the background concerned,

b) the possible effect of inadequate time intervals in promoting severe efflorescence or `map crizing' on the finished surface, and

c) the effect of climatic conditions in causing or aggravating the above as well as other troubles.

Besides, the active influences of the various atmospheric conditions, the effect of the physical properties of the building surface prior to plastering shall also receive due consideration.

2.6.12 Plastering Defects & Remedies – Applicable Only If the Engineer Deems It Necessary

It is not possible to give simple rules for the correction of all plastering defects or failures. Many serious defects may be shown to have causes outside the materials or techniques used in the plastering operations and it is often useless to repair or even replace the plaster without first having discovered and corrected the primary fault.

Thus, penetration of moisture through an external wall may cause blistering, efflorescence, flaking or complete disintegration of the plaster. To patch or to re-plaster such an area without first taking steps to prevent further damp penetration would be useless. Again, plastered ceilings may develop cracks because the ceiling construction permits excessive deflection, and no plaster repair could be expected to be effective in preventing it. Recurrent surface dampness may be associated with the presence of deliquescent salts in the plasterwork, but it would not necessarily be effective to renew the plaster. The salts may also be in the background and would probably migrate into the new plaster and bring about a renewal of the trouble. This type of defect usually traced to the use of an unwashed estuarine or sea sand, is best corrected by battening out and erecting a new plaster base out of capillary contact with the affected area.

Defects caused by the use of unsuitable plastering material or by faulty technique may be corrected by means of an appropriate repair.

2.6.13 Measurement and Payment

All Plaster work will be measured as the net area, for the different types and thickness applicable. No deductions will be made for openings of area up to 0.2 m^2.

2.7 Other Finishes

2.7.1 Scope

This specification covers the general construction requirements for finishes (except cement plaster work), such as flooring, painting, roofing, water proofing, etc. required in surface finishes of general civil construction (eg building, chambers, walls, manhole, etc.).

2.7.1.1 Interpretations

2.7.1.2 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

a) 1 General
b) 2.3 Concrete Works
c) 2.4 Brickwork
d) 2.5 Stonework
e) 2.6 Cement Plaster Works

2.7.1.3 Application

This specification contains clauses that are generally applicable to finishes on walls, floors, ceiling of cast in situ and pre cast structure and associated work.

2.7.2 Materials

Cement Concrete Floor: All the materials to be used such as cement, sand, aggregates, water, and other materials shall be as have been described in the Clauses 2.3.3 and 2.4.3 or as directed by the Engineer. Unless specified elsewhere or otherwise directed, the thickness of cement concrete floor should be of 1:2:4 proportion (Cement: Sand: Aggregate) and shall not be less than 50mm thick.

Cement Floor (Cement Screed): All the materials to be used such as cement, sand, water and other materials shall be as have been described in the Clauses 2.3.3 and 2.4.3 or as directed by the Engineer. Unless specified elsewhere or otherwise directed, the thickness of cement screed floor should be of 1:6 proportion (Cement: Sand) and shall not be less than 12.5mm thick.

Cement Punning Finishing: All the materials to be used such as cement, sand, water and other materials shall be as have been described in the Clauses 2.3.3 and 2.4.3 or as directed by the Engineer. Color pigment shall be of superior quality conforming IS standards and as approved by the Engineer. Unless specified elsewhere or otherwise directed, the thickness of cement the finishing layer shall not less than 3mm and consist of cement-sand (Cement Punning) mixed at 1:1 (cement: fine sand). Cement punning should be also used as skirting purposes.

Pointing: All materials to be used such as cement, sand, water, and other materials shall be as have been described in the Clauses 2.3.3 and 2.4.3 or as directed by the Engineer. If not specified, it shall be carried out in cement mortar not leaner than 1:3.

Terrazzo Floor Finish: Terrazzo tiles shall be not less than 250 x 250 x 20 mm size unless otherwise shown or specified on the drawings or directed by the Engineer. Terrazzo tiles shall be free from cracks, chips, flaws, stones or lumps of any kind. Their granulity of embedded color chips should be regular and uniform in order to add aesthetic purpose. These tiles shall sound hard, homogeneous texture and water absorption shall be minimum during soaking. All terrazzo tiles shall have to be approved by the Engineer and any terrazzo tiles not up to the specification must be removed from the site immediately at Contractor's own cost. Representative samples of the tiles to be used shall be submitted to the Engineer and his approval taken before bulk purchase. The samples shall be kept with the Engineer for future reference and comparison. All tiles supplied shall conform to these approved samples in all respects.

Ceramic Tiles: Ceramic tiles shall be not less than 200 x 200 x 6 mm size unless otherwise shown or specified on the drawings or directed by the Engineer. They shall be either ceramic vitreous tiles, with colours as selected by the Engineer, or approved glazed tiles conforming to IS 777 or equivalent. Cement, sand, and water used for tiling work shall be in accordance with the requirements of Clause 2.4.Granular material (e.g. marble chips) for in-situ flooring, screeds, and skirting shall be as approved by the Engineer. The Contractor shall submit samples of tiles for selection and approval by the Engineer, and all tiles used shall conform to the approved samples with regard to size, quality, texture, and color.

Painting: The materials for painting and color washing of internal and external walls and similar surfaces shall conform to the requirements of the relevant applicable standards (e.g. IS 5410 or equivalent) and shall be approved by Engineer.

Waterproofing materials: Unless and otherwise mentioned in BOQ, waterproofing material, such as waterproofing bituminous felt, other bituminous materials, specified thickness of concrete band or layer and cement sand plaster with

waterproofing concrete admixture @ 2% by weight of cement or its equivalent shall be in accordance with the relevant applicable standards (e.g. IS 1322, IS 1580, IS 2645-1975 and IS 9103-1979 or equivalent).

Other items: Pigments and other necessary additives to produce colored plasters and mortars shall conform to the relevant applicable standards (e.g. IS 57 or equivalent) and shall be applied the rate of 1% by weight of cement or to produce a color and texture indicated on the drawings or as directed by the Engineer. The sample of such color plaster shall be subjected to approval of the Engineer before applying in the work.

Caulking compounds shall be of approved manufacture such as to provide a continuous waterproof barrier installed with exposed caulking smoothly recessed from the finished steel or brick surface.

The Contractor is responsible for providing, erecting, dismantling, and removing safe and adequate lifting equipment and scaffolding where required in order execute the finishes Work at his own cost.

2.7.3 Construction Equipment

Construction Equipment shall be suitable for applying the specified flooring and coating systems and for obtaining the specified results. If, however, consistent and satisfactory results are not achieved with the equipment used by the Contractor, the Engineer may order the Contractor to obtain and use such Construction Equipment as may be necessary to achieve the required results.

2.7.4 Construction and Workmanship

Special care should be taken for draining out the water while laying the floor finishes. The slopes and position of drains shall be as shown in the detailed drawings or as directed by the engineer.

2.7.4.1 Cement Concrete Floor

In the ground floor, the cement concrete floor shall be laid on a hard surface of either cement concrete or brick soiling. If the base is made of cement concrete, the flooring work shall commence within 48 hours of laying the base. If the base consists of brick soling, the surface shall be leveled with the used of brick ballast or concrete mixture before the concrete flooring is laid. The base shall be cleaned with brushes and wetted properly before the concrete flooring is laid.

In the first floor or upper floors where cement concrete floor is to be laid on R.C.C. slabs, the surface of the R.C.C. slab shall be made rough with brushes while the concrete of the slab is still green. The bases shall be provided with the slope required for the flooring as indicated in the drawings or as directed by the engineer.

2.7.4.2 Cement Floor (Cement Screed)

In the ground floor, the cement screed floor shall be laid on a hard surface of either cement concrete or brick soiling. If the base is made of cement concrete, the flooring work shall commence within 48 hours of laying the base. If the base consists of brick soling, the surface shall be levelled with the used of brick ballast or concrete mixture before the concrete flooring is laid. The base shall be cleaned with brushes and wetted properly before the cement screed flooring is laid.

In the first floor or upper floors where cement screed floor is to be laid on R.C.C. slabs, the surface of the R.C.C. slab shall be made rough with brushes while the concrete of the slab is still green.

The bases shall be provided with the slope required for the flooring as indicated in the drawings or as directed by the engineer.

2.7.4.3 Cement Floor Finishing (Cement Punning)

One layer of at least 12.5 mm thick cement sand plaster of the specified proportion shall be applied onto the surface of the cement concrete floors before cement punning. The cement plaster shall be laid according to the dimensions of the concrete floor panels and keeping the joints above the joints between the concrete floor panels. Such plaster shall be followed by a thin layer of at least 3.5 mm thick cement punning finishes of specified mix (1:1 cement sand mixture) and shall be finished with wooden or steel floats.

After laying the cement concrete floor, the surface shall be left undisturbed for about 2 hours after which it shall be covered with wet jute bags. Curing of the concrete by flooding water on the surface for at least 7 days shall commence only after 24 hours of laying the concrete.

The same brand of cement shall be used throughout and the same proportion is maintained strictly to have a uniform color. Junctions of the floor with wall plaster, dado and skirting shall be rounded of neatly.

Skirting work shall be of same mix and thickness of cement punning. Skirting work shall be done simultaneously with flooring work or as directed. Skirting work shall include racking, cleaning and wetting of the base as well as applying cement plaster and cement punning. The top edge of the skirting shall be champhered to prevent dust collection.

Curing and protection of cast in situ floor shall be in accordance with the requirements of Clauses 2.3.6.13 and 2.6.10.

2.7.4.4 Pointing

Pointing, if specified, shall be carried out in cement mortar not leaner than 1:3. The thickness of joints shall not exceed what is prescribed for each type of masonry. In the face works, the raked out joints up to a depth of at least 20 mm shall be filled with mortar of specified mix and of required consistency and then shall be well pressed and rubbed smooth.

2.7.4.5 Terrazzo Tiles

The tiles shall be socked in water for at least 2 hours before laying. Tiles which are to be fixed in the floor adjoining the wall shall be arranged so that the surface of the round edge tiles shall correspond to the skirting or dado. Neat cement grant of honey like consistency shall be spread over the bedding mortar just to cover so much area as can be tiled within half an hour. The edges of the tiles shall be smeared with neat white cement slurry and fixed in this grout one after the other, each tile being well pressed and gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. There shall be no hollows in the bed or joints. The joints shall be kept as close as possible and in straight lines. The joints between the tiles shall not exceed 4.50 mm wide. The joints shall be grouted with slurry of white cement.

Finishing of the skirting shall be in same material or different as specified in the specification and as directed by the engineer. All the top lines shall be in perfect line and level (if sloped regular). The vertical joints of the skirting in case the tiles are provided shall be in the regular pattern corresponding to the joints of floor. The parts of the walls where the tiles are to be provided shall be chiseled, rocked, brushed, and cleaned properly and cement mortar of the specified proportion is then provided. Other method of laying may also be used but only with the permission of the engineer.

Rubbing by carborendem stone at least three phase shall be carried out to give perfect finishes. The joints should be leveled and smooth as the terrazzo tiles.

Where full size tiles cannot be laid, they shall be cut (sawn) to the required size and the edges rubbed smooth to ensure a true and straight joint.

Joints in tile work shall be accurately aligned with horizontal joints level and vertical joints plumb. The joints shall be maintained uniformly wide by aligning spacer lugs on tile edges if tiles are so manufactured or by use of wetted strings.

The layout of tile work shall be so that no tile less than half size occurs. Where tiles must be cut at edges or penetrations, the cut edges shall be carefully fitted and neatly ground. No chipped, cracked, or broken tile shall be used and all defective work shall be replaced and repaired to the satisfaction of the Engineer and at the Contractor's expense.

After tiles have been set firm and joint strings removed, tiles shall be dampened and joints grouted full with a plastic mix of neat cement by trowel, brush, or finger application. Unless otherwise directed, grout shall be made with white cement. During grouting all excess grout shall be cleaned off the tile surface with damp cloth sponges.

Where the setting bed is applied directly to a concrete slab, the slab surface shall be thoroughly wetted, with no free water left standing, and sprinkled with dry cement. The setting bed shall be 1:4 cement mortar and shall be placed to the required level, grade and slope and tamped firmly.

All finishing tile work shall be adequately protected from damage during the progress of construction and any damage shall be repaired to the satisfaction of the Engineer at the Contractor's expense.

2.7.4.6 Ceramic Tiles

Wall and floor surface shall be brushed clean, wetted, and fitted with an approximately 12.5 mm thick level and plumb scratch coat of cement mortar 1:3 applied in accordance with Clause 2.6. The scratch coat shall be moist cured for at least 24 h before the application of a floating coat. Before applying this floating coat, the scratch coat shall be thoroughly wetted. The floating coat, a plastic mix of neat cement of approximately 3 mm thickness shall be applied even, and with screed to true plane. The floating coat shall be applied over areas no larger than can be covered with tiles while the mortar is still plastic (half set). Glazed tiles shall be soaked, completely immersed in clean water, at least 30 minimum and drained.

Tiles shall be installed by applying a skin coat of a plastic mix of neat cement to backs of tiles and firmly pressing them into the floating coat to true plane and position. White cement shall be used for the skin coat where white joints are required.

Tiles shall be installed by dusting a thin layer of dry cement over the setting bed worked lightly with trowel or brush until damp, and tiles shall than be set with straight uniform joints 1 mm or less in width, accurately aligned in both directions and tamped solidly to the bed.

During the process of setting tiles, continuous horizontal and vertical cuts every 40 to 60 cm shall be made through the floating coat while plastic, using the point of a trowel turned edge wise. Care shall be taken to prevent cutting into the scratch coat.

Where full size tiles cannot be laid, they shall be cut (sawn) to the required size and the edges rubbed smooth to ensure a true and straight joint.

Joints in tile work shall be accurately aligned with horizontal joints level and vertical joints plumb. The joints shall be maintained uniformly wide by aligning spacer lugs on tile edges if tiles are so manufactured or by use of wetted strings.

The layout of tile work shall be so that no tile less than half size occurs. Where tiles must be cut at edges or penetrations, the cut edges shall be carefully fitted and neatly ground. No chipped, cracked, or broken tile shall be used and all defective work shall be replaced and repaired to the satisfaction of the Engineer and at the Contractor's expense.

After tiles have been set firm and joint spacers removed, tiles shall be dampened and joints grouted full with a plastic mix of neat cement by trowel, brush or finger application. Unless otherwise directed, grout shall be made with white cement. During grouting all excess grout shall be cleaned off the tile surface with damp cloth sponges.

Where the setting bed is applied directly to a concrete slab, the slab surface shall be thoroughly wetted, with no free water left standing, and sprinkled with dry cement. The setting bed shall be 1:5 cement mortars and shall be placed to the required level, grade, and slope and tamped firmly. Cement mortar at a rate of 4.4 kg per square meter shall then be spread. The floor tiles shall then be placed in position and tapped with a wooden mallet until the tiles are properly bedded in line and level.

Where the setting bed is applied over a waterproofing membrane, metal reinforcing wire mesh shall be installed lapped at least one full mesh at edges and supported so as to be located approximately mid-height of setting bed. At edges where wall tiles are foreseen, the mesh shall be turned up at least 80 mm.

All finishing tile work shall be adequately protected from damage during the progress of construction and any damage shall be repaired to the satisfaction of the Engineer at the Contractor's expense.

2.7.4.7 Waterproof Cement Paint

The contents of each fresh container of the paint shall be loosened by rolling or shaking the container before opening for the first time. To one volume of water in a clean container, an equal volume of cement paint shall be added and stirred well to achieve a uniform consistency. No further dilution will be permitted.

The cement paint powder shall be kept secured from exposure to atmosphere by properly tying up the polythene liner in the container and keeping the lid firmly closed.

The cement paint shall be used within two hours of mixing and shall be kept stirring during use.

For application, the base surface shall be cleaned by use of a stiff brush to remove loose dust and dirt. The base surface shall be thoroughly wetted and water allowed to run off.

The first coat shall be well brushed in a manner to give a good bond of the paint with the surface. The second and subsequent coats shall be brushed or sprayed as approved. The cement paint shall be applied at the following rate:

- on brickwork 2 kg/m²
- on in situ concrete 3.5 kg/m²
- on concrete blocks 2 kg/m²
- on cement sand rendering 3.2 kg/m²

The curing of the waterproof cement paint shall be carried out by application of fine water spray at an interval of 6 to 8 h after the application of the paint for duration of at least 7d.

The finished surface shall be protected from any damages, staining, etc., by approved means.

2.7.4.8 Oil bound distemper

All plaster surfaces shall be thoroughly cleaned and shall receive 3 or more coats. The first coat shall be a prime coat. The second and third coats shall be of oil bound distemper of approved colour, shade, and quality, and shall be mixed in accordance with the manufacturer's recommendations.

After these operations, if the work is not to the satisfaction of the Engineer, one or more coats shall be applied without extra cost to the Employer until a smooth and even surface is achieved and approved by the Engineer.

2.7.4.9 Distempering

Distemper shall be dry distemper as approved by the Engineer. The distemper shall be mixed with clean water as recommended by the manufacturer and shall be stirred until the mixture attains an even consistency.

The surface shall be cleaned, cracks and holes repaired, all irregularities and inequalities sand papered smooth and wiped clean to present a fine smooth surface which shall be completely dry before distempering is started.

The mixture shall be applied evenly with a brush in long parallel strokes evenly so as not to leave any visible brush marks.

The surface of this first application shall be allowed to dry and harden. Then the second coat shall be applied on the first coat. If a uniform surface is not achieved, a third coat shall be applied.

2.7.4.10 Plastic Emulsion Paint

The surface shall be prepared as specified for oil paints. First, a priming coat of primer as specified by the manufacturer shall be applied.

The second and third coats of plastic emulsion paint of approved shade and manufacture shall be applied to achieve an even surface. If the finish is not to the satisfaction of the Engineer, more coats shall be applied at no cost to the Employer to achieve a smooth and even surface.

2.7.4.11 Ready-mixed Enamel Paint

Surfaces to be painted shall be dry, free from dust and dirt, and rubbed smooth by means of sand paper or pumice stone to the satisfaction of the Engineer.

The paint shall be ready-mixed synthetic enamel or oil paint of approved make and manufacture. The primary coat (primer) shall be applied evenly with a brush. After the primary coat is applied and perfectly dried, all holes, cracks etc. shall be filled with putty and the surfaces sand papered (finishing touch in primary coat). A first coat of paint of approved shade and manufacture shall then be evenly applied and allowed to dry (after giving finishing touch to primer). The second coat shall be carefully applied as and when required, to achieve a smooth and even surface.

2.7.4.12 French Polish

The work shall be first cleaned and sandpapered thoroughly. It then will be painted with a `filler', composed of methylated spirit, and sandpapered.

A thin coat of French Polish shall then be applied and sand papered. Subsequent coats of French Polish shall be applied till the proper finishing is achieved to the satisfaction of the Engineer.

2.7.4.13 Roofing

A water proofing coating on bare reinforced concrete roofs shall be bitumen based and shall be applied in two layers of primer and one layer of finishing coat in accordance with the manufacturer's instructions and recommendations.

Such coating shall be applied by brushing, spraying, or roller application and shall be placed on concrete which has been cured and has reached an age of not less than 3 months.

If not otherwise shown on the drawings or directed by the Engineer, the prime coats shall be applied at a rate of approximately 0.85 l/m² and the final coat at a rate of about 1.2 l/m².

Care shall be taken in connection with drains, gutters, etc. to achieve proper flashing and lapping with the bitumen coating.

2.7.5 Tolerances

The tolerances for flooring work shall be as described in Clause 2.3.7, as applicable, unless otherwise agreed between the Contractor and the Engineer prior to the commencement of the work.

2.7.6 Measurement and Payment

Finishing work will be measured as the net areas covered and no deductions made for openings of area up to 0.10 m² or else unit as mentioned in BOQ. Separate items will be scheduled for each type of finish, and for different location of application, if such location will substantially effect the pricing.

2.8 Steel and Metalwork

2.8.1 Scope

This specification covers metalwork for structural steelwork, buildings, and other structures, it includes sundry items such as metal doors, and windows, ladders, stairs, handrails, open grid flooring, fences, railings, grills, gates etc.

2.8.2 Structural Steel Work

Structural steel work shall conform to the requirements of BS 449; steel shall comply with BS 15, BS 548, BS 968 whichever is appropriate and steel tubes for structural purposes shall comply with BS 1775 and shall be obtained from a manufacturer to the prior approval of the Engineer

Steelwork shall be thoroughly de-scaled to BS 4232 second quality and shall be painted with two coats of two pack epoxy based red lead primer before leaving the manufacturer's works. Any damage to this coating shall be repainted before erection.

2.8.3 Bolts and Nuts

Bolts, ragbolts, nuts and washers shall conform to BS 15 as regards material and BS 916 as regards dimensions. Each bolt shall be provided with two washers and bolts shall be long enough to show a full thread through the nut after fixing. All bolts, ragbolts, nuts and washers shall be hot-dip galvanized in accordance with BS 729.

2.8.4 Steel Chequered Plate

Chequer plating shall be mild steel and shall have a non-slip pattern on its upper face.

Chequer plates shall be securely bolted with countersunk screw studs to frames set in the edges of and spanning the ducts or opening. Chequer plates for use in valve chambers or manholes shall be hinged to one side of the frames unless otherwise specified.

The sizes of chequer plates shall be such that no discernible deflection occurs under the weights of a man standing upon it. Where it is not practicable to provide individual frames to each plate, the plates shall be stiffened by welding steel angles on their underside to eliminate discernible deflection. The plate panel sizes shall be such that they can be lifted by two men easily and each panel shall be provided with suitable sized lifting holes.

The edges of all chequer plates shall be finished straight or to the outline of obstructions and shall be free of burn marks or irregularities. Chequer plating which has been cut with a torch shall afterwards be ground to present a straight edge.

Chequer plating shall be thoroughly wire brushed and painted with two coats of two pack epoxy based red lead primer before delivery. After installation on Site chequer plates sued in valve chambers shall be painted with a further two

coats of two pack coal tar epoxy paint. Chequer plates used elsewhere shall be painted on the lower (hidden) upper (exposed) surfaces with one undercoat, two coats of semi-gloss high finishing paint of approved quality and colour.

2.8.5 Handrailing

Handrailings shall be made from hot-dip galvanized mild steel hollow sections and flats. After cleaning with lithoform, it shall be painted with two coats of two pack epoxy red lead primer, an undercoat and a further 2 coats of an approved gloss paint after installation. Expansion units shall be provided where the handrailings are more than 15 metre long.

Where safety chains are required, they are to be galvanised mild steel 10mm nominal size, short links, smooth welded chains in accordance with BS 4942 Part 2. Each length of chain shall be fitted with a shackle at one end and a nap fastening at the other.

The rates for handrailing shall include for painting and formation and subsequent grouting up of pockets in the concrete for stanchions.

2.8.6 Ladder

Mild steel ladders shall be hot-dip galvanised in accordance with BS 729. After cleaning with lithoform it shall be painted with two coats of approved two pack coal tar epoxy paint which shall be obtained from an approved manufacturer. Unless detailed on the Drawings, the Contractor shall submit to the Engineer detailed drawings of the ladder for approval before placing any orders.

Steel ladders shall be 450mm wide, of welded construction and shall not have an unsupported length of more than 2 metre. Intermediate support between the ends of the ladder shall be by means of stays securely fixed to the nearest part of the structure.

The steel ladders shall be galvanised before leaving the manufacturers' premises and the Contract Rates for supplying and fixing steel ladders shall include for painting as specified, and for all nuts, bolts, stays and other things necessary for fixing the ladders securely in place.

2.8.7 Step Irons

Steel irons for use in chambers shall unless otherwise specified be bent from 25mm diameter mild steel bars to the shape and dimensions shown on the Drawings and shall be hot-dip galvanised after bending. Step irons shall be measured by number and the Contract Rates for step irons shall include for the supply and all necessary fixing work galvanising and painting with 2 coats of approved two pack coal tar epoxy paint.

2.8.8 Fencing

Fencing shall be as detailed on the Drawings. If it is not mentioned in the drawings the Fencing shall be:

Chain link for fencing shall be PVC coated and consist of hot dipped galvanised 3.7mm wire of 50mm square mesh reinforced with 3 nos. 4.1 mm hot dipped galvanised line wires. Barbed wires shall be galvanised two ply 2.64 mm with 4 point barbs spaced at 75 mm interval.

Fence posts shall be of 64mm x 64mm x 9.4mm hot dipped galvanised mild steel angles spaced at 3.0 metre intervals with straining posts at all corners and at intervals of 15 metre. Stays for straining posts shall be 51mm x 51mm x 6.3mm hot dipped galvanised mild steel angles raked at 45. All mild steel angles shall be galvanised and painted in accordance with BS 5493. All fence posts and struts shall be sunk into post holes 300mm x 300mm x 750mm deep, and filled in with Grade 20 concrete to be flushed with ground level.

Suitable gate as shown in the drawings shall be provided to match the fencing. This gate shall be complete with lock gears and a 75mm lock of approved brand. Four (4) keys shall be provided for the locks.

The Contract Rates for fencing and gate shall include for the supply of all materials, galvanising, excavation, erection of the fencing complete painting with 2 coats of approved paint, fence posts, stays corner posts, concrete support and dwarf walls. Payment will be made for the net length of fencing and number of gate erected.

2.8.9 Aluminium Structures and Sections

Aluminium structures shall be constructed in alloy NE8M to BS 1474. Cold working shall be avoided. All hollow boxed and pressed sections shall be extruded from fully heat treated aluminium alloy and etched and anodised in bronze colour to BS 1615. Recesses on internal faces of boxed sections shall be finished with a strip of 13mm x 6.5mm black vinyl glued on. Where aluminium members are in contact with other non-aluminium structures the contact faces shall be protected by insulating pads of neoprene bitumen alloy.

2.8.10 Galvanized Metals

All metals to be galvanized shall be of the full dimensions shown or specified and all punching, cutting, drilling, screw tapping, welding and the removal of burrs shall be completed before the galvanising process commences.

All galvanizing shall be done by the hot-dip process with spilter, not less than 98% of which shall be pure zinc. Bolts, nuts and washers shall be completely galvanized including the threads but galvanizing removed in the course of nut fixing may be replaced with an approved zinc rich paint.

The galvanizing shall be uniform, clean, smooth and as free from spangle as possible. It shall weigh not less than 6.00 grams per square meter of area covered and be not less than 0.1mm thick.

All galvanized metal parts shall be protected from damage due to electrolytic action, white rust and abrasion during delivery, storage and erection. Minor damage shall be touched up with an approved zinc chromate or other approved metallic compound but if, in the opinion of the Engineer the damage to the galvanizing is too severe or extensive the part shall be removed and be re-galvanized.

2.8.11 Dissimilar Metals

The Contractor shall not use fixtures and fittings for metalwork including pipe-work in which dissimilar metals likely to lead to galvanic action are placed in permanent contact with each other.

2.8.12 Manhole Covers, Surface Boxes, etc.

Ductile iron manhole and access covers, surface boxes, gulley grating and frames shall be obtained from an approved manufacturer and shall comply generally with BS 497. Items not covered by this standard shall be of a quality equal to the first grade available in the country.

Access covers and surface boxes exposed to the weather shall incorporate a waterproof seal.

Frames shall be firmly bedded in 1:3 cement/sand mortar and the tops of all covers and gratings shall be flush with the finished surface of the surrounding floor, ground for pavement. Four sets of each type of lifting key shall be supplied by the Contractor.

2.8.12.1 Metal Doors, Windows, Ventilators, Glazed Shutters etc.

Glazed units shall be made from galvanized steel folded sheets sections, anodised extruded aluminium sections, or approved equivalent free from rolling defects.

All steel doors, windows and glazing shall be conform to IS 4351 or equal approved with electro galvanized finish conforming IS 1570 unless otherwise directed. The doors, windows and ventilation frame section are made of folded plate as per manufacturer's specification to conform to the drawings.

2.8.12.2 Window grills, fences, railing and gates.

Mild steel grill, fences, railing and gates of approved pattern and manufacture, all complete, shall be as shown on the drawings or as directed and shall comply with the requirements of IS 800 or equal approved.

2.8.12.3 Collapsible gates and rolling shutters.

These shall be double or single collapsible gates depending upon the size of the opening. The collapsible gates shall consist of vertical channels 20 x 5 mm and top and bottom rails of T-iron 40 x 40 x 6 mm with 38 mm dia. steel pulleys or ball bearings in every 4th double channels, unless otherwise specified. Where a collapsible gate is provided with the opening and is fixed along the outer surface the T-iron at the top may be replaced by flat iron 40 x 10 mm. The collapsible gate shall be provided with necessary bolts and nuts, locking arrangement, stoppers, and handles.

Unless otherwise ordered, the rolling shutters shall conform to IS 6248 and be suitable for fixing in the position ordered i.e. outside, inside, on or below lintel or between jambs. Shutters up to 12 m² in area shall be manually operated or push up type while bigger sizes shall be of reduction gear type mechanically operated by chain or handles. Laths shall be of 18 gauge best quality mild steel 75 mm wide strips interlocking, rolling centres, machine rolled and straightened with an effective bridge depth of 16 mm. Side guides and bottom rails shall be built up mild steel rolled sections. The spring assembly shall be supported on strong mild steel or malleable cast iron brackets shaped to fit the lintel. The rolling springs shall be from tested unbreakable high tensile steel wire or strip of adequate strength to balance the shutter in all positions. The shutter shall be complete with door suspension shafts, locking arrangement, pulling hooks, handles and other accessories.

2.8.12.4 Welding Consumables

Welding electrodes shall comply with, and shall be stored and handled in accordance with, the requirements set out in the relevant applicable standards (e.g. BS 639, IS 814). Welding consumables shall be such that they produce weld metal that has a minimum yield stress and minimum tensile strength at least equal to those of the parent metals.

2.8.12.5 Coating Materials

All coating materials and constituents shall be delivered in the manufacturer's original sealed containers which bear the manufacturer's labels. Each label shall display all the information necessary to ensure correct storage and traceability, and instructions for the application of the contents of the containers. Any container showing traces of leakage shall, before use, be rejected together with its contents.

The Engineer may require that the contents of any container be subjected to sample testing. All coating materials held in storage prior to use shall be kept in an approved store which shall be dry and enclosed. Care shall be taken to avoid the accumulation of old stock.

All Site stores used for the storage of coating material shall be provided with adequate fire extinguishers placed in a prominent and accessible position outside the entrances. "No smoking" signs shall be placed inside and outside such stores. No naked flames shall be permitted inside such stores.

Stores for coating materials shall not, at any time, be used for the accommodation of personnel.

2.8.13 Measurement and Payment

Work involving metalwork will be measured as specified relevant section of the specification or in BOQ, which will include all materials, fabrication, corrosion protection, and installation.

2.9 Carpentry and Joinery Works

2.9.1 Scope

This specification covers the general construction requirements for timber work, carpentry and joinery, required in general building construction (e.g. office building, guardhouse and operator's quarter at reservoir sites, etc.).

2.9.1.1 Interpretations

2.9.1.2 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

a) 1 Item of General Application
b) 2.3 Cement Concrete
c) 2.4 Brickwork
d) 2.5 Stone Masonry Work, as applicable
e) 2.6 Cement plaster Works, as applicable

2.9.1.3 Application

This specification contains clauses that are generally applicable to timber works, carpentry and joinery for buildings and associated work.

2.9.2 Materials

Woodwork in doors & windows frames and shutters with good finish including fixing with necessary fixtures all complete as per drawing and instruction.

2.9.2.1 Timber

Timber for general purposes shall be approved hardwood of the best quality generally complying with IS: 1326, Grade1, or similar and planed on all sides. The timbers shall be impregnated with an odourless wood preservative. It shall be uniform in substance, straight in fiber, free from large, loose, dead and cluster knots, flaws, shakes, wasp, cup spring, twist, bends, saps and defects of any kind. It should be free from spongy, brittle, flaky or brushy condition, sapwood and bore holes.

All timber shall be seasoned and be free from decay, and harmful fungi and insect attacks and from any other damage or harmful nature which will affect the strength, durability, appearances or its usefulness for the purpose for which it is required.

The timber shall be of best quality timbers specified in the item. The samples of the timber to be used shall be submitted for the approval of the Engineer. The samples of the approved timber to be used shall be deposited in the office of Engineer for the purpose of comparison.

Treated lumber shall be accompanied by a certificate from a recognized lumber treating company, certifying the amount of treatment and the percentage of moisture after drying.

For the structural components which will be concealed after installation, e.g., in the case of built-in cupboards, wardrobes or wall linings, either the type of wood specified for the unconcealed structural components (spruce, fir, pine or a wood of at least equal quality) or an equally suitable material may be used at the Contractor's own choice, unless otherwise specified.

The timber shall be in a suitable condition so that the components made of it will neither crack, warp nor twist. The moisture content of timber assemblies when leaving the manufacturer's works shall be as follows (referred to the oven- dry weight):

- 8 to 12% for interior finish components
- 10 to 15% for structural parts in permanent connection with the outside air. Proof

of this moisture content shall be furnished to the Engineer.

For plywood and wood chip boards, all surfaces to be veneered or seal coated shall be adequately closed.

Wooden fiber boards, veneers, coating slabs and coating foils of plastics shall be suitable for their intended applications.

All coating materials shall form a good bond with the base. Their surface shall be readily brushable and insensitive to wiping contact.

All polish (polishing varnish) shall be fast to light and unsuitable condition so that it provides a surface which is elastic to the greatest possible extent and resistant to scratches, water, acid and heat.

2.9.2.2 Preservatives

All timber for carpentry and joinery placed in contact with masonry or concrete shall be given a coating of coaltar or cresote before being fixed in position. Wood preservatives shall be of an officially approved type. Where subsequent painting of the timber is required, the wood preservative shall be compatible with the paint. In interior applications, the wood preservative shall be odourless. The rates quoted for woodwork shall include for such treatments.

2.9.2.3 Cover Moulds

In areas where the door or window frame are fixed flush with wall or plaster surface, teakwoods cover moulds of size 40 x 12mm shall be provided all round without an extra charge. The cover mould shall be given the same finish as the main frame, and overlap the masonry / plaster by at least 25mm.

2.9.2.4 Rebates

All door and window frames shall have cut rebates as per the drawings. Planted rebates shall not be allowed. The unrebated edges of the frames shall be rounded or chamfered as may be shown on the drawings. When not indicated on the drawings, they shall be beaded uniformly.

2.9.2.5 Post Keys

The vertical post of doorframes in the ground floor shall be embedded 25mm. On upper floors they shall be embedded in the floor slab by chiping a receptacle 12mm deep. The frames shall be installed in position and held plumb and level with strong supports from both sides as masonry works proceed.

2.9.2.6 Hold Fast

These shall be of M.S. flat with one end split into two and turned for anchorage into cement concrete blocks 1:2:4, the holdfasts shall be fixed to an adequately sized recess in the door frames with 30mm screws. There shall be one such holdfast on each side of frames of up 76 cm height, 2 on each side of frames upto 152 cm height. The position of the holdfasts shall be as shown on the drawings with minor adjustment to suit brick coursed or as directed by the Engineer. All holdfasts with concrete blocks shall be laid as the masonry work proceeds and not fixed afterwards. This concrete block shall neither be measured separately nor any deduction is made in brick work for these blocks.

Door frames when abutting on RCC member shall be fixed to RCC members with rawl plugs 50mm long and wooden screws of required sizes. Screws heads shall be sunk into frame and plugged properly.

2.9.2.7 Panelled Shutter

The shutter shall be paneled single, double, triple or more. The design, panels and the number of panels to be used shall be as per drawing or as per the direction of the Engineer. The styles shall be continuous from top to bottom. The top, freize, muntins or mullions shall be jointed to the styles and their muntins shall be jointed to the rail with wooden or bamboo pins or as directed by the Engineer. The thickness of the frame for the shutter varies depending upon the size of the door, situation and thickness of the panel as shown in the drawings or as directed by the Engineer. Grooves shall be made on all the inside faces of the frames to receive panels. Before fixing the panels in the grooves of styles, rails etc. plaster of white zinc shall be treated on the panel for proper adhesion.

Mortice and tenon joints between the styles and the top frienze, the muntins and rails shall be to the full width of the member. The tenon shall not be less than 12mm thick and shall be glued into the mortices inaddition to being pinned with wood dowels of not less than mm diameter. If mortices are tapered, the tenons may be wedged into them.

Each panel shall be in a single width piece, the contractor shall endure that the solid panels shall have their grains running along the layer dimensions.

Grooves in stile for panel fixing shall be 12mm wide and at least 20mm deep, panel edges shall be coated with and approved glue prior to insertion into the groove. Care shall be taken to see that there is no gap between the panel face and the sides of the groove.

The clearances between the finished shutter and the door frames and between the shutters themselves (when couble leafed) shall not exceed 3 mm unless otherwise specified in the drawings.

2.9.2.8 Flush Door Shutter

Unless specified elsewhere or otherwise directed, door shutters shall be of veneered plywood of thickness not less than 4.5mm or plain galvanized sheet of 18 standard wire gauge. The thickness of the frame for the shutter varies depending upon the size of the door, situation and thickness of the panel as shown in the drawings or as directed by the Engineer. Sheets shall be flushed on both sides of wooden frame as per drawings. The beading shall be of solid timber of any of the species mentioned in Table 3 of IS: 2202 (Part I) -1966. The beading shall be to the full thickness of the door. The depth of beading all round shall be not less than 25 mm excluding the tongue and brew joint using BWR type adhesives conforming to IS:848-1956, and the beading shall be further secured by additional screws of adequate length. The tongue shall not be less than 12 mm deep and its width shall not be less than 1/3 of the finished thickness of the shutter.

The timber used for beading for flush doors with decorative face shall preferably be of the same species as the face veneers unless otherwise mentioned. Samples of such shutters shall be submitted for approval.

Each sheet on the flush door shall be in a single width piece. The clearances between the finished shutter and the door frames and between the shutters themselves (when double leafed) shall not exceed 3 mm unless otherwise specified in the drawings.

2.9.2.9 Fixtures & Fastening

Unless specified elsewhere or otherwise directed, every leaf of door and window shutter should provided and find fixed in position with following fixtures & fastening. All fittings shall be submitted to the Engineer in good time for approval.

Description of Fixtures	Door Leaf	Window Leaf
Brass or mortise lock of approved size and quality	1 No.	Nil
Hinges, 150mm long with screw	3 Nos. (150 mm long)	(2 Nos. 100 mm long)
Aluminum tower bolt with screw	2 Nos. (300 mm long)	2 Nos. (200 mm long)
Brass handle with screws	2 Nos (150 mm long)	1 Nos (100 mm long)
Rubber buffer stops with screws	2 Nos	Not Necessary
Aluminum locking pin (restricting window leaf movement during wind)	Not Necessary	1 No. (125 mm long)

All fixtures shall be fixed to the jointing in a secure and efficient manner. Any of the fixtures damaged during fixing shall be removed and new ones fixed in their place and the surface of the joinery made good where affected at the Contractor's expenses. When the type is not mentioned on the drawing it shall be as directed by the Engineer.

If detailed drawing specifies different types of fixture, the work shall be carried out according to the drawing. Screw shall be suitable length & cover diameter & shall be fixed with screws driven & not by hammers.

2.9.3 Construction Equipment

Equipment and tools for the execution of timber work, carpentry and joinery shall be sufficient in number and capacity, in good working order, and in accordance with the requirements of the applicable safety regulations.

2.9.4 Construction and Workmanship

If not otherwise shown on the drawings, or directed by the Engineer, DIN 18334 shall be binding for the execution of the Works as well as the other DIN Standards as follow:

a) DIN 1052 Timber Structures
b) DIN 68365 Timber for Carpenters' Work, Quality Specifications
c) DIN 4074 Timber for Wood Building Components
d) DIN 68800 Timber Protection in Building Construction
e) DIN 17440 Stainless Steel; Quality Specification
f) DIN 18202 Dimensional Tolerances in Building Construction,

Timber as specified shall be jointed and erected in accordance with DIN 1052 and the drawings, including the required wind bracing. Posts shall be fixed to the concrete slab by means of bearing plates, straps and angles according to the structural calculations. Only non-rusting steel according to DIN 17440, Material No. 1.4571 shall be used for fixing components.

The Contractor shall supply to the Engineer shop drawings in accordance with the architectural design and Contractor's static analysis, which are subject to approval before any execution starts.

All structural components shall not warp or crack under any circumstances including stresses due to temperature and humidity that will have to be expected.

All timber connections and metres shall be accurately fitted. The surface exposed to view shall be trimmed, eg by planing and grinding. There shall be no plane cutting marks.

Solid timbers shall be joined in such a way that in the event of variations of air humidity, the wood is free to swell and shrink without affecting the joint.

Framing timbers shall not be butted. Dovetailing may be used subject to the Engineer's consent.

All edge surfaces of plywood, plain galvanized sheets and composite shutter exposed to view shall be veneered or provided with banding (insets or strips). On sealed, veneered and coated surfaces joints and irregularities of the base shall not show even after final drying.

All grained veneers and Plain Galvanized sheets shutter shall be protected against tearing. All timbers ultimately in contact with outside air, or permanently in contact with particularly humid air, or connected to masonry or concrete, shall be treated on all sides with suitable wood preservative before being inserted. The manufacturer's instructions shall be observed.

2.9.5 Test and Acceptance

A selection of samples for visual inspection and dimensional checks on material and fittings may be made by the Engineer. Supplier's material and test certificates relating to the material to be used shall be supplied to the Engineer by the Contractor. The Engineer shall have access at all reasonable times to all places where the work is being carried out and shall be provided with all the necessary facilities for inspection during all stages of manufacture or construction.

2.9.6 Measurement and Payment

Generally, the items shall be measured in-situ. The method of measurement shall be based on the following:

Unless stated otherwise in the BOQ, payment for windows and doors shall be made by number for each type and size. If items scheduled call for measurement by area, architraves linings, sills etc. shall not be measured separately but shall be considered as being included in the area of the opening closed by the window, door, shuttering or any other specified closure.

Wall panels or linings will be paid for by area. The unit rate shall include all substructure, fasteners, doweling etc.

Built-in cupboards, cabinets and wardrobes will be paid for separately according to types and dimensions, by covered rear wall area.

Surface treatment will be paid separately at the area treated.

All costs for hardware and iron ironmongery shall be included in the unit rate of the relevant bill item.

2.10 Roads and Parking Areas

2.10.1 Scope

This specification covers the construction of new roads, parking areas and reinstatement of Roads, Bridges and Culverts.

2.10.1.1 Interpretations

2.10.1.2 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

a) General
b) Site Clearance
c) Earthworks

2.10.1.3 Application

This specification contains clauses that are generally applicable to construction of new roads, parking areas and reinstatement of Roads, Culverts, and Bridges.

2.10.2 Materials

2.10.2.1 Classification for excavation purposes

All excavations for new roads and parking areas will be classified as set out in Clause 2.2.3.1.

2.10.2.2 Classification for placing purposes

All materials for new roads and parking areas will be classified as set out in Sub-section below:

2.10.2.3 Fill for Embankments

Fill for embankments shall comply with the provisions of Clause 2.2.3.2.

2.10.2.4 Sub-base and Gravelling

The grading of material shall be a smooth curve within and approximately parallel to the envelope given in table 2. 10. The plasticity index shall not exceed 6.

The minimum 4 day soaked CBR of the material shall be 30% at the specified in situ density.

Table 2-8: Grading Envelope

Sieve Size (mm)	Percentage by weight passing	
	Type A	Type B
63	100	-
50	-	100
37.5	65 – 95	80 – 100
20	50 – 85	60 – 100
10	40 – 75	-
5	30 – 60	30 – 100
2.36	20 – 45	-
1.18	15 – 37	17 – 7
0.3	-	9 – 50
0.075	4 – 15	5 – 25

2.10.2.4.1 Water Bound Macadam

Coarse aggregates - Coarse aggregates shall be crushed or broken stone. The aggregates shall conform to the physical requirements set forth in Table 2.11.

Table 2-9: Physical requirements of Coarse Aggregates for Water Bound Macadam for Base Course

Los Angeles Abrasion Max	45
Flakiness Index Max.	35
Aggregate Impact Value Max	35

The crushed or broken stone shall be hard, durable, and free from excess flat, elongated, soft, and disintegrated graded particles, dirt, and other deleterious material.

The coarse aggregate shall conform to the gradings given in Table 2.12.

Table 2-10: Grading Requirements of Coarse Aggregates

Sieve Size (mm)	Per cent Passing by Weight		
	Grading 1	Grading 2	Grading 3
125	100	-	-
90	90 – 100	100	-
63	25 – 60	90 – 100	100
53	-	25 – 75	95 – 100
45	0 – 15	0 – 15	65 – 90
22.4	0 – 5	0 – 5	0 – 10
11.2	-	-	0 – 5

Screenings - Screenings to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate. However, predominantly non-plastic crushed rock fines or natural angular pit sand may also be used for this purpose provided the liquid limit and plasticity index of such material are below 20 and 6 respectively and the fraction passing 0.075 mm sieve does not exceed 10 percent.

Screenings shall conform to the grading set forth in Table 2.13. Type A screening shall be used with Grading 1 and 2 coarse aggregates. Type B screening shall be used with Grading 2 and 3 coarse aggregates.

Table 2-11: Grading for Screenings

Sieve Size (mm)	Per cent Passing by Weight	
	Type A	Type B
13.2	100	-
11.2	95 – 100	100
5.6	15 – 35	90 – 100
0.180	0 – 10	15 – 35

2.10.2.4.2 Prime Coat

The prime coat shall consist of a medium curing cut-back bitumen complying with IS 217-1961 from a source approved by the Engineer.

2.10.2.4.3 Asphaltic Concrete

(a) Coarse Aggregate

Coarse Aggregate is defined as all material retained on a No. 12 U.S. Sieve (No. 10 B. S. 1.68 mm). It shall consist of broken stones or crushed gravel. It shall be of reasonably uniform quality throughout, clean, free from dust, and flat or elongated pieces. Rock and gravel shall have a per cent of wear in the Los Angeles Abrasion Test (500 revolutions) not exceeding 50 for base or intermediate coarse material or 40 for surface coarse material. The aggregate shall fall within the grading limits set out in Table 2.14. Material passing the No. 10 U. S. Sieve and retained on a No. 200 U. S. Sieve shall in laboratory tests and for the purpose of proportioning the mixture be treated as Fine Aggregate. In a like manner, material passing the No. 200 Sieve shall be considered as mineral filler. Should the coarse aggregate material and the fine aggregate material contain so little material between the No. 4 and No. 10 sieve that upon combination of the two the resulting percentage of this fraction is less than the minimum specified Table 2.15 such deficiency shall be made up by the addition of stone screenings or coarse sand of the appropriate particle size.

Table 2-12: Asphaltic Concrete, Grading Limits of Coarse Aggregate

U.S. Sieve Size		Mix Number and Percent Passing by Weight				
Inches	mm. Approx.	I	II	III	IV	V
2 ½"	63.5	100				
2"	51	95-100	100			
1½"	48	-	95-100	100		
1"	25	25-70	-	90-100	100	
¾"	19	-	35-70	-	90-100	100
½"	13	10-30	-	25-60	-	90-100
3/8"	9.5	-	10-30	-	20-55	40-75
No. 4	6.5	0.15	0.15	0.15	0.15	0.15
No. 10	1.5	0-5	0-5	0-5	0-5	0-5

(b) Fine Aggregate

Fine aggregate is defined as all material passing the No. 10 and retained on the No. 200 sieve. It shall consist of sand or stone screenings, or a mixture of the two, composed of clean, tough rough surfaced grains, free from clay, loam and other foreign matter, together with particles which pass a No. 10 sieve which may be contained in the Coarse Aggregate material. As delivered to the mixer it shall be free of lumps or loosely bonded aggregations. The grading shall fall within the limits set out in Table below.

Table 2-13: Asphaltic Concrete, Grading Limits of Fine Aggregate.

U.S. Sieve Size		Percent by Weight
PASSING	**RETAINED**	
No. 4	-	98-100
No. 4	No. 10	0-15
No. 10	No. 40	15-50
No. 40	No. 80	30-60
No. 80	No. 200	15-40
No. 200	-	0-5

(c) Mineral Filler

Mineral filler is defined as all material passing the No. 200 sieve. It shall consist of thoroughly dry limestone dust, cement or other mineral dust approved by the Engineer. As delivered to the mixer it shall be free from lumps and loosely bonded aggregations. The grading shall fall within the limits set out in Table 2.16.

Table 2-14: Asphaltic Concrete, Grading Limits of Mineral Filler

U.S. Sieve Size	Percent Passing by Weight
No. 30	100
No. 100	Not less than 85
No. 200	Not less than 65

Material retained on the No. 200 sieve shall be considered as Fine Aggregate for the purposes of grading analysis and mix proportioning.

(d) Binder

The Binder shall be straight run bitumen of 80-100 penetration complying with IS 73-1961.

Samples of the bituminous materials that the Contractor proposes to use, together with a statement as to their source and character shall be submitted and approved before use of such material. The Contractor shall require the manufacturer or producer of the bituminous materials to furnish material subject to this and all other pertinent requirements of the Contract. Only satisfactory materials, so demonstrated by service tests, shall be acceptable.

The Contractor shall furnish vendor's certified test reports for each load of bituminous material shipped to the Project. The report shall be delivered to the Engineer before permission is granted for use of the material. The furnishing of the vendor's certified test report for the bituminous material shall not be interpreted as basis for final acceptance. All such test report shall be subject to verification by testing samples of materials received for use on the Project.

2.10.2.4.4 Chippings

Chippings/Cover aggregate for surface dressing specified in the relevant items of the Bill of Quantities shall be obtained from a source approved by the Engineer and shall be natural screened gravel or crushed hard rock/stone, clean and free from adhering dust, achieved by washing and drying, or any other detrimental substance that could impair the adhesion of bitumen. The size of the chippings shall be as specified in the relevant item in the Bill of Quantities.

The flakiness index and elongation index of the chippings, when tested in accordance with B.S. 812, shall not exceed 40. The aggregate crushing value (ACV), when tested in accordance with B.S. 812, shall not exceed 35. The Los Angeles abrasion value (LAV) of the chippings shall not exceed 40.

Cover aggregates/Chippings shall be stockpiled in their separate sizes on a clear hard well drained area. The stockpiles shall be covered with tarpaulins or other suitable cover during periods when rain is expected. Grading of the chippings shall be as specified in the Table 2.17.

Table 2-15: Grading Requirements of Chippings

Sieve Size	Percentage Passing for nominal chippings size			
mm	20 mm	14 mm	10 mm	6 mm
28	100	-	-	-
20	85 – 100	100	-	-
14	0 - 25	85 - 100	100	-
10	0 - 7	0 - 25	85 - 100	100
6.3	-	0 - 7	0 - 20	85 - 100
4.75	-	-	0 - 10	-
4.0	-	-	-	0 - 20
2.80	0 - 2	0 - 2	0 - 2	0 - 10
0.075	0 - 1.5	0 - 1.5	0 - 1.5	0 - 1.5

2.10.3 Construction Equipment

2.10.3.1 General

The relevant requirements of Clause 2.2.4 shall apply.

2.10.4 Mixing Equipment

The mixing equipment to be used for asphaltic concrete shall be approved by the Engineer. The Contractor shall provide such attendance, access to the equipment and testing facilities as the Engineer may require at any time for the verification of the weights or proportions, character of materials and determination of temperatures used in the preparation of the mixture. The binder shall be heated to a temperature of 150ºC (302ºF) at the equipment.

2.10.4.1 Binder Distributors

Distributors shall be of constant volume or preferably constant pressure type, self-propelled, equipped with pneumatic tyres and have a minimum binder capacity of 4000 litres and each machine shall require the approval in writing of the Engineer for use in constructing the Works.

Distributors shall be equipped with low range speedometer (fifth wheel) in good working condition, so located to be visible to the driver to enable him to maintain accurately the constant speed for spraying binder at the uniform specified rate. They shall be fitted with either a calibrated pressure gauge which accurately records the pressure of the bitumen at the spray bar for constant pressure distributors, or a binder pump delivery meter for constant volume distributors. Binder pumps shall be capable of maintaining constant pressure or constant volume during spray runs.

Distributors shall be fitted with burners in combination with a circulating pump capable of maintaining the bitumen without overheating within the specified temperature range and an accurately calibrated thermometer for indicating the spraying temperature of the bitumen.

The spray bar shall be capable of applying bitumen binder to a minimum width of 2.30 meters with provision for application of lesser widths by closing jets. The spray bar shall have the capability of being raised and lowered to specified heights above the road and of being adjusted so that it is parallel with the road surface. The distributors shall be so designed to allow the circulation of hot binder through the spray bar when not spraying.

Spray bars shall be fitted with either slotted spray jets or preferably whirling spray jets, whose essential features are the ability to spray binder uniformly at the specified rate of spray, such that the speed of the distributor can be matched by the following chipping spreader during its normal chip spreading operation. If whirling spray jets are fitted the spray bar shall be protected by a hood to reduce wind interference. Distributors shall be fitted with hand-lances with nozzle spray attachments for spraying small, inaccessible areas and to correct deficiencies in the spray rate.

Prior to surface dressing operations, distributors shall be checked for leakages from spray jets and any other sources and these shall be eliminated. Distributors shall then be calibrated by a method approved by the Engineer and under his supervision, to establish uniformity of lateral spray of bitumen to within ±10% permitted variation at any point on the surface from the mean spray rate. This calibration includes setting the spray bar height above the surface to be sprayed, in accordance with the manufacture's instructions, so as to ensure that the designed overlap of jets is achieved. All spray jets shall be functioning so that each jet requirement has been achieved. Calibration shall be undertaken in accordance with the manufacturer's instructions or in accordance with TRRL-ORN 3 - Section 6.3 Distributor Speed Control and Calibration - to establish the relationship between spray rate and road speed for constant pressure distributors and in addition, bitumen pump delivery rate and spray bar width for constant volume distributors. The distributors shall be

capable of achieving a mean spray rate measured by the TRRL-ORN 3 Method B, which shall not vary by more than 5% from the specified spray rate.

Chip-spreaders: Mechanical chip-spreaders shall be capable of spreading the chippings uniformly over variable widths, from 0.5 to 3.5 m, at the rates specified.

The number and output of chip-spreaders shall be sufficient to ensure that chippings are spread immediately after the bituminous binder has been applied. Chip-spreaders shall be checked and calibrated before starting any work or when required by the Engineer.

Rollers: The main rolling shall be carried out with self-propelled pneumatic tyred rollers, having a wheel-load of more than 2 tonnes. The tyres shall be smooth and their pressure shall be more than 0.4 N/mm2.

The number and output of rollers shall be sufficient to ensure that rolling does not lag behind spreading. To the extent possible, at least two pneumatic tyred rollers shall be used for each chip-spreader.

Miscellaneous Equipment: Sufficient trucks and loading machinery shall be employed to ensure an adequate, prompt and continuous supply of chippings. Rubber tyred mechanical rotary brooms towed by or mounted on rubber tyred vehicles shall be provided. Tractor toed air compressor with sufficient length of hose pipes and air jet nozzle shall be provided to ensure sufficient cleaning of surface to be sprayed with bituminous layers

2.10.5 Construction and Workmanship

2.10.5.1 General

With regard to safety, existing services, nuisance, dealing with traffic etc., the relevant requirements of Clause 2.2.5 shall apply. With regard to site clearance and stripping of site, the relevant requirements of Clauses 2.1 and 2.2 shall apply.

The subgrade and sub-base shall be kept continuously drained and any damage caused by water accumulating on or running off the surface shall be made good at the Contractor's expense.

Should water accumulate on any part of the subgrade or subbase, the Contractor shall remove and dispose of any material which becomes saturated, or cannot then be compacted to the required density, and shall replace it to specification, all at his own expense.

2.10.5.2 Compaction

Before commencing construction and from time to time as may be considered necessary by the Engineer, the Contractor shall carry out compaction trials in the presence of the Engineer on each main type of materials to be compacted in the Works. He shall carry out all necessary laboratory and field tests and supply the Engineer with full copies of the results of all tests.

Following completion of the compaction trials, the Contractor shall submit to the Engineer, for his approval, proposals for the compaction of each main type of material. The Contractor's proposals shall include reference to the type of equipment, the operating weights, and the method of adjusting moisture content.

If, in the opinion of the Engineer, the results of the compaction trials indicate that the Contractor's proposed equipment and methods will achieve the densities specified, the Engineer will approve the same. Otherwise the Contractor shall submit in writing proposals for modifying the equipment and/or methods and shall, if the Engineer so requires, compact further trials in accordance with these modified proposals until the Engineer approves the Contractor's proposals.

2.10.5.3 Cut and Borrow

Cut and borrow shall be carried out in accordance with Clause 2.2.5.2

All cuts carried below the designated level or the bottom of the subbase shall be backfilled with suitable material that has a CBR of at least 7% and compacted at the Contractor's own expense. The Contractor shall conserve all suitable material and shall not borrow, spoil, or waste any material without approval of the engineer.

2.10.5.4 Formation of Embankment

This work shall consist of the construction of embankment and other areas of fill and backfill not specified elsewhere by providing, placing, compacting and shaping suitable material of acceptable quality obtained from approved sources and to the lines, levels, grades, dimensions and cross-sections on the drawings or as required by the Engineer.

Prior to placing any embankment upon any area all clearing and grubbing activities shall be completed in accordance with Clause 2.1. Topsoil shall be removed and stockpiled for later use. Prior to the placing of any materials for formation of the embankment, the sub-grade after removal of top soil shall be leveled to a specified grade as per the drawing or the engineers instructions and the top 15 cm shall be watered if necessary and compacted to 93% of the modified AASHTO maximum dry density.

All earthwork material placed in or below embankments, below formation level in cuttings or elsewhere in the Works shall be deposited and compacted in layers of thickness appropriate to the compaction equipment and confirmed by the compaction tests. The embankment materials shall be compacted to a minimum 93% of modified AASHTO maximum dry density and to 95% in the top 30 cm below formation or sub-grade level.

Isolated boulders each within the range 0.05 cubic meter to 0.1 cubic meter in size may be incorporated in embankments not of rock fill at the discretion of Engineer provided that the specified compaction requirements are met and no stone exceeding 0.05 cubic meter shall be placed less than 1 meter below formation level of carriageway or hard shoulder.

Rock used in rock fill embankments shall except for any specified external cover to slopes or near formation level, be of such size that it can be deposited in horizontal layers each not exceeding 450 mm in loose depth and extending over the full width of the embankment. Material shall be spread and levelled by a crawler tractor weighing not less than 15 tonnes and compacted as specified above. Each layer shall consist of reasonably graded rock and all surface voids shall be filled with broken fragments before the next layer is placed. The top surface and side slopes of embankments so formed shall be thoroughly blinded with approved fine graded material to seal the surface. Such material on side slopes and verges shall be top soil.

All materials used in embankment and filling elsewhere shall be compacted as soon as practical after deposition Hand

compaction shall be allowed only on restricted areas.

2.10.5.5 Sub-base and Gravelling

The material shall be deposited in such quantity and spread in a uniform layer across the full width required, so that the final compacted thickness is nowhere less than shown on the Drawings or instructed by the Engineer. Every reasonable effort shall be made to prevent segregation after mixing and during the dumping, spreading, trimming, and compacting operation.

The compacted thickness of any layer laid, processed, and compacted at one time shall not exceed 150 mm and where a greater compacted thickness is required, the material shall be laid and processed in two or more layers. The minimum layer thickness shall be 80 mm.

The material shall be broken down to the grading specified in Table 2.10. Any oversize material which cannot be broken down to the required size shall be removed and disposed of.

The material shall be scarified and the moisture content adjusted by either uniformly mixing in water or drying out the material such that the moisture content during compaction is between 95% and 100% of the Optimum Moisture Content. It shall be graded and trimmed to final line and level. Light compaction may be applied before the final trim is carried out but once 25% of the compaction has been applied no further trimming or correction of surface irregularities will be allowed.

The final trim shall be in cut and the Contractor shall ensure that material from the trim is neither deposited in low areas nor spread across the section but graded clear of the Works. Following the final trim the material shall be compacted to a dry density of at least 95% of modified AASHTO maximum dry density. During the grading, trimming and compaction of the material the Contractor shall ensure that the surface and/or the material does not dry out by applying fog sprays of water or other approved means sufficient to maintain the surface and/or material within the specified limits of moisture content.

On completion of compaction, the surface shall be well closed, free from movement under compaction equipment, and free from compaction planes, ridges, cracks, loose or segregated material.

2.10.5.6 Water Bound Macadam Base

2.10.5.6.1 General

This Clause covers the construction of base course from clean, crushed aggregates mechanically interlocked by rolling and bonded together with screening material and water laid on a properly prepared sub-base and finished in accordance with the requirements of these specifications and in close conformity with the lines, grades, cross sections and thickness as per approved plans or as directed by the Engineer.

2.10.5.6.2 Preparation of Base

The surface of the sub-base base to receive the water bound macadam course shall be prepared to the specified lines and crossfall and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is achieved. Sub-base/base surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course.

2.10.5.6.3 Spreading Coarse Aggregates

The coarse aggregates shall be spread uniformly and evenly upon the prepared sub-base to proper profile by using templates placed across the road about 6 m apart, in such quantities that the thickness of each compacted layer is not

greater than 100 mm for Grading 1 coarse aggregate and 75 mm for Grading 2 and 3 coarse aggregates (Table 2.12). Aggregates placed at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any approved means so as to achieve the specified results.

The spreading shall be done from stockpiles along the side of the roadway or directly from vehicles. In no case shall the aggregates be dumped in heaps directly on the surface prepared to receive the aggregates nor shall hauling over uncompacted or partially compacted base be permitted. No segregation of large or fine particles shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material.

The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved plan.

The compacted thickness of any layer laid, processed and compacted at one time shall not exceed 150 mm and when a greater compacted thickness is required, the material shall be laid and processed in two or more layers. The minimum layer thickness shall be 80 mm.

2.10.5.6.4 Rolling

Immediately following the spreading of the coarse aggregate, rolling shall be started with vibrator rollers of 12 to 20 ton capacity of approved type.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the center. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centerline of the road, in successive passes uniformly lapping preceding tracks by at least one half widths.

Rolling shall be discontinued when the aggregates are partially compacted with sufficient void space in them to permit application of screenings. During rolling, slight sprinkling of water may be done, if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wave-like motion in the sub-grade or sub-base course.

The rolled surface shall be checked transversely and longitudinally, with templates and any irregularities corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to desired crossfall and grade. In no case shall the use of screenings be permitted to make up depressions.

Material which is crushed excessively during compaction or becomes segregated shall be removed and replaced with suitable aggregates.

The minimum dry density to be achieved as a percentage of the Maximum Dry Density (MDD) determined in accordance with IS 2720 Part 8 shall be 98% of MDD.

2.10.5.6.5 Application of Screenings

After the coarse aggregate has been rolled as above, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motions of hand shovels or by mechanical spreaders, or directly from tipper with suitable grit spreading arrangement. Tipper operating for spreading the screenings shall be so driven as not to disturb the coarse aggregate.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand-brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes of ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.

The spreading, rolling, and brooming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation.

The final trim shall be in cut and the Contractor shall ensure that material from the trim is neither deposited in low areas nor spread across the section but graded clear of the Works. During the grading, trimming and compaction of the material the Contractor shall ensure that the surface and/or the material does not dry out by applying fog sprays of water or other approved means sufficient to maintain the surface and/or material within the specified limits of moisture content.

2.10.5.6.6 Sprinkling of Water Grouting

After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operation shall be continued, with additional screenings applied as necessary until the coarse aggregate has been thoroughly keyed, well-bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be

taken to see that the base or sub-grade does not get damaged due to the addition of excessive quantities of water during construction.

2.10.5.6.7 Setting and Drying

After the final compaction of water bound macadam course, the pavement shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer shall have the discretion to stop hauling traffic from using the completed water bound macadam course if in his opinion it would cause excessive damage to the surface.

The compacted water bound macadam course should be allowed to completely dry and set before the next pavement course is laid over it.

2.10.5.7 Prime Coat

2.10.5.7.1 General

A Bituminous Prime Coat shall consist of an application of bituminous material on the prepared non-bituminous surface like base course, shoulder, before any further bituminous layers are applied in accordance with this specification, applied at the rate specified below or any modification instructed by the Engineer.

2.10.5.7.2 Weather

The prime coat shall be applied only when the existing surface is dry or sufficiently low in moisture to assure uniform distribution of the bituminous material, when the atmospheric temperature is above 15ºC, and when the weather is not foggy or rainy. The temperature requirements may be waived, but only when so directed by the Engineer.

2.10.5.7.3 Application

The amount of bituminous material for the prime coat shall be 1.0 kg/m2 (net bitumen) or as directed by the Engineer. Prior to the application of prime coat to any area of the Permanent Works, the Contractor shall carry out trials to determine the rates of spread of binder. In the course of such trials by the Contractor the Engineer may amend the rate of spread of binder.

Immediately before applying the prime coat, the full width of the surface to be primed shall be swept with a power broom or other method approved by the Engineer to remove all loose dirt and other objectionable materials.

The application of the bituminous material shall be made by means of a pressure distributor at the temperature, pressure and in the amount directed by the Engineer. The application temperature shall be generally in the range of 50-60º C for MC-30 and 65-80º C for MC-70.

Following the application, the primed surface unblinded shall be allowed to cure, as agreed with the Engineer, without being disturbed. If after 24 hours the asphalt prime is not absorbed, sand shall be applied to blot up excess asphalt until the primed surface will not be picked up by traffic or equipment. Blotting material, where required, shall be to the approval of the Engineer and shall consist of clean, dry sand free from cohesive material and containing no organic matter. Blotting material shall not be paid for as a separate item. This period shall be determined by the Engineer. The surface shall then be maintained by the Contractor until the surfacing has been placed. Prime coated surfaces damaged by traffic shall be repaired by the Contractor without additional payment, in a manner instructed by the Engineer. Suitable precautions shall be taken by the Contractor to protect the primed surface against damage during this interval, including supplying and spreading any sand necessary to blot up excess bituminous material.

The depth of penetration shall be about 3 – 10 mm and the quantity sprayed shall be such that the surface is dry within a few hours.

For minor activities or small areas of surfacing failures where the size of the activities does not justify using a bitumen distributor, manual application of binder using watering cans, hand pumps and lances shall be used with the approval of the Engineer.

2.10.5.8 Asphaltic Concrete

2.10.5.8.1 Characteristics of Asphaltic Concrete Mixtures

The mixture of mixes to be used shall meet the requirements set out in Table 2.18 for proportions of coarse aggregate, fine aggregate, mineral filler and binder. The mix property shall meet the requirements set in Table 2.19. The Contractor shall carry out such tests of mix composition as the Engineer shall require to determine the precise proportions of the various materials to be used in the mix. After completion of these tests the Engineer shall specify or approve a job mix coming within the limits in Table 2.18 for each type of mix selected, which in his judgment will be suitable. Unless specifically permitted by the Engineer in writing the maximum permissible variations from the job mix shall be as set out in the Table 2.20.

2.10.5.8.2 Approval of Materials

Prior to use the Contractor shall supply the Engineer with samples of all materials proposed to be used. He shall carry out such tests as the Engineer may require satisfying himself that the materials and proportions satisfy this Specification. No materials shall be used nor job mix adopted until approved in writing by the Engineer.

2.10.5.8.3 Mixing

The aggregate shall be dried and heated at plant equipment so that when delivered to the mixer it shall be at as low a temperature as is consistent with proper mixing, transport without binder segregation, and proper laying and in no case will exceed 163ºC (325ºF).

2.10.5.8.4 Transporting, Laying and Compacting

The mixture shall be transported, laid and compacted to the satisfaction of the Engineer. The temperature of the mixture at the time of rolling shall be not less than 90ºC.

Table 2-16: Asphaltic Concrete, Mix Proportions

Courses for which recommended		Base or Intermediate			Intermediate Surface			
Mix Number		I	II	III	IV	V		
Minimum Thickness		75 mm	63 mm	50 mm	38 mm	25 mm		
Maximum Thickness		90 mm	90 mm	76 mm	63 mm	51 mm		
Aggregate and Filler Combination								
	Passing U. S. Sieve	Retained U. S. Sieve	Percent by Weight					
Coarse Aggregate	2”	1”	15-45	-	-	-	-	
	1½”	¾”	-	14-48	-	-	-	
	1”	½”	3-45	-	17-52	-	-	
	¾”	3/8”	-	3-45	-	18-50	-	
	½”	No. 4	-	-	6-42	-	-	
	3/8”	No. 4	-	-	-	3-36	8-45	
	No. 4	No. 10	5-15	5-15	5-15	9-22	9-27	
Sub Total	-	No. 10		60-80	55-70	50-65	50-65	
Fine Aggregate	No. 10	No. 40	3-19	3-21	4-20	5-22	5-22	
	No. 40	No. 80	5-22	6-25	8-25	9-27	9-27	
	No. 80	No. 200	3-15	3-16	4-16	5-18	5-18	
Filler	No. 200	-	3-5	4-6	4-7	5-8	5-8	
Sub Total	No. 10	-	20-40	25-45	30-45	35-50	35-50	
Total Aggregate and Filler			100	100	100	100	100	
Total Mix								
Total Aggregate and Filler			93.5	93.0	93.0	92.0	92.0	
			95.5	95.0	95.0	94	94	
Binder			4.5-6.5	5.0-7.0	5.0-7.0	6.0-8.0	6.0-8.0	
Total Mix			100	100	100	100	100	

Table 2-17: Mix Property Requirements

Mix Property	Property Limits
Effective Bitumen Content Absorbed Bitumen Content Total Actual Bitumen Content	Min. 6.8% Min 0%; Max. 1.7% Min 7.3%
Air Void Content	Min 3%; Max 6%
Bitumen Film Thickness	Min 8 micron
Marshall Quotient (AASHTO T 245-78)	Min 1.0 kN/mm; Max 4.0kN/mm
Marshall Stability (AASHTO T 245-78)	Min 450 kg; Max 850 kg
Retained Marshall Stability after soaking 24 hours at 60°C	Min 75%

Table 2-18: Asphaltic Concrete, Permissible Variations from Job Mix

U. S. Sieve Size		Mix Number				
Passing	Retained	Percentage variation by weight plus or minus				
		I	II	III	IV	V
2”	1”	5	-	-	-	-
1½”	¾”	-	5	-	-	-
1”	½”	5	-	5	-	-
¾”	3/8”	-	5	-	5	-
½”	3/8”	-	-	-	-	5
½”	No. 4	5	-	5	-	-
3/8”	No. 4	-	3	-	5	5
No. 4	No. 10	3	3	3	3	3
No. 10	No. 200	2	2	2	2	2
No. 200	-	1	1	1	1	1
Binder	-	0.3	0.3	0.3	0.3	0.3

2.10.5.9 Surface Dressing Work

2.10.5.9.1 Rate of Application of Binder

The rate of spray of binder and the size and rate of spread of chippings shall be as specified in clause no. 2.10.5.9.4 below or as instructed by the Engineer.

Tray tests shall be carried out at least twice per run during surface dressing operations to check spray and spread rates calculated from spray truck chippings and chip-spreader coverage, and more frequently when a number of short lengths are being surface dressed. Spray truck dipping and chip-spreader coverage shall be checked for each length sprayed.

2.10.5.9.2 Safety and Maintenance

Bitumen heating, pumping and spraying operations shall be entrusted only to personnel who have been adequately trained and who are competent in the use of the equipment. Unauthorized personnel shall not be allowed to remain in the vicinity during the above operations. Authorized personnel shall be provided with, and be required to wear, suitable protective clothing, i.e. overalls, heat-proof gloves, boots, helmets and goggles.

Special care is needed when changing the type of binder being used in the distributor. When changing from hot binders to bitumen emulsions, all residual binder in the tank and spraying system shall be drained completely and the spraying system flushed using diesel. When changing from emulsions to hot binders, all emulsion shall be drained/flushed from the distributor in order to avoid foaming when hot binder is loaded. When it is necessary to load hot binder after using the distributor for spraying cutback bitumen, the cutback bitumen shall be drained completely and the manhole left open for some time to allow solvent vapour to escape.

The spray bar shall be emptied of binder by blowing with air, or by diesel flushing when spraying is suspended for lengthy periods and at the end of each day’s work.

The binder shall be introduced into the distributor at a temperature equal to or just above the spraying temperature after preheating in separate tanks fitted with burners and circulating pumps for this purpose. The capacity of the decanters/preheating tank shall be sufficient to preheat the binder required for the full day’s work.

The distributor burners shall be used only to make relatively small adjustments to the binder temperature and shall not be used to raise the binder from ambient to spraying temperature. Under no circumstances shall distributor burners be operated during the spraying operation, or when the level of binder in the tank is less than 150 mm over the top of the flues, or when the distributor is moving. The need for end of day maintenance of the distributor is emphasised to reduce fire risk and to ensure its adequate performance when next used for binder application.

Maintenance of all equipment for the surface dressing operation shall be under the control of a competent senior mechanic, approved by the Engineer and fully experienced in the maintenance of all equipment and in the calibration of the bitumen distributor.

The Contractor shall provide all necessary traffic control equipment and shall inform the engineer at least 14 days before commencing the surface dressing Work, of his detailed arrangements for traffic control. After review the Engineer will

inform the Contractor in writing of his approval, subject to any modifications to the Contractor's arrangements which he requires for traffic and convenience of the public.

2.10.5.9.3 Preparation of Surface

If the surface to be treated contains holes and depressions, which in the opinion of the Engineer require treatment such irregularities shall be repaired by removal of all loose and defective material and replacement with a patching mixture compatible with the surrounding surface or other material approved by the Engineer, which shall be compacted to produce a right surface conforming with the adjacent area. Irregularities which impair the riding qualities of the underlying surface shall be corrected as instructed by the Engineer.

Immediately before spraying, all loose material and foreign matter shall be removed by thorough brushing with mechanical brooms and/or washing or by use of compressors or by other methods acceptable to the Engineer. All hardened mud or other foreign matter shall be loosened by scraping before sweeping. The debris shall be deposited well clear of the surface to be sprayed. Road furniture (manholes covers etc.) shall be covered with adhesive paper or similar materials. Kerb stones, roadside, and any other objects what shall not benefit from binder spray shall be protected in a manner approved by the Engineer.

2.10.5.9.4 Application of Surface Dressing

a) Application of Binder

The specified bitumen binder, cut back if instructed by the Engineer, its application rate and spraying temperature shall be instructed by the Engineer on Site after design of the surface dressing, in accordance with the procedures set out in Chapter 5 of TRRL-ORN 3. The range of spraying temperature for binders is given in TRRL-ORN 3, and is normally within the range 140°C to 200°C.

The Contractor shall present his detailed programme and arrangements and methods for the planning and execution of the surface dressing process to the Engineer for approval at least 28 days before he intends to commence this Work. The Contractor's authorized representative shall be responsible for preparation of the programmes and arrangements and the Contractor shall not commence surface dressing until the Engineer has approved his programme.

The Contractor shall base his programme on TRRL-ORN 3 - Section 7. The Surface Dressing Process, Sub-Section 7.1 Planning and 7.2 The Surface Dressing Operation - by selecting the activities appropriate to his particular Work Programme. The Contractor shall appoint a surface dressing overseer approved by the Engineer who shall be fully competent to organize and implement the surface dressing operation with experience in operating all essential equipment.

All operations associated with the surface dressing process shall be described in the Contractor's arrangements and shall include but not be limited to:

- method of bitumen supply, decanting, cutting back where required, heating and storing, transfer to distributor including lists of equipment and capacities;
- location and method of production of cover aggregates and pre-coating with type and output of equipment, including crushers where appropriate; and.
- method of performing the surface dressing process including type and capacity/weight of all main and ancillary items of equipment along with workforce details.

The Contractor shall provide, one day in advance, his following day's surface dressing Work Programme, including his expected spray lengths and widths for each run with details of the quantity of cover aggregate available in approved chip spreaders standing by at the commencement of the spray run. Spraying shall not commence until sufficient cover aggregate is in this position to cover the area programmed for spraying.

The distributor shall be filled with preheated bitumen binder on the same day, shortly before start of binder application. The distributor spray bar and jets shall be preheated by circulating hot binder and the jets operated for at least 10 seconds for testing. This operation shall be carried out before each spray run, off-road onto trays, or at a location where no environmental damage will be created. Jets shall be inspected by the Engineer for shape, direction, blockage or any other defects which shall be corrected before spraying is permitted. At the end of each spray run the distributor shall be driven off-road to avoid binder drippage on the pavement surface. Binder drippage from any location which may contaminate the road surface shall be sufficient for the Engineer to order removal of the offending source from the roadway until repairs are completed.

As emergency/temporary measures, drip protection of the pavement surface shall be provided by use of buckets/trays etc. These shall be available for use at all times, along with equipment for removal of binder spillages on the pavement surface, to the approval of the Engineer.

The Contractor shall carry out a trial section of surface dressing at a location instructed by the Engineer to demonstrate to the Engineer that his surface dressing operation is capable of constructing the surface dressing in accordance with the

Specification. The trial length shall be minimum 200 meters using full spray bar width with full width application of cover aggregate. If the trial section of surface dressing complies with the Specification, the Contractor shall receive payment for the Work in accordance with the Contract as if it were Permanent Work. If the trial section of surface dressing fails to comply with the Specification, the Contractor shall carry out further trial sections his surface dressing operation complies with the Specification. No payment will be made for trial sections that do not comply with the Specification.

When the Engineer is satisfied that the Contractor is capable of constructing surface dressing that complies with the Specification after trial section or sections, the Contractor will receive permission to commence surface dressing as permanent Work on the road pavement.

Application of binder shall only be undertaken when the surface is dry or slightly damp, but in no circumstances when wet. If in the opinion of the Engineer rainfall is likely before the application of binder or cover aggregate or the temperature or the pavement surface has time to fall below the specified minimum temperature of 15°C, the Engineer will instruct the Contractor to delay surface dressing work until weather conditions are satisfactory. Areas damaged by rainfall shall be rectified by the Contractor without additional payment, in a manner instructed by the Engineer.

If in the opinion of the Engineer the ambient temperature is too cold for surface dressing, the Contractor shall delay this operation until the temperature increases to the specified minimum level of 15°C.

Building paper or other approved protective material shall be used at the start and finish of each spray run of sufficient width (not less than 600mm) to enable the distributor to reach its calibrated road speed with spray jets open before discharging binder onto the pavement under treatment. Ends of previous surface treatment runs shall be trimmed back to clean, straight transverse edges and these shall form the start point for subsequent runs, with completed work suitably protected as described above. Spray runs will be limited to 300 metres length initially until the Contractor demonstrates his ability to plan and execute longer lengths. Spray widths shall be calculated allowing for 150mm longitudinal overlap with adjoining passes and for the width that the following chipping spreader is able to cover. Longitudinal sprayed butt joints will not be permitted. The Contractor shall submit his spray width and length proposals to the Engineer for approval.

During spraying all passing traffic shall be stopped. If spray jets block, or the chipping spreader stops, or any other event occurs which may affect the surface treatment process, then the spray bar operator immediately shall stop spraying. When the defective equipment or operation is rectified, spraying may restart with the Engineer's approval.

To ensure that the spray runs are parallel with the road pavement the road centerline or edgeline shall be marked every 25 meters and a string line laid out for the distributor driver to follow with the guide bar attached to his side of the cab.

Where a second surface dressing is specified, the first surface dressing shall be left open to traffic for a minimum period of 21 days and preferably a longer period before applying the second surface dressing unless special approval is obtained from the Engineer for a shorter period. Surplus chippings shall be removed by firm hand-brooming or power- brooming before applying the second surface dressing.

The spraying widths shall be so selected that the centerline joint of the second surface dressing is offset from that in the first surface dressing by a minimum 300 mm.

Hand-pouring pots or hand-lances shall be used to touch up carefully any parts of the first surface missed by the distributor/chipping spreader, or for the treatment of areas in which the distributor cannot operate and in this case only, chippings may be applied by an approved manual method.

Areas damaged by excess bitumen or spillages of diesel or other deleterious material shall be repaired by careful cutting out and removal followed by careful hand-poured or hand-lance application of binder and chipping in a manner approved by the Engineer.

The second surface dressing shall be undertaken when the first surface has been approved by the Engineer after all surplus chippings are removed, repairs carried out and the surface thoroughly cleaned as specified. The procedures to be followed are those specified for Surface Dressing in this Specification.

b) Application of Cover Aggregate

The cover aggregate shall be applied at the rate instructed by the Engineer on Site in square metres of coverage per cubic metre of loose aggregate after design of the surface dressing, in accordance with procedures set out in Chapter 5 of TRRL-ORN 3.

The cover aggregate shall be applied immediately after the binder is applied and with the approval of the Engineer may be applied slightly damp if not pre-coated to depress dust and help adhesion. Aggregate applied to sprayed bitumen emulsion shall, however, be dry.

The cover aggregate shall be applied using approved mechanical spreaders, which shall be tailgate mounted on tipper trucks, pushed spreaders or self-propelled spreaders, specifically manufactured for the purpose and they shall preferably

be metered. They shall be capable of uniformly spreading cover aggregate at the instructed rate such that they can deliver the rate specified whilst travelling at the same speed as the binder distributors during spraying.

The bitumen binder surface shall be covered with cover aggregate closely packed in one layer so that adjacent chippings are touching and no bitumen binder is left uncovered.

A sufficient number of loaded spreaders shall be available at the start of binder application to provide cover aggregate over the whole area programmed for spraying. The Contractor shall not commence spraying unless sufficient loaded spreaders are in place. Aggregate spreading by manual methods will not be permitted except in circumstances where:

- mechanical spreaders cannot operate effectively or safely;
- additional aggregate (back-up work) is required;
- breakdown of mechanical spreaders occurs during the spreading operations before stoppage of spraying;
- minor surface repairs are instructed.

The spreader shall follow the distributor at an interval not exceeding 10m for hot binder work and not exceeding 5m when using bitumen emulsion binder. A back-up vehicle or other approved means shall be constantly in attendance during surface dressing, from which additional aggregate may be hand-applied to ensure complete and rapid coverage.

Where an adjoining pass of the distributor is required, no aggregate shall be applied to the binder over a 150 - 200 mm strip so as to permit subsequent overlap.

Under no circumstances will general brooming of the chipped surface be permitted. Aggregate spillage shall be removed with care and excess aggregates may be brushed off carefully after a minimum of 3 days under traffic, after approval of the Engineer.

The cover aggregate shall be rolled with pneumatic multi - tyred power rollers. Tyre pressures and sizes shall be in accordance with the manufacture's recommendations and shall be the same on each axle and tyres shall be smooth and in good condition to provide uniform rolling of chippings. The roller shall follow directly behind the spreader and shall continue to roll at a speed of approximately 8-10kph, so as to provide minimum 10 passes over the entire treated area. Excessive rolling, resulting the crushing of chippings, shall be avoided. Each pass shall overlap the previous pass by minimum half width of roller rolling shall be continued until all cover aggregate particles are firmly bedded. Tyres shall be in good condition and be kept clean and smooth to avoid pick-up of bitumen and chippings.

2.10.5.9.5 Aftercare and Control of Traffic

The road shall not be opened to traffic until the binder has attained sufficient viscosity to prevent the stones being whipped off.

The Contractor shall erect temporary traffic restriction signs, barriers and any other device, as instructed by the Engineer, to prevent vehicles traveling too fast over the newly laid surface dressing. Vehicle speed shall be restricted to a maximum of 30 km/h, until there is sufficient adhesion to ensure that the chippings shall not be dislodged by faster vehicles.

Where possible, the traffic shall be distributed across the road so as to obtain uniform polishing of the road surface.

After traffic has been permitted to run on the surface dressing for a period of at least two weeks and when instructed by the Engineer, all loose chippings shall be swept and taken away. Windrows of loose chipping shall not be allowed to accumulate at the sides of the road.

2.10.6 Tolerances

2.10.6.1 Embankments

The surface of the fill and selected layer shall be finished true to line and level to within the tolerances +10 mm and –30 mm.

The slopes of cuttings shall be trimmed to neat lines and to a standard that is generally attainable with proper care and workmanship in the type of material concerned. Fill slopes shall be finished to neat lines and all loose rocks and uncompacted material shall be removed. The finish shall be as smooth as is consistent with the nature of the material and good workmanship.

The degree of finish required for all earthfill slopes and for earthcut slopes of gradient less than 1:4 shall be that normally obtainable by motor grader or hand-shovel operations.

2.10.6.2 Sub base and Gravelling

The layer shall be set out and constructed to tolerances of +10 mm and –30 mm in surface level, ±25mm in thickness and ±200mm in width.

2.10.6.3 Waterbound Macadam

Water bound macadam base shall be constructed to construction tolerances of ± 10 mm in surface level, ±25mm in thickness and ±200mm in width..

2.10.6.4 Prime Coat

The actual spray rate shall not deviate from the specified spray rate by more than 5 percent.

2.10.6.5 Asphaltic Concrete

On completion the surface level shall not deviate vertically from the true pavement surface by more than 8 mm.

2.10.7 Tests and Acceptance

Any materials or workmanship that do not comply with the specified requirements shall be removed and replaced with materials and workmanship complying with the specified requirements, or be repaired so that after being repaired it will comply with the specified requirements.

2.10.7.1 Embankments

Tests shall comply with Clause 2.2.6.

2.10.7.2 Sub Base and Gravelling

The minimum testing frequency that will be required for the purpose of process control shall be the following:

Tests	Testing Frequency	
	One Test Every	Min. No of Tests per km Or Specific Area
Materials:		
Gradation	200 m3	2
Plasticity Index	200 m3	2
Maximum Dry Density and Optimum Moisture Content	1000 m3 or every change in source	2
Field Density and Moisture Content	500 m3	2
CBR	1000 m3 or every change in source	2

Additional routine inspection and testing will be carried out to test the quality of materials and workmanship for compliance with the requirements of this section.

2.10.7.3 Waterbound Macadam

The minimum testing frequency that will be required for the purpose of process control shall be the following:

Tests	Testing Frequency	
	One test every	Min. No of Tests per km Or Specific Area
Materials:		
Plasticity Index	1000 m3	2
Gradation	200 m3	2
Flakiness Index	200 m3	2
Los Angeles Abrasion	1000 m3	-
Aggregate Impact Value	1000 m3	-

In addition routine inspection and testing will be carried out to test the quality of materials and workmanship for compliance with the requirements of this section.

2.10.7.4 Prime Coat

The actual spray rate shall be tested before the start of application of the prime coat and when required by the Engineer.

2.10.7.5 Asphaltic Concrete

The tests that will be required for purpose of process control shall be following:

a) Sieve analyses (wash method) for at least two samples of aggregate from each hot bin.
b) Sieve analyses (wash method) for at least two samples of the combined hot aggregate.
c) Temperature of mix when sampled at the mixing equipment and on the road (once per hour).

d) Density of Laboratory-compacted mix (Marshall Density) for at least two samples.

e) Compacted density and percentage compaction of the mix relative to the laboratory Marshall Density for at least two samples.

f) Marshall Stability and Flow and calculated Marshall Quotient, as defined in Table 2.18, for at least two samples.

g) Asphalt content and aggregate grading of mix as determined by bitumen extraction testing for at least two samples. When the centrifuge extraction method is used an ash correction shall be applied as required by AASHTO T 164 CI 8.6.

h) Air voids in mix, as calculated on the basis of the Maximum Specific Gravity of Bituminous Paving Mixtures (AASHTO T 209-74).

i) The bitumen absorbed by the aggregates, as calculated on the basis of the Maximum Specific Gravity of Bituminous Paving Mixtures (AASHTO T 209-74).

From time to time, as directed by the Engineer, the Contractor shall also submit test results for the penetration and softening point (Ring and Ball) of samples of the bitumen extracted from the finished mix.

2.10.8 Measurement and Payment

2.10.8.1 Excavation and Fill

Excavation and fill shall be measured in accordance with Clause 2.2.8.

2.10.8.2 Subbase and Gravelling

Unless otherwise mention in the BOQ gravel for subbase shall be measured by cubic meter placed and compacted upon the road calculated as the product of the compacted sectional area specified to be laid and the length instructed.

The rates for gravel for subbase shall include for the cost of opening up the borrow area, excavation and selection of material, removing and spoiling of oversize material, screening or breaking, stockpiling, transportation, spreading, compacting, rolling, making good defective areas and maintenance of the surface and all incidentals in accordance with the requirements of these specifications.

2.10.8.3 Water Bound Macadam for Base

Unless otherwise mention in the BOQ water bound macadam for base shall be measured by the cubic meter placed and compacted upon the road calculated as the product of the compacted sectional area specified to be laid and the length instructed.

The rates for water bound macadam for base shall include for the cost of opening up the borrow area, excavation and selection of material, removing and spoiling of oversize material, screening or breaking, stockpiling, transportation, spreading, compacting, rolling, application of screening, watering, making good defective areas and maintenance of the surface and all incidental in accordance with the requirements of these specifications.

2.10.8.4 Prime Coat

2.10.8.4.1 Basic Cost

The basic prime coat shall be measured in square meters in the accepted work as instructed by the Engineer on Site. The application rate for measurement shall be 1.0 kg/m2 (net bitumen). Cutter shall not be measured and shall be deemed included along with other associated costs shall be included in the item rate of prime coat. The measured quantity shall be the area instructed and accepted by the Engineer. The binder application rate shall be corrected to 15.6ºC.

The contract unit rates for prime coat shall be payment in full for carrying out the required operations including full compensation for:

a) Providing all materials for all preparation, delivering and application and

b) Providing all labor, tools, equipment, and incidentals necessary to complete the work.

2.10.8.4.2 Variation in application rate

Measurement of variation of binder application shall be by litre calculated as the difference between the above specified binder application rate and the binder application rate (net bitumen) instructed by the Engineer, corrected to 15.6ºC. Adjustment of compensation to the Contractor shall be as follows:

As a payment to the Contractor where the binder application rate is increased above the specified rate, but only where such increase has been instructed in writing by the Engineer.

As a refund to the Employer where the application rate is reduced below the specified rate of application. The binder application rate shall be reduced if the Engineer so instructed in writing.

2.10.8.5 Asphaltic Concrete

Asphaltic concrete shall be measured by cubic meter placed and compacted upon the road calculated as the product of the compacted sectional area specified to be laid and the length instructed.

The rates for asphaltic concrete shall include for the cost of opening up the borrow area, excavation and selection of material, removing and spoiling of overburden material, screening or breaking, stockpiling, provision of binder, mixing, transportation, spreading, compacting, rolling, making good defective areas and maintenance of the surface and all incidentals in accordance with the requirements of these specifications.

2.10.8.6 Surface Dressing

The distributor shall be dipped and the binder temperature recorded before and after each spray run and spray length and width recorded on approved Record Sheets. The hot application rate shall be calculated and recorded and checked against the specified rate. The calculated actual rate shall not vary by more than ± 5% from the specified rate. The actual quantity of binder sprayed corrected to 15.6°C shall be calculated.

At least eight clean pre-weighed metal spray trays shall be available for sampling the spray rate for each spray run, to be used in accordance with TRRL-ORN 3 - Section 6.3 Method B - if so instructed by the Engineer.

Binding material bitumen and cutter shall be measured separately in litre. For computation of the quantity the following methods shall be adopted.

(a) Design/instructed rate of application times specified area sprayed computed in litres corrected to 15.6°C.

(b) Actual rate of application measured through tray tests times specified area sprayed, computed in litres corrected to 15.6°C.

(c) Actual consumption in specified area sprayed measured in litres corrected to 15.6°C by dip stick feading of the distribution.

The lowest value of the above three methods shall be adopted for payment. However, if the rate of actual spray of binder is much less or more than the designed/ instructed rate of spray so as to impair quality of surface dressing, the Engineer shall reject the work or shall ask for appropriate rectification which the contractor shall execute at his own cost.

Bitumen and cutter shall be computed on the basis of percentage actually used in the work.

Chipping of each nominal size shall be measured in cubic metre. For computation of quantity the following methods shall be adopted.

(a) Design/instructed rate of application of chippings times specified area applied.

(b) Actual rate of application of chippings times' specified area of application.

The lower of these two values shall be adopted for payment. However rate of application shall not vary with designed/instructed rate of application to impair quality of surface dressing. In such event the Engineer shall reject the work or ask the Contractor to rectify at his own

3 DRAINAGE, PIPELINES AND RELATED ACTIVITIES

3.1 Pipe Trenches

3.1.1 Scope

This specification covers earthworks for trenches for all types and sizes of pipes. It covers excavation, the preparation of a trench bottom, backfilling and the reinstatement of surfaces.

3.1.2 Interpretations

Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:
1 General
2.1 Site Clearance
2.2 Earthworks

Application

This specification contains clauses that are applicable to earthworks for pipe trenches associated with the proposed sub-project.

Definitions

For the purpose of this specification the following definitions shall apply:

Backfill - The approved filling material placed in a pipe trench after the pipe has been laid, bedded, and surrounded by the blanket that has been compacted at the sides and over the top of the pipe.
Bedding - The material, and the operation of placing it, of the bedding cradle and blanket, up to the underside of the backfill.
Blanket - The bedding zone in which material is placed and compacted on or from the top of the cradle up the sides and over the top of the pipe in such a manner that the barrel of the pipe is supported continuously and firmly on the sides and protected over the top by a dense cushion of material.
Cradle - The bedding zone in which material is placed firmly and without voids under and up the sides of a pipe in such a manner that for all practical purposes the pipe cannot move or deflect.

3.1.3 Materials

The excavation of material will, for purpose of measurement and payment, be classified as specified in Clause **Error! Reference source not found.**, above.
For selected fill material, the requirements given in Clause Pipe Bedding shall apply.
Backfill material shall be material excavated from trenches, provided only that it contains no organic material, that it excludes stones of average dimension exceeding 150 mm, and that its moisture content will allow it to be compacted to 95% of the Modified Proctor Density to avoid significant settlement, and shall have a PI not exceeding 12.Backfill material in road or traffic areas shall in addition have a minimum CBR of 15% at specified density if placed in the upper 200 mm of the subgrade, and a minimum CBR of 7% if the backfill is to be placed lower in the subgrade. Material containing more than 10% of rock or hard fragments that are retained at a sieve of nominal aperture size 50 mm, and material containing large clay lumps that do not break up under the action of the compaction equipment being used, will be regarded as unsuitable for use in backfilling.

If the Contractor allows material which, when excavated was suitable for re-use, to become unsuitable when required for backfilling, he shall make good by running it to spoil and replacing with suitable material.

Where trenches cross or run along surfaced roads and paved areas of which the surfaces are ordered by the Engineer to be reinstated, the Contractor shall obtain prior approval for subbase and base materials that may be required to supplement such materials lost during excavation. Materials for bituminous or asphalt construction shall comply with the applicable standards of the Roads Department of the Ministry of Transport.

The Contractor is not required to use selective methods of excavation but may, if he so wishes, screen, wash or otherwise treat excavated material in order to produce material suitable for the bedding. He shall take positive steps to avoid burying or contaminating materials which otherwise would be suitable for use as different types of fill, top soil or road material, as applicable.

3.1.4 Construction Equipment

The Contractor shall use trenching equipment that will excavate to a width such that the side allowance does not exceed the appropriate values specified in Clause Minimum Base Width, below by more than 50 %.

The Contractor shall use appropriate techniques or provide equipment such as pumps, well points and sheeting or close timbering for keeping the trenches sufficiently free from water to enable him to lay pipes true to line and level and to bed them soundly.

The Contractor may use mechanical compaction equipment but he shall select such equipment and operate it in such a manner that the pipeline is not stressed or damaged. Machine compaction shall not be used directly above the pipe until sufficient backfill has been placed to ensure that machine compaction loads transmitted to the top of the pipe are not greater than would be imposed by normal road traffic over a pipeline with cover of depth 600 mm.

3.1.5 Construction and Workmanship

Precautions

With regard dealing with water, the requirements of Clause 2.2.5.12. **Error! Reference source not found.**, shall apply in addition to the stipulations below.

In the case of a trench on sloping ground, the Contractor shall take approved measures (such as the construction of cross-embankments) to minimize erosion in the trench and adjacent ground.

With regard to accommodation of traffic and access to properties, the Contractor shall, in addition to the requirements of Clause Detours and Traffic Control, construct or put in order such bypass(es) as may be required to deviate traffic from portions of the road that are to be affected by the construction; or where half-width construction is ordered or approved, so arrange his work that the traffic will at all times have free one-lane access to at least half the width of the roadway; or ensure, wherever possible, that the whole road is open at night and left in a trafficable condition, complete with traffic signs and protection facilities as specified.

He shall also ensure, wherever possible, that the usable width of the road is at least 3.5 m and he shall provide and allow reasonable access to persons occupying properties that fall within or adjoin the area over which he is working. If, for any reason, such access has to be closed during the construction period, the persons affected shall be given reasonable notice for each such period of closing.

With regard to existing services that intersect or adjoin trenches, the requirements of Clause **Error! Reference source not found.**, shall apply.

Special precautions may be necessary when buildings are close to the edge of the trench. Throughout the duration of such activities the Contractor will be fully responsible for the safety of all adjacent property. Wherever the minimum clearances cannot be complied with, e.g. in certain urban areas, the Contractor shall provide adequate temporary protective support by struts, bracing, etc. for adjacent structures and such support must be capable of safeguarding the buildings from structural damages resulting from the execution of the Works. Prior to installation the Contractor shall submit to the Engineer his proposed system of support for approval. Irrespective of the Engineer's approval sufficiency and suitability of the support will remain the sole responsibility of the Contractor. The support shall remain in place until such time as the Contractor is sufficiently convinced that there is no more imminent risk of damage of any kind to the adjacent buildings resulting from the activities. Upon removal of the support any damages caused by the attachment of the support itself shall be repaired to the satisfaction of the Engineer.

Minimum Base Width

Unless otherwise shown on the drawings, or as directed, the base width of a trench shall be not less than the external diameter of the pipe barrels plus twice the side allowance as shown below:

ND up to600 mm	side allowance 300 mm

ND over600 mm up to 1000 mm	side allowance400 mm
ND over 1000 mm up to 2000 mm	side allowance500 mm
ND over 2000 mm	side allowance600 mm

The minimum base width for pipes not exceeding 125 mm and laid at a depth not exceeding 1.5 m may be less than 600 mm for flexible, continuous piping that, in terms of the specification or schedule, requires no bedding or jointing in the trench.

Where two or more pipes are to be placed in one trench, the base width of the trench shall be no less than the sum of the external diameters of the pipe barrels plus the side allowance for each outer pipe plus, between each pair of adjacent pipes, the average of the side allowance for each pipe.

Site Clearance

The Contractor shall clear the working strip, in accordance with Clause **Error! Reference source not found.**. The working strip shall be an area of sufficient width along the route of the pipeline to ensure that his construction operations are not hampered and damage to buildings and the environment is minimized.

Excavation

The length of pipe trench excavated by a gang shall not extend more than 200m beyond the start of excavation or the completed backfill unless approved by the Engineer. The width of the trench shall provide at least the appropriate side allowance (within trench supports, if any) as specified in Clause Minimum Base Width, above, and such that half of the base width is on either side of the designated centre-line of the pipe.

The sides of each trench from the bottom up shall be as nearly vertical as possible for at least the height of the bedding.
When cutting through bituminous surfaces, the edges of the existing bitumen base and/or wearing courses shall be cut back vertically to straight lines.

In densely built-up areas with restricted and confined space, such as in urban areas, the stockpiling of excavated material adjacent to the trench for use as backfill material may not always be possible. In such cases the Contractor transport such material to and stockpile it at a distance away from the point of excavation, at locations suitable and approved by the Engineer.

All trenches shall be braced and strutted to the satisfaction of the Engineer, if they are

- so close to a building or structure, that a line between the corner of the trench bottom nearest to the building and the underside of the foundation of the building or structure would be steeper than 45°
- if the soil conditions are not providing sufficient stability to the side walls.

The Contractor will be responsible for any damage resulting from trench instability and insufficient bracing and strutting.

During the course of the Works the Contractor shall clean road surfaces and other paved areas used by his vehicles and employees to minimize disturbance to residents and road users, cleaning shall be to the satisfaction of the Engineer.

Provisions for insulating pipelines

Special provisions of insulation should be assured while insulating certain sections of pipelines (transmission mains) that lie in the freezing or snow zone. The contractor shall propose appropriate anti-freezing technologies for insulating pipelines, and get the consent for use from the DWSSM, before incorporating such technology in the site.

Trench Bottom

Material that the Engineer considers to be unsuitable at the bottom of the trench shall be excavated to the depths directed and disposed of in the manner described. The resulting space shall be refilled, as ordered, with approved material and compacted as directed.

Where the bottom of the trench has been loosened during excavation, it shall be compacted at OMC to 90 % of modified AASHTO maximum density prior to bedding and pipe laying.

Bottoms of the excavated trenches shall be trimmed flat and levelled to provide an even base for the pipeline

or pipe bedding; rocks, debris or other extraneous matter that may damage the pipes shall be removed.

Where pipes are to be laid on formation made in undisturbed ground (i.e. without bedding), the Contractor shall ensure that excavation in the first instance is stopped 75 mm above formation level and the trimming the formation shall be done by hand immediately prior to starting the laying of the pipes.

Where granular or concrete beddings are required, bottoms of trenches shall be excavated to a depth below the proposed level of the pipe to cover the full width of the trench as shown in the Drawings.

The depth of the trench shall be such that the depth of the cradle can be placed under the pipeline, and the trimming and grading of the bottom of the trench shall be such that the barrel of each length of pipe can be uniformly supported over its full length, free at the joints, and at the correct grades and levels.

The bottom of pipe trenches shall be sufficiently straight to enable the pipe to be laid without reduction of the side allowances given in Clause Minimum Base Width, above and in conformity with the applicable tolerances specified.

Backfilling

Backfilling of pipe trenches shall commence as soon as possible after the pipe has been laid and firmly bedded in the specified cradle and the blanket has been placed over the top of the pipe to the height of blanket cover specified.

Backfilling shall be carried out as described below and over the full extent of the actual trench excavation and to original ground level, except where otherwise directed.

Unless the Contractor is authorized by the Engineer to use other material, the material for backfilling above the bedding (cradle and blanket) shall be obtained from trench excavations.

Unless prior approval has been obtained, no filling shall be placed in water.

Hard and rock material shall be incorporated in the backfill above the bedding only to the extent approved. Depending on the quality of the material, the Engineer may direct that it be suitably mixed with other backfill material.

Excavated material from the trench, which is unsuitable or has become surplus because of bulking, displacement by the pipe and importation, shall be disposed of as approved by the Engineer.

Any deficiency of backfill material from trench excavations because of removal of organic or other unsuitable material shall be made up from suitable surplus material from other excavations on the Site. If, insufficient or no suitable material is available for this purpose from such excavations, the Contractor shall import sufficient suitable material. The Contractor shall so arrange his work that the importation of backfill material is kept to a minimum.

The Contractor shall complete backfilling of trenches expeditiously and in reasonable lengths.

Compaction

In normal areas backfill shall be in accordance with Clause Placing and Compaction.

In areas subject to traffic loads, trenches shall be backfilled with selected fill material in layers of thickness (after compaction) not exceeding 150 mm and the material shall be compacted to at least 95 % of modified AASHTO maximum density up to the top of the subgrade level.

Reinstatement of Surfaces

In all cases, the Contractor shall, if ordered, reinstate surfaces over the full extent of the top of the actual excavation.

On private properties or other unsurfaced areas, the top 300 mm layer of each trench that will not be subject to road traffic loads shall be of such topsoil as is available in addition to soft material from excavations. The finished surface of backfilling that is left raised of the surrounding ground to allow for initial settlement shall be not more than 150 mm above the surrounding ground

In the case of gravel roads or similar surfaced areas, the Contractor shall, immediately after completion of the backfilling to the top of the subgrade level, reinstate the road surface by filling the reminder of the trench with a well-graded and approved hard-wearing gravel surface of thickness at least 150 mm, and of quality equal to that of the existing road surface compacted to at least 95% modified AASHTO. The gravel layer shall be finished with a slight camber in order to allow for initial settlement but shall not be shaped such as to cause excessive jolting of any vehicle proceeding with normal speed.

If the surface of a road with a stabilized base has been disturbed, the base shall be replaced with crusher run base compacted with sufficient moisture to give a density of at least 98 % modified AASHTO maximum density.

Except if otherwise ordered by the Engineer, the surface of a bitumen road shall be reinstated with asphalt of at least the thickness used in the original state. The base material shall be graded to a level sufficiently below the final road surface to allow the bitumen surfacing to be accommodated, and the edges of the existing bitumen wearing course shall be cut back vertically to a straight line. Before the bituminous construction is commenced, all loose materials and dust shall have been removed and the surface shall have been approved and prime coated at 1.0 l/m2 of MC30 cutback bitumen. The bituminous surface will have a tolerance of -0+6 mm after compaction.

The Contractor shall maintain the reinstated surfaces and shall make good, at his expense, any damage due to any subsidence, pothole or other unevenness immediately after it occurs during the period of the contract or during the defects liability period.

Where, during the execution of the activities, any road or paved surface adjacent to a trench has been damaged in any way whatsoever by the Contractor's equipment, he shall, at his own expense and as soon as is practicable, repair and restore such surface to a condition at least equivalent to that previously existing, and to the satisfaction of the Engineer and the concerned authority.

3.1.6 Tolerances

Alignment and Grade

The deviation from the specified level of the invert and the specified dimensions of a trench and (for a height equal to at least the diameter of the pipe) of the lower part of the sides of the trench shall be such that the pipe may be laid and bedded in the trench within the tolerances specified for the pipeline.

Moisture Content and Density

The requirements for moisture content and density given in Clause Tolerance in Positions, Dimensions, Levels, etc. shall apply.

3.1.7 Testing and Acceptance

The Contractor shall prove: the optimum moisture content, the maximum dry density, the CBR, Marshall and the specified properties of reinstatement and backfill materials before use at a rate of one test per 200 m3 of material. In-situ density test of non-bituminous materials, and Marshall compaction/in-situ coring of bituminous materials will be carried out on each layer for every 200 linear meter of trench or part thereof by the Contractor in the presence of the Engineer, or by an independent laboratory approved by the Engineer. The cost of all testing will be included in the Contractor's rates. In the event of failure results, the Engineer will order any necessary re-testing and remedial works at the Contractor's expense.

3.1.8 Measurement and Payment

The items scheduled for clearance and demolition will be classified according to the nature of the materials involved and the methods of their disposal. The item for clearance shall include the removal of topsoil and storing for reuse.

Clearance of the working strip shall be measured as the length of pipeline with no deduction for chambers.

Demolition of structures, buildings etc, shall be measured as a sum for demolition of the identified structure.

Rates for reinstatement of the Site shall include preparing the working strip to receive topsoil, placing topsoil, disposal of surplus materials, planting and seeding, reinstatement of land drains. Additional payment will be made for work in roads according to type.

Reinstatement and work in roads shall be measured as the length of pipeline with no deduction for chambers.

Rates for trench excavation and preparation of bedding Class S shall cover the cost of excavating and re-use of the excavated or imported material in bedding and backfilling, forming embankments, terraces, shoring and supporting excavations, protection of structures, provision for existing services, dealing with storm and ground water, protection of slopes, the cost of disposal of any surplus and unsuitable material, and the import of any suitable material required for backfill. Additional payments will be made for bedding of different type.

Trench excavation and bedding will be measured as the length of pipeline with no deduction for chambers.

Excavation for chambers, abutments, columns, thrust blocks, and anchors shall be measured as the volume of excavation, on accordance with Clause Measurement and Payment, outside the nominal trench dimension.

Excavation in rock shall be measured extra over normal excavation and measured as a volume.

3.2 Pipe Bedding

3.2.1 Scope

This specification covers the bedding, consisting of the bedding cradle and the selected fill blanket, for buried pipes for carrying fluids under pressure or gravity.

3.2.2 Interpretations

Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

1 General
2.1 Site Clearance
2.2 Earthworks, as applicable
3.1 Pipe Trenches

Application

This specification contains clauses that are generally applicable to the bedding of pipes.

Definitions

For the purpose of this specification the following definitions shall apply:

Bedding - The material in the bedding cradle and fill blanket up to the underside of the main fill, and the operation of placing and compacting bedding in the manner specified.
Bedding cradle - The zone in which bedding is placed firmly and without voids under and up the sides of a pipe in such a manner that for all practical purposes the pipe cannot move or deflect.
Expansion joint - A joint in concrete bedding in which two concrete surfaces are separated by resilient filler of thickness at least 15 mm.
Flexible pipe –A pipe whose properties are such that the first limit state reached is either excessive deformation, or buckling collapse. Plastic pipes, UPVC etc, are examples of flexible pipes.
Joint hole - A depression formed in the bedding cradle to accommodate a joint in a pipeline.
Main fill - The approved filling material placed in a pipe trench after the pipe has been laid, bedded, and surrounded by selected fill blanket up to 300 mm cover above the top of the pipe.
Rigid pipe – A pipe whose properties are such that the first limit state reached is fracture of the pipe walls due to bending stress. Concrete pipes are an example of rigid pipes.
Selected fill blanket - Material placed and compacted to form a blanket on or from the top of the bedding cradle up the sides and over the top of the pipe in such a manner that the barrel of the pipe is supported continuously and firmly on the sides and is protected over the top by a dense cushion of material.
Selected fill material - Material that complies with the requirements of Clause Selected Fill Material below.
Selected granular material - Material that complies with the requirements of Clause Selected Granular Material below.
Semi-rigid pipe - A pipe that can deform enough to redistribute some of the overburden pressure to the sidefills, but which is stiff enough to rule out the possibility of buckling. The first limit state reached may be either excessive deformation, or excessive wall bending stresses. Ductile iron pipes are considered semi-rigid.

3.2.3 Materials

Selected Granular Material

Selected granular material shall be material of a granular, non-cohesive nature, free draining, a pH > 6 and the following grading.

Sieve Size (mm)	% Passing Sieve
40	100
20	80-100
5	40-100
2.5	20-80
0.6	
0.315	0-20
0.075	0-5

Selected Fill Material

Selected fill material shall be material that has a pH > 6 and the following grading.

Sieve Size (mm)	% Passing Sieve
40	100
20	80-100
5	40-100
2.5	20-100
0.6	5-100
0.315	0-70
0.075	0-10

Bedding

Rigid Pipes

Bedding for rigid pipes shall be of Class A, B, or C. The bedding cradle for Class A bedding shall be concrete. Bedding cradles for Class B and C bedding shall be of selected granular material. The material for the selected fill blanket shall be selected fill material.

Flexible and Semi-rigid Pipes

Bedding for flexible and semi-rigid pipes shall be of Class S or B. The bedding and blanket for Class S shall be selected fill material. Bedding cradles for Class B bedding shall be of selected granular material and blanket shall be selected fill material.

3.2.4 Selection

The Contractor may screen, wash, or otherwise treat excavated material from pipe trenches or other excavations in order to produce material suitable for bedding or covering the pipeline. The Contractor shall take every reasonable precaution to avoid burying or contaminating material that is suitable and is required for bedding or covering the pipeline.

When material suitable for use as selected fill material or selected granular material is not readily available from trench or other excavation within a reasonable distance, the Contractor shall, subject to the Engineer's approval for each material, obtain suitable material to replace the shortfall by opening up borrow pits at approved areas located at intervals along the route of the pipeline or by importing from commercial or other sources.

3.2.5 Construction Equipment

Adequate equipment shall be provided by the Contractor for the placing and compacting of bedding as specified in Clause Construction and Workmanship, below.

The Contractor shall also provide the necessary test equipment for performing on Site the tests referred to in Clause Testing and Acceptance, below.

3.2.6 Construction and Workmanship

General

No bedding shall be laid until the Engineer has approved the trench, measured the depth if necessary, and authorized pipelaying to proceed.

The anchoring of pressure pipes shall be as shown in the Drawings.

The bedding criteria for ductile iron is given in the following table.

Pipe Diameter	Bedding Type	
	Class S	Class B
	Pipe cover	
1400	> 4.0m	>4.0m
1100	>4.1m	>4.1m
1000	>4.3m	>4.3m
900	>4.7m	>4.7m
800	>5.1m	>5.1m
700	>5.8m	>5.8m
<600	>6.0m	>6.0m

A cavity of adequate size shall be excavated in the sides and bottom of the trench or left in the pipe bed at each joint and at each sling position.
The preparation of the trench bottom or surface of the bed shall be completed for at least one full pipe length in advance of the pipe laying, except where in exceptional circumstances another arrangement is approved.

No bedding material shall be placed in trenches containing water.

Where bedding other than concrete is to be used, stones, bricks, or similar materials shall not be used below or against the pipes to locate them in position in the trench or to level the pipes.

Except in the case of Class A bedding and concrete surround, the joint holes shall be refilled with fine granular material and lightly compacted to prevent the migration of adjacent pipe bedding material into the holes and to obviate the forming of hard spots under joints.

In the placing of bedding, all voids under the overhang of the pipes shall be filled and the compaction shall be carried out uniformly on each site of the pipes so as not to cause any lateral or vertical displacement of the pipe.

Bedding shall be carried out as pipelaying proceeds, and shall be completed before the acceptance test is carried out.

The degree of compaction attained for bedding (other than concrete) shall be 90% modified AASHTO maximum density.

Placing and Compacting of Bedding for Rigid Pipes

In addition to complying with the requirements listed above, the Contractor shall construct the bedding for rigid pipes in accordance with the following requirements:

a) Class A. The pipes shall be supported on a continuous cradle of concrete having a 28 days compressive strength of at least 20 MPa. During pipelaying and before the placing of the concrete bedding, the pipes shall be suitably supported. Care shall be taken during the placing of the concrete to prevent movement or flotation of the pipes. In the case of pipes with flexible joints, concrete shall not be allowed to enter the joints during casting of the bedding and a positive vertical expansion joint in the bedding cradle shall be formed at each pipe joint. The selected fill blanket shall not be placed in any section until a period of 24hrshas elapsed after placement of the bedding cradle in that section.

The main fill shall not be placed in any section until the bedding cradle in that section has achieved a compressive strength of at least 15 MPa.

b) Class B. The pipes shall be bedded on a continuous bed of selected granular material, the material being placed in accordance with the details, as relevant, and the bedding constructed in the manner shown, as relevant. To ensure that each pipe will be fully supported throughout the length of its barrel on the bedding

cradle, joint holes shall be formed in the bedding cradle for pipe sockets and couplings.

c) Class C. The pipes shall be placed directly on the trench bottom after this has been hand-trimmed to ensure that each pipe will be fully supported throughout the length of its barrel. Joint holes shall be formed in the trench bottom for slings, pipe sockets, and couplings.

Any material that is used to support a pipeline temporarily during construction or does not comply with the requirements for bedding or haunching shall be removed before the selected fill for Class B or C is placed.

After the pipes have been laid and tested, selected fill material shall be carefully placed into the spaces between the pipe and the sides of the trench to the level of the crown of the pipe. The material shall be thoroughly packed and rammed by careful hand tamping in layer 100 mm thick before compaction to the density specified in Clause General.

Placing and tamping shall proceed equally on both sides of the pipe. A further layer of the same material at least 300 mm thick after compaction and the full width of the trench shall be placed over the crown of the pipe in equal layers, each layer being compacted to the density specified in Clause General.

Placing and Compacting of Bedding for Flexible and Semi-Rigid Pipes

In addition to complying with the requirements of Clause General, above, the Contractor shall construct the bedding for flexible and semi-rigid pipes in accordance with the following requirements:

a) Class B Flexible and semi-rigid pipes shall be supported on a cradle as indicated on the engineer's drawings. Initially continuous bed of selected granular material of compacted depth indicated shall be placed in 100 mm layers and covering the full width of the trench. The granular material shall be compacted to the density specified in Clause General. After laying of the pipeline, additional selected granular material shall than be placed carefully and evenly between the sides of the trench and the pipeline, in layers of uncompacted thickness approximately 100 mm and in accordance with the construction details. Each layer shall be compacted individually to the density specified in Clause General.

After completion of the bedding cradle, selected fill blanket shall be placed carefully in layers of 100 mm uncompacted thickness over the full width of the trench and shall be compacted to the density specified in Clause General up to a height of at least 300 mm above the crown of the pipeline.

b) Class S Flexible and semi-rigid pipes shall be supported on a cradle as indicated on the engineer's drawings. Initially continuous bed of selected fill material of compacted depth indicated shall be placed in 100 mm layers and covering the full width of the trench. The fill material shall be compacted to the density specified in Clause Handling of Pipes and Fittings. After laying of the pipeline, additional selected fill material shall than be placed carefully and evenly between the sides of the trench and the pipeline, in layers of uncompacted thickness approximately 100 mm and in accordance with the construction details. Each layer shall be compacted individually to the density specified in Clause General.

After completion of the bedding cradle, selected fill blanket shall be placed carefully in layers of 100 mm uncompacted thickness over the full width of the trench and shall be compacted to the density specified in Clause General, up to a height of at least 300 mm above the crown of the pipeline.

When placing and compacting the bedding particular care shall be exercised to prevent damage, deflection, or displacement of the pipeline and the polyethelenesleeving.

Concrete Surround for Flexible and Semi-Rigid Pipes

In special cases, and where ordered by the Engineer, pipes shall be surrounded in concrete of the specified grade, generally of at least 20 MPa. The lower part of the encasement shall be constructed in the manner specified for Class A bedding. Once the pipeline has been tested and approved, the pipes shall be covered with concrete to the specified depth and expansion joints shall be cut or constructed in the upper part to coincide with those in the lower part. No earth filling over the concrete shall be commenced until at least 5 days after the concrete has been placed or until the concrete has attained a strength of at least 15 MPa.

3.2.7 Tolerances

The permissible deviations shall be as follows:

(i) Moisture Content in field during compaction OMC -2, +1 %

(ii) Density when bedding rigid pipes -0, +5 %
(iii)Density when bedding flexible and semi-rigid pipes -0, +3 %

3.2.8 Testing and Acceptance

The Engineer may order density tests to be carried out to determine the density and grading of the bedding. Tests will be carried out for every 200 linear meter of trench or part thereof by the Contractor in the presence of the Engineer, or by an independent laboratory approved by the Engineer. The cost of all testing will be included in the Contractor's rates. If the density is found to be below the specified value, the Engineer may order removal and recompaction at the Contractor's expense, and the cost of retesting shall be borne by the Contractor.

The tests may be carried out by the sand replacement method or, where the grading of the bedding is such that the particle size is not less than 0.075 and not more than 2 mm, by use of a dynamic cone penetrometer.

3.2.9 Measurement and Payment

These shall be made according to Clause Measurement and Payment.

3.3 Pressure Pipelines

3.3.1 Scope

This specification covers the transportation to Site, installation and testing of ductile iron pipe, valves, fittings and plastic sleeving supplied by the Employer.

It also covers the construction of valve chamber, thrust blocks and other structures required for the operation of the bulk distribution mains.

3.3.2 Interpretations

Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:
1 General
2.1 Site Clearance
2.2 Earthworks
2.3 Concrete
3.1 Pipe Trenches
3.2 Pipe Bedding
2.4 Brickwork

Application

This specification contains clauses that are generally applicable to the construction of ductile iron pipelines and appurtenances.

Definitions

For the purpose of this specification the following definitions shall apply:

Fitting - A special or a valve, or a process of jointing (except welding) straight pipes to one another and to specials and valves.
Pressure Pipelines – A pipeline in which the normal internal working pressure exceeds 3 metres of water (0.3Bar) and such other pipework as may be so designated
Special - Any pipe other than straight pipe, such as bends, tees, reducers, etc.
Straight pipe - A straight pipe of uniform bore and of standard or non-standard length.

Abbreviations

For the purpose of this specification the following abbreviations shall apply:
DI *Ductile iron*

IRHD	*International rubber hardness degree*
PTFE	*Polytetrafluor ethylene*

3.3.3 Materials

Ductile cast iron pipes, specials, polyethelene sleeving and valves, shall comply with the specification as mentioned in Clause. They shall be capable of withstanding the applicable test pressure specified in Clause. General below. All pipes and fittings shall be supplied complete with couplings and jointing material.

Satisfactory temporary end covers shall be provided by the contractor for the protection of threads, flanges, and prepared ends of plain-ended pipes and fittings, and to prevent damage to internal lining during transportation and during handling on Site.

The Contractor shall supply a mastic putty, and a wrapping tape, to protect all buried nuts and bolts from corrosion

The Contractor shall supply protective wrapping tape to be used to protect the pipe and joints from corrosion in the locations indicated on the Drawings. The primer used before application shall consist of xylene and bituminous material and shall be supplied by the tape manufacturer. The tape shall be black in colour and consist of a PVC backing bonded to a self adhesive bituminous rubber compound with a total thickness of 1.65mm.The PVC backing shall be extruded (non-calendered) and have an average thickness of 0.75mm.The tape shall be supplied on a high quality overwidth silicone release paper, extending some 12.5mm wider than the tape.

Pipeline materials shall be so transported, stored, and handled that pipes are not overstressed at any time and fittings are not damaged in any way.Pipes damaged or cracked in any way shall be removed from the Site and replaced at the Contractor's expense.

Materials for manhole covers and surface boxes shall be as specified in Clause 3.3.5.8 Covers for Chambers.

3.3.4 Construction Equipment

Any vehicle on which pipes are transported shall have a body of such length that the pipes do not overhang. Large pipes shall be placed on cradles and the loads properly secured during transit. The pipes shall be handled in accordance with the manufacturer's recommendations.

The equipment and rigging equipment used by the Contractor for the handling and placing of pipes shall be in accordance with the manufacturer's recommendations and shall be such that no pipe is overstressed during any operation covered by the specification.

The Contractor shall provide all tools and equipment used for the cutting, jointing and laying of pipes, fittings and valves.

The Contractor may use any acceptable device, including one incorporating a laser beam, to control the alignment and laying of the pipeline subject to the approval of the Engineer.

The Contractor shall provide all equipment and tools required for installation of polyethylene sheeting, mastic putty and all types of wrapping tape.

The Contractor shall provide all equipment, materials, tools and fittings required for the cleaning and swabbing of the pipeline.

The Contractor shall provide all the equipment, materials, tools, and fittings required for the performance of the tests given in Sub-section 3.3.7 below. Test gauges shall be of approved manufacturer having dials at least 200 mm diameter, graduated such that the test pressure is at least 75% of the gauge reading. If necessary different gauges shall be supplied for different pipeline sections. Two gauges of each type shall be provided for the sole use of the Engineer and shall remain in the Engineer's possession for the duration of the Contract.

All gauges shall be dead weight tested and proved at the commencement of use and at regular intervals thereafter as required by the Engineer.

All equipment and methods shall be subject to the approval by the Engineer

3.3.5 Construction and Workmanship

Handling of Pipes and Fittings

Coated pipes shall be transported on trucks or trailers fitted with approved padded timber cradles shaped to fit the curvature of the pipes and of adequate dimensions so as to prevent any damage to the pipe coating. Successive tiers of coated pipes shall be separated by similar suitable shaped timber cradles when more than one tier of pipes is being transported. Pillows shall be provided between securing chains or lashings when loads are being transported.

Particular care shall be taken during unloading, loading, handling and transportation to avoid distortion, flattening, denting, scoring or any other damage to the pipes, fittings and any damage to the external or internal coating or lining of the pipes, fittings etc. Under no circumstances shall pipes be dropped, be allowed to strike on another, be rolled freely or dragged along the ground.

Loading, unloading and handling shall be carried out using special hooks, well padded, with a curved plate to fit the curvature of the pipes or webbing slings not less than 30 cm wide or other means approved by the Engineer. Steadying ropes shall be employed. The positions of lifting slings shall ensure that stresses and tendency towards deformation in the pipes are kept at a minimum. Pipe handling equipment shall be maintained in good repair and any equipment which in the opinion of the Engineer may cause damage to the pipes shall be discarded.

End covers and protection shall not be removed until incorporation of the pipes and fittings into the Works.

Care shall be taken during loading, transporting, and unloading to prevent damage to the pipes, fittings or coatings. When loading pipes in the stockyard the Contractor will be responsible for any damage to pipes and fittings which shall be noted and reported to the Engineer. After unloading all pipes or fittings will be examined and any defects or damage shall be noted and reported to the Engineer. Any damage shall be repaired in a manner recommended by the Manufacturer with the approval of the Engineer. Any pipe not considered by the Engineer to be of an acceptable quality after repair will not be accepted and the Contractor will be required to compensate the Employer.

When materials are temporarily stored at the edge of the way leave they shall be stored clear of the ground and positioned to avoid damage by passing traffic in a manner approved by the Engineer.

Laying

To ensure that his supervisors and operators are familiar with the manufacturer's instructions/pipeline construction manuals for the laying and jointing of pipes and that these instructions are strictly adhered to, the Contractor shall employ the manufacturer to demonstrate laying and jointing. The demonstration shall also include the cutting of pipes and the repair of damaged pipes.

Pipe laying shall not commence until the bottom of the trench and the pipe bed have been approved by the Engineer's representative.

The trench bottom shall be prepared as specified in Clause. Pipe Trenches. Trenches shall be kept dry to allow proper and safe bedding, laying, jointing of pipes and construction of the selected fill blanket over the pipes.

The pipeline shall be tape wrapped or sheathed in polythene sleeve for protection. The use of the type of protection shall be based on ground conditions in accordance with the following table or as directed. The Contractor shall measure soil resistivity and pH at 100 m intervals.

Soil Corrosivities	Ground Condition	Protection System
Aggressive	Natural soils with resistivity between 15 and 25 Ωm with seasonal water table or permanent water logging. Natural soils with a pH range 5< pH<6 without water table.	Standard pipe coating plus PE sleeving
Highly Aggressive	Natural soils with resistivity below 15 Ωm with seasonal water table or permanent water logging. Natural Soils with a pH range 5< pH<6 with seasonal water table or permanent water logging.	Standard pipe coating plus 25 mm overlap
	Made up ground with heavy chemical contamination	Standard pipe coating plus tape wrap 55% only.

The protected pipeline shall be laid and bedded to even grades and to levels and alignments shown on the drawings or as directed. It shall be laid centrally in the trench and with the manufacturer's class and quality

identification marks visible from the top of the trench, if possible. Control of laying and bedding shall be by means of boning rods and sight rails or an acceptable laser beam device. Sight rails shall be painted black and white and shall be fixed securely and accurately.

Pipes shall be brought to the correct alignment and inclination, concentric with the pipes already laid. Adjustments to line and gradient should be made by scraping away or adding adequately compacted foundation material under the pipe barrel not using wedges and blocks or beating on the pipe.

Pipes shall be handled in manner which eliminates any possibility of high impact or point loading, taking care to protect the joint elements.

Every reasonable precaution shall be taken to prevent the entry of foreign matter and water into the pipeline. At the close of each day's work or at any time when work is suspended for a significant period, the last laid pipe shall be plugged, capped, or otherwise tightly closed until laying is recommenced.

Where so required, the cover or the alignment of a pipeline may change gradually by deflection at pipe joints, but this deflection shall not be greater than half the deflection permitted by the manufacturer of the pipe.

The minimum clearance between the outside of a pipeline being laid and the outside of any other pipe that it crosses shall be 150 mm. Where this requirement conflicts with the requirements for cover over the pipeline the Contractor shall ask the Engineer for written instructions and shall carry out the work in accordance with those instructions.

Jointing

All pipelines shall be jointed in accordance with the manufacturer's instructions and to the approval of the Engineer.

Until required for incorporation in a joint, each rubber ring or gasket shall be stored in the dark, free from the deleterious effects of heat or cold, and kept flat so as to prevent any part of the rubber being in tension.

Spigots and sockets of pipes being jointed shall be thoroughly cleaned by brushing and wiping immediately before being jointed. All rubber rings and seals shall be carefully inspected after being placed in position and before the joint is closed, to ensure that they have not suffered any cuts, tears, or other damage, and are not in any way defective.

All pipes with flexible joints shall be accurately marked prior to laying to ensure that the correct gap is left in the joint.

For push-fit and bolted gland joints only lubricants recommended by the manufacturer shall be used in connection with rubber rings and these lubricants shall not contain any constituent soluble in water conveyed in the pipe. They shall be suitable for the climatic conditions at the Site and shall contain an approved bactericide.

For bolted gland joints the joints ring shall be pushed into place by the glandring using only hand pressure, fixing nuts and bolts should then be fitted and first tightened to finger pressure. Thereafter tightening shall be in the sequence proposed by the manufacturer and to the torque recommended.

In the jointing of pipes with flanges, special care shall be taken to align, grade, and level the pipes, specials, and valves to avoid straining of the flanges. All bitumen and paint shall be removed from the mating face of each flange immediately before jointing. Bolts shall be tightened up evenly in opposite pairs to ensure uniform bearing, the final tightening shall be to the torque specified by the manufacturer.

For flanged joints the gasket shall be fitted smoothly to the flange and the joint made by tightening the nuts to finger pressure first. Thereafter the final tightening of the nuts shall be made by gradually and evenly tightening bolts in diametrically opposite positions using only standard spanners of a type approved by the Engineer.

Graphite grease shall be applied to the threads of bolts before joints are made. All joints containing nuts and bolts which are buried shall be protected with anticorrosive mastic and wrapping tape, applied in accordance with the manufacturer’s recommendations.

Care shall be taken to avoid damage to the internal surface of the pipes during assembly of the pipeline.

Once joints are made they shall be protected to a level appropriate for the pipe by: polyethylene sleeving, muffs, or with moulding putty and tape wrapping.

Setting of Valves, Specials and Fittings

Unless otherwise shown on the drawings, or directed by the Engineer, gate valves shall be set upright and butterfly valves shall be set with the main shafts horizontal. All valves, specials, and fittings shall be located in the exact positions shown on the drawings or otherwise directed. All bolts and flanges which are to be buried shall be covered with a corrosion inhibiting mastic putty or moulding compound to produce smooth contours, the prepared material shall then be wrapped in protective tape.

Cutting of Pipes

Pipes shall be cut by a method, which provides a clean square cut of the pipe and of the lining, without damage to pipe or lining. All cut or trimmed ends and the parts of any pipe on which the coating may have suffered damage shall be re-coated as specified before the pipes are laid.

The external area at cut spigot ends of ductile iron pipes shall be ground smooth for a distance of at least 125 mm, and then chamfered or otherwise made suitable for jointing as recommended by the pipe manufacturer.

Anchor/Thrust Blocks and Pedestals

At tees, bends, terminal valves, end caps, and where otherwise directed, anchor/thrust blocks shall be constructed to dimensions ordered or shown on the drawings. Unless otherwise indicated on the drawings, anchor/thrust blocks and pedestals shall be constructed of M20 concrete. The concrete shall be well punned around the pipe, if in trenches, against the undisturbed faces and bottom of the trench. Backfilling behind or under thrust faces will not be permitted. Excess excavation shall be replaced with the prescribed mix concrete given above at the Contractor's expense.

Care shall be taken to leave all joints accessible. No anchor/thrust block and pedestals shall be concreted before the approval of the Engineer has been obtained.

3.3.5.7 Valve Chambers

All washout valves, pressure reducing valves, and air valves in pipelines shall be housed in a chamber as shown on the drawings or directed by the Engineer.

3.3.5.8 Covers for Chambers

All covers and frames shall be manufactured, from cast grey or ductile iron, and be coated to the approval of the Engineer. Covers and frames shall conform to NS 104/2042.

All covers shall be fitted to the frames and tested at the manufacturer's works, and covers and frames shall be similarly numbered in a legible and permanent manner in a position which will not be visible when fitted in place, and shall be of such construction as to minimise the ingress of sand.

The Contractor shall ensure that the covers are fitted to the appropriately numbered frames after the frames have been fitted.

The name of the Employer and year of manufacture shall be embossed in all covers.

Interface Points

i. General

Where the interface is a pipe flange, the Contractor may be instructed by the Engineer either to install a blank flange, backfill and mark the interface, or to expose and connect to a flange installed by another contractor and backfill on completion. The rate included in the Bill of Quantities shall cover the cost of either operation.

ii. Installation of Flanged Connection Point

The connection point shall be provided at the location specified. The flange shall be installed so that it is vertically plumb and its face is perpendicular to the axis of the pipeline. The flange shall be covered by a PN 16 blank flange, the flange shall be installed in the specified manner. The flange shall be backfilled and the location marked with a marker post.

iii. Connection to Flanged Connection Point

The connection point shall be at the location specified and indicated on Site by a temporary marker post. The Contractor shall excavate to expose the flange, remove and dispose of the blank flange and water contained in the pipe and make the flange joint in accordance with the Specification, including the provision of all jointing materials.

Permanent Pipeline Markers

Permanent pipeline marker posts shall be installed at all changes of horizontal alignment, and at 200m intervals along the straight lengths of pipe. Marker posts shall be positioned as close as possible to a 2 m offset from the pipe centre line. In the case of twin pipelines the marker posts shall be installed along the centre line of the twin pipes.

Permanent marker posts shall be of precast concrete Class 30/20 to the dimension shown on the Drawings

Internal Pipe Cleaning

Pipelines of 750 mm diameter and larger shall be manually cleaned internally of all debris, stones and sand prior to testing.

All pipelines less than DN 750 shall be cleaned by the passing through of a foam swab before the hydraulic test on completion. Swabbing shall be carried out successively between adjacent temporary swabbing points installed by the contractor.

The foam swab shall comply with the following:
Size:
Main up to DN 300 : swab diameter = pipe diameter + 25%
Main over to DN 300 : swab diameter = pipe diameter + 75 mm

Quality:

Hard Where restrictions in the main do not reduce the diameter of the pipeline to less than two thirds of the swab diameter.
Soft: Where restrictions in the main are in excess of the above but do not reduce the diameter of the pipeline to less than one half of the swab diameter.

Disinfection of Potable Water Pipelines

The internal surfaces of all pipelines and pipework including all equipment incorporated in a pipeline or pipework through which water will pass shall be disinfected after they have been cleaned to the satisfaction of the Engineer.

Disinfection shall be effected by filling the pipeline with water heavily dosed with chlorine, and shall be carried out when filling the pipeline with water for carrying out the hydraulic test on completion. Alternative methods may be adopted with the approval of the Engineer.

The level of the chlorine dosing shall be such as to make available 50 mg/l of free chlorine throughout the pipeline.

The water, heavily dosed with chlorine, shall stand in the pipeline for a period of 24 hours or for such longer period as the Engineer shall require and all valves in the system shall be operated at least once during this period.

At the termination of the required period, chlorine residual tests shall be taken at the end of the pipeline farthest from the point of injection and the test shall be repeated if necessary until the residual is not less than 10 mg/l.

The Contractor shall obtain the Engineer's approval to the method to be adopted for disposing of the chlorinated water and the time when such disposal shall take place on completion of disinfection. The Contractor shall neutralise the chlorine by the use of sodium thiosulphate prior to disposal.

Electromechanical Works

The Contractor shall involve the persons recommended by Employer and WUSC in the construction time at construction site to built up their capacity regarding the construction and operation of Water Supply System. Contractor shall be responsible for giving solution to their question or queries to enhance their capacity regarding successful operation of project .Water users Committee shall give their priority to such persons as a human resource for testing and commissioning of the constructed water supply system as per provided in BoQ.

3.3.6 Tolerances

General

No deviation will be permitted from the minimum cover specified or as shown on the drawings.

The criteria for the level and gradient to which pressure pipelines shall be laid are as follows:

- the cover above the crown of the pipe to ground level shall be as shown on the Drawings, but in no event shall be less than 1000 mm in green areas, 1200 in the verge or carriageway of roads and 1500 mm where crossing roads.
- The upward gradient shall be steeper than 1 in 500 with flow, or steeper than 1 in 250 against the flow except where expressly shown in the Drawings.

Control Points

For the purpose of this specification valves set on the centre line of the pipeline, designated changes in gradient and designated changes in horizontal alignment, shall be regarded as control points and shall be located with a permissible deviation of + 100 mm on the centre line. The same deviation will be permissible laterally except where the Contractor is required to lay the pipeline to a curve or at a designated distance from a boundary, kerb line, or fence line, in which case the permissible deviation shall be + 30 mm. Unless otherwise directed and subject to a permissible deviation (measured along the centre line) of + 5 m, scour valves shall be located at the lowest points in pipelines and air valves at the highest points.

Alignment (Plan and Level)

Unless otherwise directed, the permissible deviation in alignment between control points from a straight line joining the control points, when measured on the top centre of the pipeline, shall be + 100 mm or + 20% of the nominal diameter, whichever is the larger, and the permissible deviation per pipe length shall be + 30 mm. The permissible deviation from the designated level at any point on the invert of the pipeline shall be + 50 mm or + 10% of the nominal diameter of the pipe, which ever is the larger.

Each pipe shall be laid to the required gradient such that the end of the pipe is+ 5mm of the required level relative to the other and of the pipe.

Valve Chambers, Manholes, etc.

Valve chambers, manholes, and the like shall be constructed centrally on the control points and, with the exception of tolerances that affect access to bolts, nuts, etc., with a permissible deviation of + 50 mm on all clearance dimensions. The clearance dimension between the outside of each nut and bolt-head and the inside face of the wall of a structure or any other fitting shall generally be not less than 150 mm.

Pipe Protective Coatings, etc.

No air must be trapped underneath the wrapping tape. Unsatisfactory pipes shall be cleaned, prepared and rewrapped.

All damage to protective coatings must be repaired. In the following manner;

j) Bitumen Coating

Damage to bitumen coating will be repaired by preparing and repainting the damaged area in accordance with the pipe manufacturers instructions.

ii) Polyethylene Sleeving

Minor damage, small holes etc, to polyethylene sleeving may be repaired by sticking adhesive tape over the damaged point. Larger damage shall be repaired by replacing the sleeve or by sticking a large patch of the sleeving material over the damaged area.

iii) Tape Wrapping.

Minor damage, small holes etc, to wrapping may be repaired by sticking adhesive tape over the damage after cleaning and preparing the damaged point. Larger damage shall be repaired by cleaning and rewrapping the damaged area.

3.3.7 Testing and Acceptance

General

Except where otherwise specified pipelines and pipework shall be subjected to hydraulic pressure tests in the presence of the Engineer which shall comply with BS 8010 or CP 312.

Testing shall be carried out in two stages:

- test of sections as construction proceeds;
- a final test of the whole of the pipework or pipeline on completion.

The Contractor shall submit to the Engineer, in advance of the time for tests, details of his proposals. The proposals shall include details of temporary works to resist test pressures and methods for carrying out the test. Proposals for testing where thrusts on structures are involved, even where thrust collars on the piping are installed, shall be submitted, with the calculations of the forces to be carried, to the Engineer for approval. The proposal shall include details for transporting the test water from the point of supply to the pipeline to be tested. No connections to the pipeline or pipework which would involved cutting, tapping or otherwise permanently altering the Permanent Works, will be allowed.

Procedure

Each section of the pipeline or pipework to be tested shall be capped or blanked off at each end and securely strutted or restrained to withstand the considerable forces that will be exerted when the test pressure is applied. Testing against closed valves will not be permitted. Hydrants, washout valves and isolation valves shall be fitted with blank flanges and these together with in-line valves shall be left open. Air valves already fitted shall be permitted to function during the test. The air valve manufacturer's confirmation shall be obtained that the valves are capable of withstanding the test pressure involved.

The section under test shall be filled making certain that all air is displaced through an air valve installed at the high end of the line. The section shall then remain under constant moderate pressure – 10 to 20 m head of water – for a period of several hours until the pressure can be maintained without additional pumping. Pipes of materials liable to absorb water, eg concrete and asbestos cement, shall be allowed to become saturated under this moderate pressure for 24 hours.

The pressure shall then be slowly increased to the full test pressure and pumping discontinued for 3 hours or until the pressure has dropped by 10 m, whichever occurs earlier. Thereafter pumping shall be resumed and continued until the test pressure has been restored. The quantity of water pumped to restore the pressure shall be the measure of leakage from discontinuation of pumping until its resumption.

The pipe section shall be considered as having passed the test if the leakage is not more than 0.365 l/mm of pipe diameter per kilometre per 24 hours for each 100 m head of pressure applied.

Notwithstanding the satisfactory completion of the hydraulic test, if there is any discernible leakage of water from any pipe or joint the Contractor shall, replace the pipe, repair the pipe or re-make the joint and repeat the hydraulic test all at his own cost.

No line shall be accepted until and unless the leakage of any section of the lines tested is not more than the rate of leakage specified above. All activities required to locate leaks and their repair and the repeat of the hydraulic test shall be at the Contractor's expense.

Pipelines shall be tested as above except where the Engineer issues such instructions as are necessary for testing parts of the Works that have been designed for stresses limited by considerations other than those applying to the pipeline systems.

Test Pressures

Test pressures are to be measured at the centre of the blank flange situated at the lowest end of the pipeline under test. All pipelines shall be tested to a pressure corresponding to a hydraulic grade of 1452 masl.

The contractor shall submit a schedule of pipeline test pressures to the Engineer for approval prior to commencing testing.

Sectional Hydraulic Test

The Sectional Hydraulic Test shall be carried out after the pipeline or pipework section to be tested has been laid, jointed and backfilled to a depth sufficient to prevent flotation of the pipeline. The sections to be tested shall be to the approval of the Engineer and shall be not longer than 2,000 m or 500 m when either the pipeline is laid adjacent to or underneath the carriageway.

In addition to the above requirements the Contractor shall perform a hydraulic test on the first 200 m length of pipeline of each diameter to be laid under the Contract. This test shall be undertaken within one month of the Contractor commencing the laying of pipes. Should the pipeline fail the test or the Contractor fail to undertake the test, all laying work for that diameter shall come to halt until that section of pipeline passes the hydraulic test.

Hydraulic Test on Completion

The test on completion shall be carried out after all the pipeline sections have been joined together on completion of sectional testing. The joints between sections shall be backfilled once the test is satisfactorily completed.

3.3.8 Measurement and Payment

The rates for pipelaying and installation shall include for transportation of the, cutting and repairing pipes, installation of polythene sleeving, laying and jointing of the pipe, testing & commissioning, protection of flanges, the provision and placing of bedding material, dewatering, and backfilling of trenches and disposal of excess material and spoil, and demonstration of laying as specified in Clause Laying.

Pipe laying and installation will be measured as the distance along the centreline of the pipeline with no deductions for chambers etc, according to the depth to invert of the pipeline.

Valve Chambers will be measured separately according to type.No separate payment will be made for, provision of materials, construction of the chamber, installation of valves and specials supplied by the Employer, backfilling and disposal of excess material.

3.4 Sewers and Stormwater Drainage

3.4.1 Scope

This specification covers the general construction requirements for sewerage and stormwater drainage systems including connecting sewers, manholes, and the like, but excluding sewer pressure mains, pump stations, treatment works, and ancillary works.

3.4.2 Interpretations

Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

1 General
2.1 Site Clearance
2.2 Earthworks, as applicable
3.1 Pipe Trenches
3.2 Pipe Bedding

2.3 Concrete
2.4 Brick/stone work

Application

This specification covers the clauses that are generally applicable to sewer and stormwater drainage construction.

Definitions

For the purpose of this specification the following definitions shall apply:

Expansion pipe joint - A pipe joint that allows relative longitudinal movement between adjacent pipes without the occurrence of fracture or leakage.

Flexible pipe joint - A pipe joint that allows relative angular (radial) and longitudinal movements between adjacent pipes without the occurrence of fracture or leakage.

Geofabric blanket - A blanket so woven from synthetic fibres that it is capable of acting as a filter that retains some or all of the solid particles carried by a fluid but, with varying degrees of restriction, allows the passage of the fluid.

Invert slab - The slab, normally of concrete, that forms the bottom of the culvert.

Prefabricated culvert units - Portal or rectangular culvert units that have been prefabricated from reinforced concrete.

Rigid pipe joint - A pipe joint that allows no relative movement between adjacent pipes without the occurrence of fracture or leakage.

Abbreviations

For the purpose of this specification the following abbreviations shall apply:

AC	*Asbestos cement*
CI	*Cast iron*
CID, DN	*Constant inside diameter*
COD	*Constant outside diameter*
PVC	*Polyvinyl chloride*
uPVC	*Unplasticized polyvinyl chloride*
CP	*Machine made concrete pipe*
RCP	*Reinforced concrete pipe*

3.4.3 Material

Pipes, Fittings and Pipe Joints

For drainage and sewerage prefabricated concrete pipes NP2 or NP3, built according to provisions of NS80/2042 or equivalent shall be used.

The concrete pipes shall have circular cross-section and jointed using a collar. The concrete pipes must be of uniform condition. They must not exhibit any damage or be affected in any way likely to impair their serviceability, their strength, water tightness and service life.

All the pipe used in the Works will be from the same manufacturer. The manufacturer must be a nationally recognized and specialized concrete pipes manufacturer. On first starting production the manufacturing plant must demonstrate, prior to delivering concrete pipes that the pipes comply with the requirements of NS 80/2042. The tests necessary for this purpose must be carried out by an accredited testing agency having suitable testing equipment at its disposal.

The collars must be matched to the dimensions of the pipes and must be included in the delivery of the pipe. The dimensions of the collars must comply with NS 80/2042 or equivalent.

Alternative Materials

Should the Contractor proposes to use pipes and fittings of material other than those referred to above, he shall submit for approval detailed specifications including full details of the type of joints and specials he proposes to use with such pipes and fittings. The Contractor shall not use such pipes or fittings until he has obtained approval for the use from the Engineer.

Bedding

The requirements for bedding of specification Clause

Pipe Bedding shall apply.

Culvert Units and Pipes

Prefabricated culvert units and pipes shall be either precast concrete pipes, or portal and rectangular precast concrete culvert units, as applicable.

Concrete

Concrete, cast-in-situ or precast concrete, shall comply with the relevant requirements of specification Clause Concrete.

Manholes, Catchpits and Accessories

Bricks and mortar shall comply with the relevant requirements of specification Clause Brickwork/Stonework..

Prefabricated manhole sections may be of spun concrete, asbestos cement, glass-reinforced polyester, PVC, or such other material as are approved by the Engineer. Covers and frames for manholes and grid inlets shall be supplied in matching sets, each set bearing a serial number to enable it to be identified.

Step irons shall comply with the applicable requirements of BS 1247 or equal approved and shall be of suitable length for the wall of the manhole into which they are to be built.

Geofabric Blanket

The synthetic fibres of a geofabric blanket shall consist of at least 85 % by mass of polyester, polyethylene, or polypropylene, or a combination of these polymers, and shall contain such additives as are necessary to render the geofabric blankets resistant to the effects of ultra-violet radiation and heat.

The Engineer's approval of the make and grade of the geofabric shall be obtained by the Contractor before he orders any geofabric or uses it on the Works.

For normal application, and if not otherwise directed by the Engineer or specified in the Particular Specification, geofabric blankets shall be of the non-woven, needle-punched type with a specific weight of approximately 270 g/m2.

3.4.4 Construction Equipment

The equipment and rigging equipment used by the Contractor for the handling and placing of pipes shall be of the type recommended by the pipe manufacturer and subject to the approval by the Engineer and shall be such that no pipe is overstressed during any operation covered by the specification.

The Contractor may use any acceptable device, including one incorporating a laser beam, to control the alignment and laying of the pipeline.

The Contractor shall provide all the equipment, materials, tools, and fittings required for the performance of the tests given in Clause Testing and Acceptance, below, and shall provide suitable equipment for the location of faults up to the date of issue of the final certificate.

3.4.5 Construction and Workmanship

Trench Bottom

The trench bottom shall be prepared as specified in Clause Pipe Trenches. Trenches shall be kept sufficiently dry to allow proper and safe bedding, laying, and jointing of pipes and kept dry until the pipeline has passed the required tests and construction of the selected fill blanket over the pipes has been completed.

For the laying of culvert elements, the trench bottom shall be excavated to a depth of 75 mm in soil, or 200 mm in rock, or such other depth as may be shown on the drawings, below the level of the underside of the precast invert slab or to the level of the underside of the cast-in-situ invert slab, as applicable, and this space shall be filled with granular material, compacted, and shaped to enable the culvert units to be bedded properly.

Where, because soft, soggy, spongy, or otherwise unsuitable material is encountered, the bottom of the trench as excavated does not provide a suitable firm foundation for the culvert, the unsuitable material shall be excavated to a depth below the bottom of the culvert indicated by the Engineer and replaced with gravel or other approved granular material compacted to at least 90 % of modified AASHTO maximum density. When so ordered, the Contractor shall construct a layer of concrete blinding, at least 75 mm thick, to provide a suitable working floor.

Bedding, Laying and Backfilling

Each pipe and fitting shall be thoroughly cleaned out and carefully examined for damage immediately before laying. The onus of detecting damaged pipes and fittings before installation shall be on the Contractor. Should any damaged pipe or fitting be found in the sewer after it has been laid, the damaged item shall be removed and replaced at the Contractor's expense.

Pipes shall be laid on the specified bedding cradle true to designated line and level, and the bedding shall be placed and compacted in accordance with the applicable requirements of Clause Construction and Workmanship. Designated invert levels shall take precedence over design depths shown on drawings.

The completed sewer or stormwater drain shall have no bends or undulations except where directed. Should pipes be allowed to have any deviation from straightness, they shall be so laid that preference is given to level over line.

The method of laying and bedding shall be such that barrels of pipes bear evenly on the bedding for their full length, that no packing is used under the barrels, and that no socket or coupling bears on the bedding. Where the slope of a pipe is greater than 1 in 10, anchor blocks shall be constructed according to the details provided.

Pipes shall be so cut as to obtain a clean and square end, and, where pipes and fittings of different material shall be jointed, shall be so only with special adaptors recommended by the pipe manufacturer(s).

All pipe openings shall be sealed by the Contractor to ensure that no water, stones, or other foreign matter enters the sewer during or after laying.

The sewer or stormwater drains shall be so jointed to the pipes built into the manholes that there is a flexible joint positioned as close as possible to the manhole.

Precast units shall be lifted and handled only by means of lifting devices approved by the manufacturer.

The Contractor shall exercise due care not to damage, overstress, or displace any culverts by the imposition of any loads such as may be caused by the movement of his own vehicles or compaction equipment. Where superimposed moving loads in excess of those prescribed in the applicable road traffic ordinance are, during the construction of the Works, likely to pass over completed culverts, the Contractor shall provide sufficient additional cover over the culverts to ensure that the design stresses on the culverts are not exceeded.

Any units that become deformed or cracked, or that are not constructed to the required lines, levels, and grades, or that become displaced in the course of the work, shall be removed and replaced by the Contractor at his own expense.

Cast-in-situ invert slabs for portal or rectangular culverts shall be constructed to the dimensions and at the locations shown on the drawings or as directed. They shall be reinforced as detailed on the drawings. The units of the upper portion of precast portal culverts shall be placed accurately on the invert slabs, with a thin layer of 1:3 cement: sand mortar between the horizontal contact surfaces to ensure a firm and uniform support. The units of the upper portion shall be butt-jointed end to end and each joint shall be covered with

geofabric blanket placed symmetrically over the joint.

Pipe culverts shall be laid and bedded to the level and alignment shown on the drawings or as directed. They shall be laid hard up against each other longitudinally to obtain tight joints and they shall be supported evenly throughout the barrel length. Holes or grooves of adequate size to allow for jointing and for bedding thickness under joints, shall be cut in the bottom of the trench. Pipes shall be laid centrally in the trench in such a manner that the side allowance as specified in Clause Pipe Trenches are available as working space for the proper bedding of the pipes in accordance with the requirements of Clause

Pipe Bedding. For ease of inspection pipes shall be laid with the manufacturer's class and quality identification marks visible from the top of the trench unless, in the case of larger pipes, the position of lifting eyes renders this impractical.

Each pipe shall be cleaned out and carefully examined for possible damage immediately before laying. The onus on detecting damage shall rest on the Contractor. Should any damaged pipe be laid, it shall be removed and replaced at the Contractor's expense and to the satisfaction of the Engineer.

Joints of butt-ended pipes shall be externally wrapped with either 2 layers of 0.5 mm thick plastics damp course or one layer of geofabric blanket. The wrapping shall be at least 200 mm wide and be centrally placed over each joint.

Ogee type pipes need not be wrapped but shall be laid with the spigot ends pointing downstream.

Spigot and socket pipes with rubber ring joints shall, unless another method is directed or approved by the Engineer, be jointed in accordance with the manufacturer's instructions.

Backfilling of pipes and pipe culverts shall comply with the applicable requirements of specification Clause Pipe Trenches.

Material for backfilling of portal or rectangular culverts shall comply with Clause Materials, and shall be obtained by the Contractor from approved borrow pits, if necessary.

Backfill alongside the walls and over the top of culverts shall be watered, mixed, placed, and compacted in layers not exceeding 150 mm after compaction, to a density at least equal to that required for the material in the adjoining layers of fill, subgrade, and subbase, as applicable, or to at least 90 % of modified AASHTO maximum density in the case of excavation made in natural ground.

Backfilling shall be carried out simultaneously and equally on both sides of the structure to avoid unequal lateral forces.

Manholes, Inspection Chambers, Catchpits etc.

Manholes, inspection chambers, catchpits, inlets, outlet structures etc., shall be constructed of cast-in-situ concrete, precast concrete, brickwork, as shown on the drawings or as directed by the Engineer.

Manholes shall be provided in following situations:
changing of direction,
changing of slope,
changing of diameter
interception of secondary lines,
interception of house connections,
on main lines at a distance of max. 80 m.

Manholes shall comply with the requirements of NS 80/2042.

The incoming and outgoing pipes shall be fixed in position as detailed before concreting. The concrete surrounding these pipes shall be placed in a single operation and particular care shall be taken to ensure that it fills the whole space beneath and around the pipe.

Benching shall be left completely smooth to the satisfaction of the Engineer. The concrete surround shall be formed using properly constructed formwork.

Selected material shall be carefully filled in and compacted behind the concrete and made solid after the concrete has hardened sufficiently and the protective coating has cured and been properly protected.

Cover slabs shall not be placed until 24 hours after the placing of the concrete manhole surround. This time may be increased or decreased to the discretion of the Engineer.

Step Irons

Step Irons shall be of cast iron or mild steel and they will be built into concrete as the work proceeds at 300 mm apart vertically.

The entire steps shall be corrosion protected as specified to the approval of the Engineer

Manhole and Chamber Covers

All covers and frames shall comply with Clause 3.3.5.8.

Concrete Casing to pipes

In special cases, and where ordered by the Engineer, pipes shall be encased in concrete of the specified grade, generally of at least 15 MPa. The lower part of the encasement shall be constructed in the manner specified for Class A bedding (see Clause

Pipe Bedding). Once the sewer or stormwater drain has been tested and approved, the pipes shall be surrounded with concrete to the specified depth and expansion joints shall be cut or constructed in the upper part to coincide with those in the lower part. Use shall be made of poker vibrators to ensure proper filling with concrete of all spaces under and around the pipe, and displacement or flotation, or both, shall be prevented. All temporary supports provided for the pipes shall be removed as concreting progresses. No earthfilling over the concrete shall be commenced until at least 5 days after the concrete has been placed or until the concrete has attained a strength of at least 10 MPa.

Raising or Lowering of Existing Manholes

Where an existing manhole is required to be raised or lowered, the work shall be so carried out that the finished manhole complies with the applicable requirements of Clause 3.3.5.3 above. Where practicable, the same cover shall be used, which shall, on completion of a manhole be flush with the surface of the finished road, shoulder, or sidewalk, as the case may be.

Connecting Pipes

Connecting sewers or stormwater drains shall be laid from junctions provided in the main lines to the positions and depths as shown on the drawings or as directed.

The Contractor shall record all relevant data (eg. street name, number of plot, location measurements and distances in relation to boundary peg(s), size of connection, depths of invert at connecting point and end of connection etc.) for the preparation of "as-built" drawings, and shall make these records available to the Engineer.

Action to be Taken During and After Testing

The Contractor shall make good any defects that may be found while the pipeline is under test and after that the tests shall be repeated at his expense until the pipeline is found to comply with the specification.

After the sewer or stormwater drain has passed the tests all access lids shall be properly sealed with bitumen or by any other approved method in watertight manner.

Reinstatements of Existing Drains

The existing drains damaged by the works shall be relocated and connected into new drains as required. Existing drains shall be cleaned out from the new drain trench face and any disturbed pipe relaid to ensure a free discharge into the new drain. The disused end of the intercepted drains shall be sealed with puddle clay or other approved materials.

Where an existing land drain is exposed and temporarily severed by trench excavation, the position of the drain shall immediately be marked and recorded. The normal functioning of the drain until permanent restoration is made shall be maintained by the construction of a watertight conduit adequately supported across the trench.

Without limiting the Contractor's liability for restoration of damage, the Contractor shall notify the Engineer of any drain which is blocked or is otherwise defective when the drain is first exposed.

When the line of an existing drain interferes with a pipeline, the Contractor shall deal with the drain as directed. Drains shall be reinstated on their original line, unless the Engineer orders otherwise.

When backfilling is being done the temporary conduit shall be removed and the ground below the line of the drain shall be compacted. The positions of the ends of the drains shall be marked and the trench reinstatement completed. The trench for the drain shall be re-excavated and the drain reinstated with approved material laid on supports. The line, level and grade of the original drain shall be maintained.

The supports shall be of durable material and shall be bedded firmly at 500 mm into the undisturbed ground on the trench sides. The supports shall be of suitable timber having a cross section not less than 150 x 65 mm or such section as would be required to permit the laying of the new drain without deflection.

3.4.6 Tolerances

General

Tolerances will be determined on the basis of permissible deviations from designated location, alignment, grades, and levels. The Contractor shall construct each of the various parts within the limits set out below.

Manhole and Catchpit Locations

The permissible deviation of the location of manholes and catchpits (other than kerbside catchpits) in plan of the designated position shall be half the pipe length longitudinally and ± 200 mm laterally, except where locations are dimensioned from fixtures such as fences, kerbs, and the like, in which event the permissible deviation in each direction will be ± 50 mm.

Such manholes or chambers shall be constructed at the meeting points of intersecting pipelines subject only to such deviations as can be tolerated by the junction channels or specials.

Invert Levels

The permissible deviation from the designated level of the invert at each manhole shall be ± 50 mm but, should the fall between any two successive manholes be less than 90 % of that specified, the said permissible deviation shall be reduced to a value such that the fall is at least 90 % of that specified.

The permissible deviation of the level of the invert of a culvert from the designated level shall be ± 25 mm.

Alignment and Grade

Subject to the permitted manufacturing tolerances applicable to the pipes being laid, the line of the pipe invert shall at no point between successive manholes deviate from a straight line by more than 5 % of the nominal diameter of the pipe, or be lower than at any other place closer to the lower manhole.

The permissible deviation of the alignment and grade of each culvert shall be ± 25 mm from the designated line and level, when measured over any 6 m length, and all such deviations shall be gradual.

Manholes and Chamber Structures

The dimensions of walls and roofs of manholes and chambers shall conform to the dimensions specified, subject to the allowable tolerances laid down for concrete structures (see Clause 2.3)

Kerbside Catchpits, Kerb Inlets or Grid Inlets

The permissible deviations of the longitudinal location shall be half a kerb length or 0.5 m, whichever is the greater and the permissible deviations of the lateral location from the designated distance from the centre line of the road shall be ± 25 mm, except that any open grid or grid frame shall be truly parallel to and within 5 mm of the face of the kerb.

3.4.7 Testing and Acceptance

General

Tests described below apply to sewers and stormwater drain and references to a sewer apply equally to a drain.

All acceptance tests shall be carried out in the presence of the Engineer and at such times and in such manner as the Engineer may direct.

No pipe joint or fitting shall be covered until the tests applicable have been completed and the Engineer has authorized such covering.
The sewer or any section of it shall be inspected by the Contractor who, if he deems it ready to be tested, shall advise the Engineer of his intention to subject the sewer or the said section of it to the appropriate tests. The sewer shall be tested in sections between manholes or chambers, as applicable, the section being tested being isolated from other sections by means of suitable plugs or stoppers that have been braced adequately. Notwithstanding any authorization by the Engineer as described above, the Engineer may, after backfilling and compaction have been completed, order that the sewer be retested to check that it has not been disturbed or damaged during backfilling.

The Engineer may order one of the following to be carried out on the sewer or any section of it:
a) an air test on pipes, other than concrete pipes, of all sizes; or in the case of pipes, other than concrete pipes, of diameter up to 600 mm, an air test followed by a water test
b) a water test in the case of pipes of diameter up to 750 mm
c) a visual internal inspection in the case of pipes of diameter greater than 750 mm.

The Contractor shall provide all labour and apparatus (including expandable plugs and flexible bag stoppers) that may be required for carrying out the tests.

All test results shall be recorded in the manner directed, whether or not the pipeline or section of pipeline has passed the test.

Tests and Acceptance/Rejection Criteria

a) Air test: An approved air testing machine shall be used to raise the gauge pressure in the section of the pipeline under test first to 3.75 kPa. After a 2 min stabilization period the pressure shall be reduced to 2.5 kPa. The machine shall than be switched off and the time taken for the pressure to drop from 2.5 to 1.25 kPa shall be measured. The time taken shall be at least 2 min for ND 100, 3 min for ND 150, 4 min for ND 200, 4.5 min for ND 250, 6 min for ND 300, 8 min for ND 400, 10 min for ND 500, 12 min for ND 600, and 14 min for ND 700. Times applicable for other diameters may be interpolated.
b) Water test: The section of the pipeline under test and the manhole at the upper end of the said section shall be filled with water to such depth that every portion of the pipeline is subjected to a pressure of not less than 12 kPa and not more than 60 kPa. During the test there shall be no discernible leakage of water. An appropriate period, which shall be at least 12 min, shall be allowed for initial absorption, and the loss of water over the next 30 min shall be noted. The amount lost, in litres, per 100 m of pipeline per hour, shall not exceed the following values: 6 for ND 100, 9 for ND 150, 12 for ND 200, 15 for ND 250, 18 for ND 300, 23 for ND 400, 29 for ND 500, 36 for ND 600, and 44 for ND 700. Amounts applicable for other diameters may be interpolated.

c) Tests on existing pipes shall be carried out in accordance with the above unless directed otherwise by the Engineer.
Should any section of the pipeline fail to pass the water test, a re-test will be permitted and, in such case, acceptance or rejection of the section will be determined on the result of the re-test.

Rejection

In the case of AC, vitrified clay, and fibre pipes, failure under the air test will be deemed to be cause for rejection. After such rejection the Contractor may apply a water test to locate the source of failure, rectify the pipeline, and re-apply the air test. In the case of concrete, failure under the water test will be deemed to be cause for rejection.

Testing of Connecting Sewers

Each connecting sewer shall be tested between its upper end and the junction at the main sewer. The upper end of the connection shall be kept securely closed with expanding plugs during the test. Where practicable the Contractor may test the main and connections simultaneously if he so wishes. On completion of the test, the upper end of the connection shall be permanently sealed by means of a plug stopper suitable for the type of pipe.

3.4.8 Measurement and Payment

The rates for pipelaying and installation of sewers and storm drains shall include for supply of the pipes, laying and jointing of the pipe, the provision and placing of bedding material, and backfilling of trenches and disposal of excess material and spoil, and testing of the sewer or drain. Pipe laying and installation will be measured as the distance along the centreline of the pipeline with no deductions for manholes etc, according to the depth to invert of the pipeline. Manholes, catchpits, inlets will be measured separately according to type. No separate payment will be made for, provision of materials, construction of the manhole, catchpit or inlet, backfilling and disposal of excess material.

3.4.9 Technical Documents

Drawings and Documentation to be submitted with Proposal

Tenderer shall submit with proposal the following drawings and documentations in addition to the information required by other section of this specification. The drawings where applicable, shall show the terminal points of Contractor's scope of supply.

3.4.10 Technical Data

All blank space in the technical data sheets in other section of specification, shall be completely filled in with the required information or where not applicable to Contractor's, offer a horizontal line shall be drawn and if any more necessary shall be added.

3.4.11 Drawings And Document

- Outline drawings showing dimension, for pump, motor, instrument panel, if any.
- Sectional drawings of major equipment
- P & I diagrams including terminal points, if sealing, cooling or lubricating are required.
- Loading diagrams for civil work
- Characteristic curves
- Recommended operating logic diagrams
- Available delivery schedule
- Test and inspection schedule
- Spare part list
- Special tool list
- Motor (or electrical power consumption) list.
- Instrument and set-point list
- Experience or reference list
- Manufacturer's catalogues and literature to supplement the drawings and illustrate the equipment, instrument, fitting, furnishing, etc.
- Control schematic and wiring diagram if required.
- Any other drawings or data not specifically called for, but necessary to fully describe the offer.

Drawings and Documents to be Submitted After Contract

- Contractor shall furnish for approval the indicated drawings and data within the time limit set forth in the purchase order.
- Drawings and documents called for below, shall be a guideline of drawings and documents to be provided by Contractor.
- Contractor shall resubmit all data and drawings, which were submitted with proposal, for approval after contract.
- Contractor shall submit the technical data and drawings for electric motor as per specification of electric motors.
- Lists and schedules
- Master drawing list showing the submission schedule
- Spare part list with sectional and/or outline drawing
- Special tool list with sectional and/or outline drawings
- Clearance and tolerance list

Detail drawings

- Assembly drawings of all equipment
- Dismantling drawings
- Detail drawings showing construction of all valve type and dimensions for all size.

Procedures and manuals

- Test and inspection procedure
- Installation manual
- Initial start-up procedure including check list and typical format
- Optical manual
- Maintenance manual
- Test and Inspections Reports
- As-Built Drawings

As Built Drawing

Contractor shall submit to the Engineer as-built drawings, which were submitted for approval and for construction.

4 PIPELINES AND RELATED WORKS

4.1 General

4.1.1 Materials

The term materials shall mean all materials and articles of every kind, raw, processed or manufactured, which are used in the manufacture of goods to be used under the Contract.

All materials shall be new and of the kinds and qualities described in the clauses hereof appropriate to the particular item and shall be at least equal to approved samples except that alternative materials may be accepted provided the Contractor has at the time of tendering :

a) Drawn particular attention to the deviation from the Specification in his bid and provided particulars of the alternative material offered at the time of tendering, and

b) Substantiated, to the satisfaction of the Engineer, that the material offered is equal or superior to the

material specified for the use to which it is to be put and has obtained from the Engineer's approval in writing to its use. Where materials to be used for any component have not been laid down in the Specification the Contractor shall use only those materials in such compositions as have been proven in actual service to be the most suitable for the particular purpose.

All pipes and assembling parts selected under this Contract must be of first quality, truly circular, of a uniform thickness, free from scale, lamination, honeycombs, and other defects, and shall be designed to withstand the stated pressures and temperatures. They shall be of service proved products of specialized manufacturers.

Each pipe length should be as long as indicated in the drawings. When not indicated, the length should be as long as practicable to keep the number of joints to a minimum.

Where the coating of pipes is damaged, the surface shall be cleaned and dried and the Contractor shall paint the damaged area with a minimum of three coats of paint and to the full thickness and specification as the original coating.

4.1.2 Equivalency of Standards and Codes

Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national, or relate to a particular country or region, other authoritative standards which ensure an equal or higher quality than the standards and codes specified will be accepted subject to the Engineer's prior review and written approval. Differences between the standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's approval.

In the event the Engineer determines that such proposed deviations do not ensure equal or higher quality, the Contractor shall comply with the standards specified in the documents.

4.1.3 Standards and Codes

All workmanship, materials and components throughout shall, where applicable and unless otherwise stated in the Contract, comply either (a) with the relevant International Standard ISO, (b)with the relevant British Standard or Code of Practice current on the date fixed for receipt of tender, (c) comparable Indian Standards, (d) with the relevant Nepal Standard or as per Engineer's approval.

The following is a list of some nationally and internationally accepted standards and codes and some associations concerned with the standardization of products and abbreviations below will be used in the following text.

4.1.4 Test Certificates

Certificates in triplicate shall be provided by the Contractor for each material such as valve, pipe, and fitting giving the process of manufacture and the results of the specified tests.

Similar certificates in triplicate shall be provided by the Contractor in respect of materials to be used in the manufacture of the valves, pipes and fittings giving the process of manufacture, chemical analysis (where relevant) and the results of specified tests.

The materials shall be suitably marked to enable them to be identified from references on the certificates.

4.1.5 Samples of Materials and Tests on Samples

The Contractor shall provide to the Engineer three copies of the results of any routine analyses or tests carried out by him or his manufacturer on materials used in the manufacture of the Goods.

In addition, when and if required by the Engineer, the Contractor shall provide samples of all or any materials used in the manufacture of the Goods and shall carry out any specified test on the said materials as may be required the Engineer at the place of manufacture or at a laboratory approved by the Engineer and shall provide to the Engineer within seven days of each such test three certified copies of the results of the analysis or test.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Engineer. The Contractor or his manufacturer shall prepare the necessary test pieces and supply all labour, appliances, testing apparatus and everything necessary for carrying out all specified tests.

The Contractor shall give the Engineer 14 days notice in writing of the date on which any of the samples will be ready for testing or inspection and unless the Engineer shall attend at the appointed place within the said 14 days, the test may proceed in his absence.

Approval by the Engineer as to the placing of orders for materials or as to samples or tests shall not prejudice any of the Engineer's rights under the Contract.

4.1.6 Independent and Local Tests

The Engineer reserves the right to carry out any independent or local tests he may deem fit on the completed pipes and fittings or on any material provided under the Contract at any stage during the Contract. In addition to any relevant clause in the General Conditions of Contract any materials, workmanship or completed pipes and fittings which are shown by such independent tests not to be in accordance with the Specification shall be rejected notwithstanding any previous certificate which may have been provided.

Any pipes and fittings, which have been rejected, shall be marked in a distinctive manner, which shall preclude any possibility of their use for the purpose for which they were supplied. Such pipes and fittings may be submitted for re-test following the correction of any defects, where such corrections are permitted by the Engineer

4.1.7 Rejected Goods

Any Goods delivered to the site which have been rejected by the Engineer shall immediately be removed

from the site. Replacement of rejected Goods shall be made as soon as possible but in no case exceeding thirty (30) days from the time of rejection.

Any pipes which have been rejected shall be marked in a distinctive manner which shall preclude any possibility of their use for the purpose for which they were supplied. Such pipes may be submitted for retest following the correction of any defects, where such correction is permitted by the Engineer.

4.2 DUCTILE IRON PIPES AND FITTINGS

4.2.1 General

Ductile iron pressure pipes and fittings shall comply with ISO 2531(2009).

All pipes are socket and spigot unless otherwise specified and up to a diameter of 300mm shall be Class C40,pipes with diameters from 350 to 600mm shall be Class C30and pipes greater than 600mm shall be Class C25.

All fittings (spigot, socket and flanged) shall be PN 16. All socketed fittings shall meet the requirements of 4.2.1.3 of ISO 2531 (2009).

Considering the geometric design of road of the Kathmandu Valley, the effective length of the pipe shall be 5.5 to 6.0m. However, smaller required length as per site condition, would then be modified at site without damaging the properties of the pipe and with no extra cost and time.

The manufacturer should be equipped with a specific devise in order to control the wall thickness of pipes.

All DI fittings have to produce by Sand Mould cast using a sand mould plus a resin-sand core, so as to ensure the designed shape(to ensure accurate dimensions that guarantee joint water tightness) and thickness(to ensure strength) of fittings.

4.2.2 Materials

The materials used in the manufacture pipes and fittings shall comply with ISO 2531(2009).

4.2.3 Tests

Tests on pipes and fittings shall be carried out in accordance with ISO 2531 (2009). The Employer shall be permitted free access to the place to manufacture for the purpose of examining and witnessing the testing of pipes and fittings.

4.2.4 Joints

4.2.4.1 Flexible non restrained (push fit)

These shall be flexible spigot and socket joints with sockets integral with the pipes and incorporating rubber rings recommended by the manufacturer and approved by the Engineer. Elastomeric gasket components shall comply with ISO 4633.

All push on joints shall be designed to be fully flexible; consequently, the angular deflection certified by the manufacturer shall not be less than the allowable angular deflection in article 5.2.2 of ISO 2531(2009), but preferably to provide below angular deflection degree in order to achieve the best protection to the safety of the pipeline in the event of unequal ground settlement due to the earthquake and swampy area.

All joints shall be designed to provide sufficient axial movement, the manufacturer shall declare the allowable withdrawal.

4.2.4.2 Mechanical joints

These shall be flexible spigot and socket joints with the sockets integral with the pipes. The joint shall be sealed by compressions of a rubber ring in the socket by means of bolting. The joint shall be suitable for use on the spigot of normal push fit jointed pipe.

4.2.4.3 Restrained joints

These shall be push fit type joints and shall incorporate some means of preventing the spigot being withdrawn from the socket once the joint is made. The joint shall be able to withstand the forces imposed when testing the pipeline using an end cap fixed with the restrained joint.

4.2.4.4 Flanged Joints

All flanges shall comply with ISO 7005-2 or EN 1092-2. Joint sets shall be provided with all necessary nuts, bolts, washers and gaskets. The Contractor shall also supply in suitable containers sufficient graphite grease for application to the bolt threads when joints are made.

4.2.4.5 Nuts, Bolts and Washers

Hexagonal Nuts, bolts and plain washers shall be of product grade C suitable for use with ISO 2531(2009) or BS EN 1092-2 flanges and shall be made of steel with hot dipped galvanization.

Bolts shall be of sufficient length that one thread shall show through the nut when in the fully tightened condition.

4.2.4.6 Gaskets and Joint Rings

Joint rings shall be manufactured to conform to ISO 4633 and shall be of chloroprene rubber or other approved synthetic material suitable for temperatures up to 50 C.

Gaskets for flanged joints may be inside the bolt circle type and shall comply with BS EN 1514 or ISO 7483. Alternatively the gasket shall be to the full diameter of the flange, drilled to suit the appropriate bolt provisions.

Until immediately required for incorporation in a joint, each rubber ring or gasket shall be stored in the dark, free from the deleterious effects of heat or cold, and kept flat so as to prevent any part of the rubber being in tension.

Only lubricants suitable for use with potable water and recommended by the manufacturer shall be used in connection with rubber rings and these lubricants shall not contain any soluble constituent, shall be suitable for the climatic conditions of the Site and shall contain an approved bactericide.

4.2.4.7 Underground Warning Tape

The underground warning tape shall be non-detectable, color blue, 10cm wide,4mm thick made of PVC or Polyethylene, The Tape shall be printed with the words " WATER LINE BELOW" at intervals not exceeding 500mm. The tape shall have a minimum tensile strength of 1750 psi.

4.2.4.8 Puddle and Thrust Flanges

Puddle and thrust flanges shall comply with Clause 6.4.1 but remain un-drilled.

4.2.5 Internal Linings- Pipe

4.2.5.1 Pipes

The pipes shall be internally lined in the factory with Portland cement mortar. The thickness and the lining shall be in accordance with ISO 4179. Prior to application of the lining the internal surfaces shall be shot blast cleaned to acceptable standard. The lining shall be applied centrifugally. The cement composition shall conform to BS EN 197-1.

Certain sections are amplified as follows:

No additives shall be used without the written approval of the Engineer, and shall be used strictly in accordance with the manufacturer's recommendations.

The thickness of the lining at any one point shall not be less than the specified minimum thickness. All linings shall have a smooth uniform surface finish.

4.2.5.2 Fittings

The fittings shall be internally lined in the factory with fusion bonded epoxy coating of 250microns, in accordance with EN 14901-2006. The epoxy coating shall be suitable for potable water by test certificate from an international health institute, shall be abrasion resistant, and shall be subject to the approval of the Engineer. Prior to application of the lining the internal surfaces shall be shot blast cleaned to acceptable standard. All linings shall have a smooth uniform surface finish.

4.2.6 External Coating

4.2.6.1 General

Unless otherwise specified, ductile iron pipes and fittings shall be zinc coated with a bitumen over coating, all in accordance with the following Specifications. Buried pipes and fittings shall also have a site or factory applied polythene sleeving. Pipe coatings shall be inspected on site and any damage or defective areas made good to the satisfaction of the Engineer.

4.2.6.2 Zinc Coating

Zinc coating shall comply with ISO 8179-1and shall be applied as a spray coating. The mass of sprayed metal shall not be less than 130 g/m2 when measured as described in Clause 4.5 of ISO 8179-2.

4.2.6.3 Bitumen Coating

Bitumen coating shall be of normal thickness 0.07 mm unless otherwise specified. It shall be a cold applied compound complying with the requirements of BS 3416 Type II, suitable for tropical climates, factory applied in accordance with the manufacturer's instructions.

Damaged areas of coating shall be repainted on site as per the manufacturer's instructions after removing any remaining loose coating and wire brushing and rusted areas of pipe.

4.2.6.4 Polyethylene Sleeving

Unless indicated otherwise, polyethylene sleeving shall be provided in addition to bitumen coating. Polyethylene sleeving shall comply with ISO 8180 and be marked in accordance with AWWA C105.

Site applied sleeving shall be stored under cover, out of direct sunlit, and its exposure to sunlight shall be kept to a minimum. Pipes having a factory applied sleeving must be stored in the same conditions.

4.2.7 Pipes and Fittings Marking

In addition to the marking required to comply with ISO 2531, the pipes and fittings shall additionally bear readable and indelible marks as follows:

- A unique identification number
- Employer's Name

Spigot ends will show control marks for ease in connection.

Pipes which are gauged to allow them to be cut shall be marked by a two diametrically opposed longitudinal lines each at least 20mm wide.

4.3 HDPE PIPES AND FITTINGS

4.3.1 General Requirements

4.3.1.1 Materials

Term "materials" shall mean all materials and articles of every kind whether raw, processed or manufactured which are used in manufacture of the Goods to be supplied under the Contract.

4.3.1.2 Composition

The pipes raw materials shall be PE - 100 or equivalent approved compound consisting of virgin polythene as described in NS 40 in which carbon black and a suitable non-toxic anti-oxidant are evenly dispersed.

The Client may ask to the suppliers to produce certificate of evidence of the original raw materials used for producing pipes and also the evidence of these materials imported or purchased.

All materials shall be new and of the kinds and qualities described in the clauses hereof appropriate to the particular item and shall be at least equal to approved samples except that alternative materials may be accepted provided the Supplier has at the time of tendering:

a) Drawn particular attention to the deviation from the Specification in his tender and provided particulars of the alternative material offered at the time of tendering; and
b) Substantiated to the satisfaction of the Purchaser that the material offered is equal or superior to the material specified for the use to which it in to be put and has obtained from the Purchaser approval in writing to its use.

Where materials to be used for any component have not been laid down in the Specification, the manufacturer shall use only those materials in such compositions as have been proven in actual service to be the most suitable for the particular purpose. All pipes shall be smooth, clean and free from all defects.

The supplier must name the manufacturer(s) at the time of tendering from whom he proposes to obtain any material under the contract. As a proof, he should also include a Letter of Consent from the manufacturer(s) stating his acceptance to sell the material to the supplier on award of the contract. Normally, the material supplied should be the product from the quoted manufacturer(s). However, in situation beyond the control of the supplier, the Purchaser may consent to accept material from other manufacturer; provided he is satisfied, that the new experienced and capable to produce the material and that the product is either equivalent or superior to the product from the previously agreed manufacture. No orders shall be placed with the newly named manufacturer without the written consent of the Purchaser.

4.3.1.3 Samples of Materials and Tests on Samples

The Contractor shall provide to the Purchaser three certified copies of the results of any routine analyses or tests carried out by him or his manufacturer on materials used in the manufacture of the Goods when and if asked by the Purchaser.

In addition, when and if required by the Purchaser, the Contractor shall provide samples of all or any materials used in the manufacture of the Goods and shall carry out any specified test on the said materials as may be required by the Purchaser at the place of manufacture or at a laboratory approved by the Purchaser and shall provide to the Purchaser within seven days of each such test three certified copies of the results of the analysis or test.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Purchaser. The Supplier or his manufacturer shall prepare the necessary test pieces and supply all labor, appliances, testing apparatus and everything necessary for carrying out all specified tests.

The Contractor shall give the Purchaser 14 days notice in writing of the date on which any of the samples will be ready for testing or inspection and unless the Purchaser shall attend at the appointed place within the said 14 days, the test may proceed in his absence.

Approval by the Purchaser as to the placing of orders for materials or as to samples or tests shall not prejudice any of the Purchaser's rights under the Contract.

4.3.1.4 Test Certificates

Test certificates in triplicate shall be provided by the Supplier for each consignment of pipe supplied, giving

the process of manufacture and the results of the specified tests.

Similar certificates in triplicate shall be provided by the Supplier in respect of materials to be used in the manufacture of the pipes giving the process of manufacture, chemical analysis (where relevant) and the results of the specified tests. The material shall be suitably marked to enable it to be identified from references on the certificates.

Any materials subject to tests incorporated in the manufacture of the pipes before the Purchaser has received a satisfactory Test Certificate shall be at the Supplier's risk.

4.3.1.5 Independent Tests

The purchaser or his designated agent reserves the right to inspect and carry out any independent tests he may deem fit on the completed pipes or on any material to be used in the Contract at any stage of manufacturing in the plant or delivery, in addition to those tests specified to be made by the manufacturer.

Any samples of materials, which may be required for such tests shall be provided by the Supplier at no extra cost to the Purchaser.

The cost of making any such independent tests shall be borne by the Purchaser, unless it is shown that the workmanship or materials under test are not in accordance with the Specification, in which case the cost of the tests shall be borne by the Supplier.

Any materials, workmanship or completed pipes, which are shown by such independent tests not to be in accordance with the Specification, shall be rejected, notwithstanding any previous certificate which may have been provided.

4.3.1.6 Rejected Goods

Any Goods delivered to the Site which have been rejected by the Purchaser shall immediately be removed from the Site by, and at the expense of, the Supplier. Replacement or rejected Goods shall be made as soon as possible but in no case exceeding forty- five (45) days from the time of rejection.

Any pipes, which have been rejected, shall be marked in a distinctive manner, which shall preclude any possibility of their use for the purpose for which they were supplied. Such pipes may be submitted for retest following the correction of any defects, where such correction is permitted by the Purchaser.

4.3.1.7 Standards

All materials, workmanship and components shall, where applicable and unless otherwise stated in the Contract, comply with either:

(a) a relevant Nepal, Indian, current on the date fixed for receipt of tenders, or any other internationally accepted equivalent standards which, in the opinion of the Purchaser, are equal to or better than the specified standards.

Nepal Standard NS: 40 – 2079 published by Nepal Bureau of Standards and Metrology

Indian Standards IS : 4984 - 2016 published by Bureau of Indian Standards, Manak Bhawan, New Delhi, India;

The acceptance of a tender based upon a Standard or Code of Practice proposed by the Supplier shall only signify the Purchaser's general approval to the use of such Standard or Code of Practice and shall not signify acceptance by the Purchaser of any materials or workmanship subsequently found to be inferior to that specified in the corresponding Standard or Code of Practice.

4.3.1.8 Supply and Marking of Pipes

The Pipes shall be supplied as coils with a minimum inner diameter of 25 times the DN of the pipes (PN 6) for DN sizes of 16 mm to 50 mm as given below and for higher DN sizes in lengths of five/six meters. The pipes may also be supplied in other lengths where so agreed between the Supplier and the Purchaser. The ends shall be cut at right angles to the pipe axis and shall be plugged or covered.

Labeling and Marking of the pipe shall be done as per the requirements of NS 40:2079

Each pipe shall also have the following information marked on it: On every meter length.

i. Item number; pipe size - outer diameter; Pressure rating PN; Length; NS, IS, etc. or relevant authoritative Standards mark.
ii. The method of marking shall be such as to ensure that all of the information will remain legible after shipping, local haulage and storage in the open.

4.3.2 Testing of Pipes before Delivery

4.3.2.1 Tests

At the place of manufacture; hydraulic tests, reversion tests and internal pressure creep tests shall be carried out on ten random samples from each pipe series and diameter spaced throughout the manufacturing period.

The requirement may be reduced where a small length of a particular pipe diameter and series is to be supplied.

Pipe shall be classified by pressure rating (PN) corresponding to the maximum permissible working pressure at 30°C, as follows :

Pressure Rating	Working Pressure
PN - 6	0.60 MPa (6 kgf/cm2)
PN - 10	1.00 MPa (10 kgf/cm2)
PN - 12.5	1.25 MPa (12.5 kgf/cm2)
PN – 16	1.60 MPa (16 kgf/cm2)
PN-20	2.0 MPa (20 kgf/cm2)

Tests shall be witnessed by an independent inspection agent/ or purchaser's agent, to be appointed by the Purchaser, who shall approve the tests on behalf of the Purchaser.

4.3.2.2 Site Inspection and Testing

All Goods will be inspected after delivery to site and the Purchaser will reject any item which is damaged or not complying with the specifications.

4.3.2.3 HDP Fittings

All HDP fittings shall be manufactured by Injection Moulding Process in accordance with IS: 8008:2022 or equivalent to join HDP pipes to IS: 4984 - 2016 or equivalent. All fittings shall be moulded from a compound consisting of virgin polyethylene in which carbon black and suitable non-toxic anti-oxidant are evenly dispersed and shall be suitable for butt - welding at fusion temperature 200° C - 220 °C All fittings shall be suitable for a nominal pressure rating of PN 16 (16 bar) and shall be compatible with PE 100, PN 16 HDPE pipes. The pressure rating of the fittings shall not be less than that of the corresponding pipeline

4.3.2.4 Jointing

All HDP pipes and fittings shall be jointed with the automatic butt-welding fusion machine at fusion temperature of 200° C - 220 °C. The welding shall be as specified by the welding machine and as per manufacturer's specification.

Before joining it has to be ensured that equipment is clean, in good condition, regularly maintained and within required calibration/service. The cutter/blades and scarpers should be clean and in good condition. Mechanical Scrapers must be used wherever possible and the restraining clamps should be in good condition. Clean and dry place to place tools and equipments should be checked before during electro fusion process. The joining process should not be started unless it can be completed in one go.

Shelter and ground sheet, both in dry and wet condition should be used in order to minimize contaminations. Clamps should be used for alignment/restraining/re-rounding. Voltage should be ensured compatible with fittings.

4.3.3 Electro fusion Fittings:

Electro fusion fittings shall be used when joining polyethylene materials like couplers, reducers, tees, end caps, bends, elbows, etc. Only if absolutely necessary due to field conditions, butt fusion will be allowed, subject to the approval of the engineer. All fittings shall be manufactured by injection moulding process, with a clear marking of the manufacturer's name, pipe connection size and working pressure rating. In addition, each fitting shall have a bore code to set the fusion procedure.

The fittings shall contain no recycled compound, and shall be homogenous throughout and free of visible cracks, holes, voids, foreign inclusions and other defects that may affect the wall integrity.

The electro fusion control box should be capable of downloading jointing reports of each weld to a computer. The reports shall be appropriately identified and provided to the engineer in both paper and electronic form. The reports shall include, as a minimum, the fusion date, time, ambient temperature, fitting type and size, user ID and manufacturer of the part.

Qualification of the fusion technician shall be demonstrated by evidence of electro fusion training, within the past year, on the equipment to be utilized for the project. The training shall be certified by the electro fusion equipment supplier.

The Contractor shall submit to the Engineer a detailed installation guideline/procedure, in accordance with the fitting manufacturer's recommendations. This should include safety procedures, tools/equipment required, staff requirements including list of names of qualified electro fusion operators, pre-installation requirements, installation steps, fault rectification, inspection and process documentation as discussed above

4.3.4 Electro fusion Tapping Tee

EF tapping tee Fittings manufacturers must have relevant ISO quality certifications.
EF tapping tee is of top loading type. EF Tapping Tee Fittings must comply with the requirements of BS EN 12201-3 or ISO 4427-3 standards and to be certified by any international certifying body for compliance with BS EN 12201-3 Standard. Material of construction for – Body -- Virgin compounded PE 100 Black polymer, Composite cutter – Brass & Polymer. The grade of raw material of EF Tapping Tee used must be suitable for drinking water like WRAS, UK NSF International or equivalent. The polymer used should comply with the requirements of BS 3412 and/or BS EN 12201-1. Pressure rating will be SDR 11 (PN 16) suitable for fusing to PE 100 PN 10 Pipes manufactured in accordance with ISO 4427-2/ IS 4984 standard or as per National Standards.
EF tapping tee shall be of top loading type and EF shall be with only a single heating coil to fully electro-fuse the fitting to the adjoining pipe or pipe component as applicable. The heating coils shall be terminated at terminal pins of 4.0 millimeter diameter.
No heating element shall be exposed and all coils are to be integral part of the body of the fitting. The insertion of the heating element in the fitting should be part of the injection moulding process and coils inserted after the injection moulding process or attached to the body of the fitting as a separate embedded pad etc. are strictly not acceptable.
The brand name, size, raw material grade, SDR rating and batch identification are to be embossed as part of the injection moulding process. Each fitting should also be supplied with a barcode sticker for fusion parameters attached to the body for setting the fusion parameters on an automatic fusion control box. The barcode sticker should also include the fusion and cooling time applicable for the fitting for the manual setting of a manual fusion control box.
EF Tapping Tee should be Voltage-regulated type designed to fuse at a fusion voltage of 40 volts AC. The heating elements should be designed for fusion at any ambient temperatures between -5°C to +45°C with auto temperature compensation using automatic Barcode reader fusion machine i.e. without need for any manual compensation of fusion time for different ambient temperatures. A limited path style fusion indicator acting for each fusion zone as visual recognition of completed fusion cycle should be incorporated into the body of each fitting near the terminals. The fusion indicators should not allow the escape of the molten polymer through them during or after the fusion process A limited path style fusion indicator acting for each fusion zone as visual recognition of completed fusion cycle should be incorporated into the body of each fitting near the terminals. The fusion indicators should not allow the escape of the molten polymer through them during or after the fusion process A limited path style fusion indicator acting for each fusion zone as visual recognition of completed fusion cycle should be incorporated into the body of each fitting near the terminals. The fusion indicators should not allow the escape of the molten polymer through them during or after the fusion process EF Tapping Tee shall have such spigot length to enable second fusion of a socket fitting in case the first fusion fails. EF Tapping Tee shall have in built composite cutter with cutting edges to cut the pipe for making suitable bore. EF Tapping Tee shall have in built composite cutter with cutting edges to cut the pipe for making suitable bore. For proper fusion it is necessary to exert a pressure of 1.5 KN on top of Tapping Tee stack to ensure the coils are properly in contact with the pipe surface before fusion. Suitable top loading clamps preferably strap type shall be used which indicates the desired pressure of 1.5 KN has been achieved.
Installation: Mark the required area for scraping by placing the tapping tee of the bagged fitting alongside the pipe end without removing packing of the fitting.

Carefully scrape the marked area of the pipe in axial direction over length using a hand scraper.
Wipe the scraped surface of pipe with a suitable degreasing agent & tissue paper.

Top loaded type tapping tees to be fixed with PE pipe using spring loaded top loading clamp. In case of strap type top loading clamp tighten the knob until indicator flush to the surface and in case of pillar type top loading clamp tighten the knob till indicator pop ups to RED marking which indicates the 1.5 KN load.
Connect leads of EF Machine (control unit) with connector pins.
Read the bar code on the fitting with bar code reader (scanner) of the Electro fusion machine. Confirm parameters and start fusion.
Cool the fitting up to minimum cooling time as indicated on the fitting / barcode.
Remove cap rotate the cutter clockwise with the help of Allen key to make a hole on the pipe. Once hole is made, rotate the cutter anti-clockwise till it stops to rotate and gets locked in the groove.
The torque required to operate the cutter after fusion on the PE mains should not exceed 45 N-m.
Jointing of spigot outlet of EF Tapping Tee and EF Coupler shall be carried out as per IS 7634
EF Tapping Tee Fittings to be individually packed in sealed PE bag so that they can be used instantaneously at site without additional cleaning process. The protective packing should be transparent to allow easy identification of the fittings without opening the bag.

4.4 Galvanized Mild Steel Pipes and Fittings

4.4.1 Materials

The term materials shall mean all materials and articles of every kind, raw, processed or manufactured, which are used in the manufacture of goods to be supplied under the Contract.
All materials shall be new and of the kinds and qualities described in the clauses hereof appropriate to the particular item and shall be at least equal to approved samples except that alternative materials may be accepted provided the Supplier has at the time of tendering:-

(a) Drawn particular attention to the deviation from the Specification in his tender and provided particulars of the alternative material offered at the time of tendering, and
(b) Substantiated, to the satisfaction of the Engineer, that the material offered is equal or superior to the material specified for the use to which it is to be put and has obtained from the Engineer approval in writing to its use. Where materials to be used for any component have not been laid down in the Specification the Supplier shall use only those materials in such compositions as have been proven in actual service to be the most suitable for the particular purpose.

4.4.2 Standards

All workmanship, materials and components throughout shall, where applicable and unless otherwise stated in the Contract, comply either

(a) with the relevant Nepal, Indian or British Standards or Code of Practice current on the date fixed for receipt of tenders, or
(b) with other internationally accepted equivalent Standards or Codes of Practice which are equal or superior than the specification.

The acceptance of a tender based upon a Standard or Code proposed by the Supplier shall only signify the Engineer's general approval to the use of such Standards or Codes and shall not make the Engineer liable to accept a Standard or Code subsequently found to be inferior to that specified in the corresponding Standard or Code of Practice.

4.4.3 Test Certificates

Certificates in triplicate shall be provided by the Supplier for each valve, pipe and fitting supplied giving the process of manufacture and the results of the specified tests.

Similar certificates in triplicate shall be provided by the Supplier in respect of materials to be used in the manufacture of the valves, pipes and fittings giving the process of manufacture, chemical analysis (where relevant) and the results of specified tests.

The materials shall be suitably marked to enable them to be identified from references on the certificates.

4.4.4 Independent and Local Tests

The Engineer reserves the right to carry out any independent or local tests he may deem fit on the completed goods or on any material provided under the Contract at any stage during the Contract including the guarantee period. In addition to any relevant clause in the General Conditions of Contract any materials, workmanship or completed pipes and fittings which are shown by such independent tests not to be in accordance with the Specification shall be rejected notwithstanding any previous certificate which may have been provided.

4.4.5 Rejected Materials

Any goods delivered to site, which are rejected by the Engineer, shall immediately removed from site by the Supplier free of costs.

Any pipes and fittings, which have been rejected, shall be marked in a distinctive manner, which shall preclude any possibility of their use for the purpose for which they were supplied. Such pipes and fittings may be submitted for re-test following the correction of any defects, where such corrections are permitted by the Engineer.

4.4.6 Manufacture and Testing

Tube shall be made from tested quality steel manufactured by any approved process.
The manufacture and testing of all galvanized steel pipes and fittings shall comply with the current edition of NS, IS, BS or equivalent. Galvanized steel pipe shall be of the class specified in the Bills of Quantities.

Ends of pipes shall be plain, threaded, or beveled as per site condition and instruction of Engineer,.If threaded end instructed then it shall be generally be screwed at both ends as per IS 554 - 1975, BS 21 threads or equivalent. Ends of pipe specials and fittings shall be screw socketed suitable for screwing to IS : 554 - 1975 or BS : 27 threads or equivalent pipe threads. Where flanged pipe work is specified this shall be suitable for jointing with other flanged pipe work and valves.

4.4.7 Process of Manufacture

"Medium" and "Heavy" duty galvanized steel pipes and sockets shall be either welded or seamless as agreed to between the Engineer and the manufacturer.

4.4.8 Standard and Non Standard Lengths

The pipe shall be supplied in standard lengths of 6 metres each. Each pipe shall be provided with a corresponding size of one socket at one end and a plastic ring (cover) at the other end for protection of the threads of the pipes.

Non standard lengths shall be approximately 3 metres in length or as required by the Engineer. One socket to be provided with each pipe at one end and a plastic ring on the other end as mentioned above.

In both the cases, the total lengths for each class and diameter shall be the sum of the pipe lengths measured excluding the sockets.

4.4.9 Pipe Dimensions and Tolerances

The pipe wall thickness and outside diameter of the pipes shall comply with Section 2.4 of BS 1387 or equivalent.

The weights per metre in Kgs. of Screwed and Socketed Galvanized Mild Steel Tubes (including sockets) shall not be less than:-

Dia (mm)	Heavy Duty Kg/m	Medium Duty Kg/m	Light Duty, Kg/m
15	1.51	1.28	1.02
20	1.97	1.65	1.48
25	3.07	2.54	2.11
32	3.97	3.27	2.72
40	4.59	3.77	3.41
50	6.39	5.32	4.33
65	8.21	6.82	6.11
80	10.52	8.87	7.21
100	-	12.69	10.49

4.4.10 Hydraulic Tests

Each pipe and fitting shall be tested at the place of manufacture to a hydraulic test pressure of 50 bar without showing defects of any kind, the pressure being maintained sufficiently long (in any case not less than three minutes) for proof and inspection.

4.4.11 Galvanizing

After hydraulic testing of each item has been completed, pipes, fittings and flanges shall be thoroughly descaled, washed as required and then dipped in a bath of molten zinc, containing not less than 98.5% by weight of zinc at a temperature suitable to produce a complete and uniformly adherent coating of zinc. Where tubes are required to be galvanized, the zinc coating on the tubes shall be in accordance with IS : 4736 - 1968 or equivalent. Pipes and fittings which are to be screwed shall be screwed after galvanizing has been completed.

4.4.12 Tests on Finished Pipes

The Supplier shall arrange and carry out tests on the galvanizing in accordance with Appendix A of BS 1387 or equivalent. One pipe per batch of 500 pipes shall be sampled for this test.

The Supplier shall also arrange and carry out bending and flattening tests on pipes above 50 mm nominal diameter in accordance with Section 2.9 of BS 1387 or Section 14 of IS : 1239 (Part I) - 1979. Two pipes per batch of 500 pipes shall be subjected to these tests.

4.4.13 Pipe Specials and Fittings

Galvanized mild steel pipe specials and fittings shall conform to the appropriate dimensions given either in BS 1387 or BS 1740 or IS : 1879 - 1987 or equivalent. The material used for the manufacture of malleable cast iron fittings shall conforms any of the grade specified in IS : 2107- 1977 or IS : 2108 - 1977 or equivalent. Outlets of fittings shall be threaded to dimensions and the tolerances as specified in IS : 554 - 1975 or equivalent. Fittings shall be galvanized to meet the requirements ofIS : 4759 - 1985 or equivalent. Pressure test shall be as per section 13 of IS : 1879 - 1987 or equivalent. The dimension and weight of all fittings shall be as per the corresponding section of standards e.g. IS : 1879 - 1987 or equivalent. The ends of all pipe specials shall generally be screw socketed. If the supplier offers screw spigot ended pipe specials, a matching screwer socket shall be provided for each end of the pipe specials. All standard lengths shall be supplied with one coupling and the price quoted shall include for this.

4.4.14 Flanged Joints

Flanges shall be the boss screwed type in accordance with BS 4504 Table 16/4 or equivalent suitable for screwing to BS : 21 pipe threads or equivalent. Each flange to be supplied with one set of jointing materials.

Each set of flange jointing materials shall be supplied complete with nuts, bolts, washers and joint rings with an additional 10% as spares.Body bolts and nuts shall be galvanized, joint rings shall be of flat section 3 mm thick, medium rubber reinforced with two-ply flax fabric and complying with BS 5292 or equivalent and shall not extend beyond the bolt circle.Bolts and nuts shall be hexagonal and shall be in accordance with BS 4190 or equivalent.

4.4.15 Markings

Each standard length Medium Class galvanized pipe shall be marked with two blue bands 50 mm wide (one band at each end of the pipe) the nominal diameter, the length of pipe and the relevant manufacturing standard. Similarly for light class pipes except that the band colour shall be brown or yellow and that for heavy class red bands colour.

4.4.16 Protection Against Damage in Transit

Pipes and specials shall be protected with a suitable varnish throughout their entire length. Straight pipes shall be bundled together into convenient lots (for transport) by rope or 105 WC wire or other suitable material in at least three places. Sockets and other small fittings shall be packed in strong wooden boxes.

The threads of all pipes shall be effectively covered with a good quality grease or other suitable compound and each pipe above 50 mm diameter shall have a protecting ring affixed to the screwed spigot end. Rates should include for all packaging.

4.5 HIGH TENSILE CARBON STEEL SEAMLESS PIPE

4.5.1 Scope and Standards:

Application & Scope: This specification details the minimum requirements for the manufacture, supply, testing, internal potable-water FBE lining, transportation, and delivery of seamless carbon steel pipes. These pipes are intended for high-head mains projects in Nepal, demanding high resistance to internal hydraulic pressures, transient surges, and severe mountain transit conditions.

Mandatory Material Restraints: Only seamless ASTM A106 Grade B pipe is permitted. Any form of welded pipe (ERW, longitudinal, spiral), galvanized pipe, or reclaimed/previously used pipe is strictly prohibited under this specification.

Governing Standards: All manufacturing, fabrication, and testing must comply with the latest editions of ASTM A106/A106M, ASTM A530/A530M, ASME B36.10M, ASME B16.25, AWWA C213, NSF/ANSI/CAN 61, NACE/AMPP SP0188, ASTM D6677, ASTM D4417, and EN 10204.Seamless ASTM A106 Grade B carbon steel pipes with internal FBE lining designed for high-head, potable water mains in Nepal; welded, galvanized, or reclaimed pipes are strictly prohibited.

4.5.2 Pipe Material & Mechanical Properties:

Grade Specification: Pipes shall be manufactured from ASTM A106 Grade B seamless carbon steel.

Mechanical Limits: Pipes must demonstrate a minimum tensile strength of 415 MPa and a minimum yield strength of 240 MPa. Elongation must strictly comply with ASTM A106 requirements.

Chemical Composition: Heat-analysis chemistry must be documented on the Material Test Certificate (MTC). A maximum Carbon Equivalent (CE) of 0.45% may be enforced where specifically required by the approved welding procedure or project welding engineer.

4.5.3 Dimensions, wall thickness & tolerances

Nominal wall thickness shall conform to ASME B36.10M as designated in the Bill of Quantities (BoQ). Under no circumstances shall the minimum wall thickness at any point be more than 12.5% under the nominal thickness specified.

Nominal Size (DN / NPS)	Outside Diameter (D)	Schedule 40 (STD)	Schedule80 (XS)	Schedule 160
DN 50 (2")	60.3 mm	3.91 mm	5.54 mm	8.74 mm
DN 80 (3")	88.9 mm	5.49 mm	7.62 mm	11.13 mm
DN 100 (4")	114.3 mm	6.02 mm	8.56 mm	13.49 mm
DN 150 (6")	168.3 mm	7.11 mm	10.97 mm	18.26 mm
DN 200 (8")	219.1 mm	8.18 mm	12.70 mm	23.01 mm
DN 250 (10")	273.0 mm	9.27 mm	15.09 mm	28.58 mm

4.5.4 Hydrostatic inspection test

Each individual pipe must be hydrostatically tested at the factory in accordance with ASTM A106/A530. The test pressure shall be calculated based on the applicable ASTM stress criteria (P = 2St/D). Acceptance criteria mandate zero visible leakage, sweating, or permanent deformation. Striking the pipe while under pressure is strictly prohibited

> **P = (2 × S × t) / D [MPa] or P = (200 × S × t) / D [kgf/cm²]**
> Where: P = Hydrostatic test pressure | S = applied test stress, t = Nominal wall thickness (mm) | D = Specified outside diameter (mm).

NDE / Inspection: All seamless pipes shall be examined per ASTM A106/A530. For critical high-head sections, the Employer may mandate supplementary Non-Destructive Examination (NDE), including 100% Ultrasonic Testing (UT) to detect manufacturing anomalies.

4.5.5 Internal food-grade FBE anti-corrosion lining

Coating Standard & Certification: The internal surface must be protected with a shop-applied 100% solids Fusion-Bonded Epoxy (FBE). The system must fully comply with AWWA C213 and hold current NSF/ANSI/CAN 61 certification (or an Employer-approved equivalent) verifying its safety for continuous contact with drinking water.

Dry Film Thickness (DFT): The minimum acceptable DFT at any measured point is 300 µm. The target nominal application thickness should be approximately 350 µm. The absolute maximum DFT is 400 µm, unless a greater thickness is specifically permitted by the coating manufacturer's certified product data and NSF 61 limits.

Surface Preparation: Internal steel surfaces must be completely free of oil, grease, dirt, and moisture. Surfaces must be abrasive blast cleaned to a Near-White Metal finish (SSPC-SP 10 / NACE No. 2 / ISO 8501-1 Sa 2.5) with a surface profile of 50–90 µm measured per ASTM D4417.

Holiday Testing & Acceptance: The fully cured internal lining shall undergo 100% electrical holiday inspection using a low-voltage wet-sponge detector (generally ≤ 75 V) according to AWWA C213 and NACE/AMPP SP0188. Any detected holidays or discontinuities must be completely repaired, cured, and retested prior to final dispatch. Zero unrepaired holidays are permitted.

Field Weld Cutbacks: Factory FBE must be terminated approximately 50 ± 10 mm from the pipe ends to allow for field welding. Following field welding and cooling, the internal joints must be cleaned, coated with a compatible NSF 61-approved field-repair system, inspected for DFT, and fully holiday tested.

4.5.6 External Corrosion Protection

Atmospheric Protection: Because the pipeline will be installed above ground, the external surface requires a robust, high-performance protective coating system to defend against continuous atmospheric exposure, UV degradation, precipitation, and environmental wear.

System Requirements: The specific external coating system shall be selected to provide long-term durability in outdoor mountainous environments and must be formally approved by the Employer prior to application.

4.5.7 Handling, Storage & Transportation

Handling Restrictions: Pipes must be handled with utmost care to preserve the integrity of the internal FBE lining and the external coating. Pipes shall not be dragged, dropped, or subjected to impact. Lifting must be performed using wide, soft non-metallic slings or padded hooks. Direct contact with unpadded steel chains or cables is prohibited.

Transport Logistics: Transportation logistics must utilize vehicles equipped to navigate Nepal's challenging mountain road infrastructure. The transport configuration must include appropriate timber or rubber saddles, strict separation of pipe layers, and comprehensive tie-down strapping to prevent rolling and transit damage. End caps must remain firmly in place throughout storage and staging.

4.5.8 Quality Assurance, Traceability & Submittals

Material Traceability: Strict traceability is mandatory. Each individual pipe must remain traceable to its original manufacturing heat. The traceability chain shall link: Pipe Number → Heat Number → Material Test Certificate (MTC) → Hydrotest Record → FBE Batch Number → Coating Inspection Report.

Material Test Certificates: Each supplied lot must be accompanied by an EN 10204 Type 3.1 MTC containing the manufacturer's details, grade, size, heat chemistry, mechanical property test results, hydrostatic test pressures, and dimensional verifications.

Third-Party Inspection (TPI): An independent Third-Party Inspection must be performed and certified prior to factory dispatch. The scope of the TPI includes verification of bare steel compliance, blast profile, coating DFT, successful holiday clearance, and verification of potable water certifications.

Pre-Procurement Submittals: Before initiating procurement, the Contractor is required to submit comprehensive hydraulic calculations (including maximum static pressure and transient/surge margins), the selected pipeline schedules, Welding Procedure Specifications (WPS/PQR), FBE technical data sheets, and up-to-date NSF/ANSI/CAN 61 certificates for final Employer approval

4.6 CARBON STEEL PIPE , BUTTWELDING FITTINGS AND FLANGE

4.6.1 General

Structural Steel	
Specification	**AS/NZS 1163**
Dimensions	**AS/NZS 1163**
Product	Structural Steel Hollow Sections
Grade	C350L0, Refer standard for others

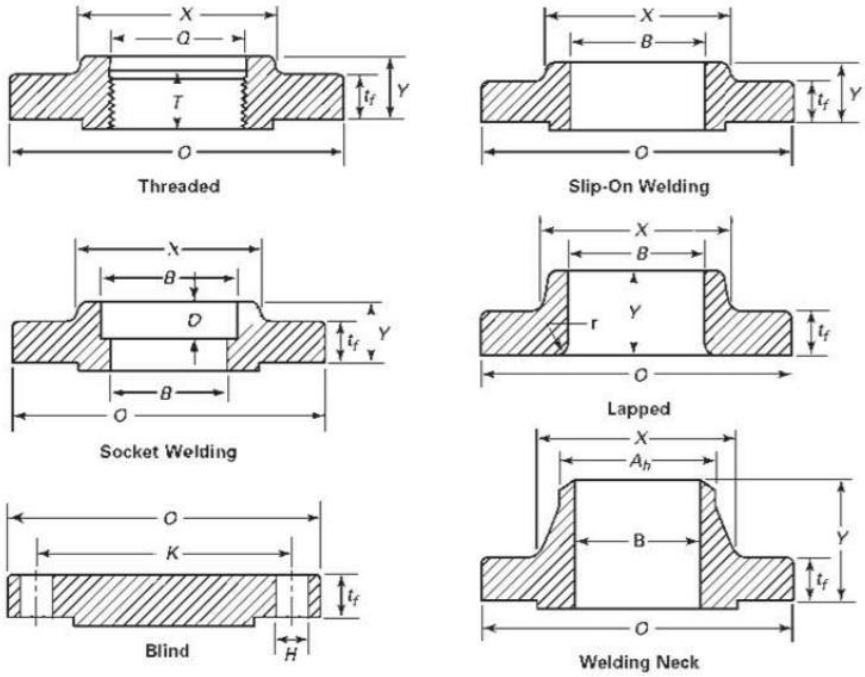
4.6.2 Jointing

Buttwelding Fittings	
Specification	**ASTM A234M** Welded and Seamless Carbon and Alloy Steel Pipe Fittings for Moderate and High Temperature Service **ASTM A420M** Welded and Seamless Carbon and Alloy Steel Pipe Fittings for Low Temperature Service
Dimensions	**ASME B16.9**
Product	Elbows, Reducing Elbows, Returns, Tees, Crosses, Reducers, Stub Ends, Caps
Grade	ASTM A234M WPB, ASTM A420M WPL6. Refer standard for others

Carbon Steel ASME/ANSI Flanges – Dimensions & Weights

These diagrams relate to the tables of flange specified dimensions on the following pages.

The Notes shown on this page also relate to the tables on the following pages.



Note 1: To be specified by purchase
Note 2: Flange weights are approximate
Note 3: Welding neck flange bore sizes listed are for sch 40S / Standard Wall pipe

4.6.3 Flange

Flanges	
Specification	**ASTM A105M** Carbon Steel Forgings for Piping Applications
Dimensions	**ASME B16.5**
Product Face Bore Class	Weld Neck, Slip-on, Blind Flanges. Others refer to the specification. Plain, Raised Face Pipe Schedule 150, 300, 400, 600, 900, 1500, 2500 (to 600mm only)
Grade	Carbon Steel
Specification	**AS 2129** Flanges for Pipes, Valves and Fittings
Dimensions	**AS 2129** "Table" flanges pressure – temperature ratings, materials and dimensions
Application Face Bore Table	Slip-on, Blind "Table" Flanges Plain To suit Pipe & Tube OD D, E, F and H

4.7 EXPANSION JOINT

4.7.1 Purpose

This specification establishes the minimum conditions required for design and fabrication of a packed metallic bellows universal expansion joint for the steel pipe system in high temperature variation zone of the water supply project.

The corresponding expansion joint data sheet follows in continuation to this specification.

4.7.2 General Conditions

All deviations and exceptions from the specification shall be clearly identified in the proposal and submitted for approval. Otherwise the proposal will be considered as full acceptance of the specification, and no work regarding such non-conformities shall be performed.

The bidder shall submit information about the size, and thickness of the bellows, the material of all parts, the design movements, the bellows spring rates, and overall dimensions of the expansion joint. Constructional details specified in this technical specification, as well as on the data sheet shall also be submitted.

Compliance with this specification does not exempt vendor from the responsibility of supplying any accessories suitable for the intended service.

Vendor shall guarantee that the expansion joint is free from defects of workmanship, materials and design for a period of one year from the unit start-up or two years after shipment, whichever occurs first.

The manufacturer shall provide a supply list of similar applications in water supply projects.

The manufacturer shall provide a recommended spare parts list with the proposal.

The schematic drawing shown on the last sheet of this specification is to be used as a reference only. Vendor shall provide all the features considered necessary to achieve the minimum requirements established herein.

All work shall conform to acceptable practice for water supply project installations as well as comply with required codes and standards mentioned in item 3 below. Any conflict between specifications, recommended practices, and codes or standards shall be brought to the attention of and resolved with the OWNER before proceeding with the fabrication of the affected parts.

4.7.3 Codes And Standards

The following codes and standards shall apply:

- ASME Code Se II – Materials
- ASME Code Section IX – Welding ;
- ASME B16.5 – Pipe Flanges and Flanged Fittings NPS ½ through 24;
- ASME B31.3 – Process Piping;
- ASTM C795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel;
- ASTM E94 – Standard Guide for Radiographic Examination;.

4.7.4 General Requirements

The expansion joint referred to in this specification shall be a universal type expansion joint with packed metallic bellows.

The expansion joint shall be cold wall design, with a double layer refractory lining applied to its inside surface.

The refractory material shall be specified, supplied and installed according to PMO Standards and Specifications. A typical refractory-lined expansion joint detail is shown on the schematic drawing mentioned in item 2.7.

A typical packing detail for metallic bellows is also presented on the schematic drawing above mentioned. Packing requirements are defined in item 6.

All pressure containing and structural parts shall be in accordance with the Process Piping Code (ASME B31.3). Special items to be designed by analysis shall be in accordance with ASME Sec.VIII – Div.1.

Supplier shall provide any necessary supporting device and lifting lugs to expansion joint. Supporting device shall be designed for minimum and easy maintenance.

Supplier shall supply electronic files of the following drawings and data reports for installation, maintenance and records purposes:

a) Certified fabrication drawings of the equipment, showing complete longitudinal section and cross section, overall dimensions, bellows dimensions and details, bellows spring rates, cold clearances and construction materials of supplied expansion joint. When transportation bars or rods are supplied, the drawings shall contain instructions as to removal of such devices prior of plant operation.

b) Calculation report, including: EJMA calculation, FEM – Finite Element Analysis reports for thermal and structural analysis, whenever this calculation is performed.

The criteria to establish the design allowable stress shall consider the accumulated creep damage due to upset temperatures.

The expansion joint supplier shall provide all necessary data for mechanical assessment of the existing piping system, considering expansion joint reaction, such as: spring rate, expansion joint weight, bellows

effective area or mean diameter of bellows corrugations, and geometrical data. The rated movements and other expansion joint limitations shall also be informed.

The specified axial, offset and rotation movements shall be available simultaneously, unless otherwise noted.

The design life of the expansion joint shall be at least 1,000 cycles at design condition.

Internal sleeves shall be provided to minimize catalyst volume trapped in, and the erosion action of catalyst impingement on bellows. The sleeves shall be designed so as to avoid interferences caused by lateral deflections and rotations and shall not reduce the internal flow area.

4.7.5 Packing And Sealing Requirements

The spaces between the internal sleeves and the metallic bellows shall be packed with ceramic fiber blanket insulation. The ceramic fiber insulation shall be installed in blanket form and shall be in accordance with ASTM Specification C795. The insulation dimensions shall be determined to avoid temperature above bellows material limits, and catalyst impingement

An external protection of woven wire mesh covered with a layer of aluminized fiberglass or silica cloth shall be provided with the ceramic fiber blanket, for mechanical sealing and easy handling. Alternative methods may be accepted, but shall be submitted for approval.

A heavy duty liner seal shall be provided in order to retain the ceramic fiber blanket and keep large particles out of the bellows/liner cavity. This liner seal shall be made of a 309 SS knitted wire hope, covered with a 309 SS hose braid. The

liner seal shall be one-piece continuous circular section provided with only one splice.

The diameter of the liner seal shall be 1½ times the specified clearance in the radial direction for the expansion joint in the cold position before preset.

The liner seal shall be anchored by means of a seal rod, which is a "U" shaped clip, made of 309 SS, to be annealed after forming. As an alternative two retaining rings could be used.

The inner sleeve shall be connected to the shell by means of a conical transition with a 30° max. lateral angle.

Each sleeve shall be installed so that its free end is turned towards the expansion joint flow exit (downstream) end.

4.7.6 Specific Requirements

The expansion joint shall be provided with double ply testable bellows, as follows:

- Each bellows' ply shall be designed for the full design condition. The redundant ply shall guarantee the performance and sealing of the expansion joint in case of primary ply failure.
- Each expansion joint bellows shall be provided with a pressure sensor between the plies, for testing and detection of internal ply failure.
- The double ply assembly shall be configured to avoid galling or any obstruction that interfere on pressure reading.

Metallic bellows skin temperature shall range from -30 to 40°C. Manufacturer shall provide proper external and internal blanket thermal insulation in order to achieve this range. This blanket shall be shop applied.

Supplier shall provide means of monitoring the bellows skin temperature.

Composite bellows plies are not allowed.

Bellows material shall be ASTM B433 alloy 625 LCF.

Bellows minimum thickness: 1.27 mm.

The number of convolutions per bellows shall be not less than three.

Bellows shall be protected by removable external covers with 6mm minimum thickness.

Whenever requested, equalizing or reinforcing rings shall be used, otherwise the manufacturer must justify why they are not used.

Torsion loads (movements) shall not be transferred to metallic bellows.

Expansion joints shall be provided with movement indicators.

The expansion joint design shall be such as to allow easy access to any bellows, for inspection and maintenance purposes.

4.7.7 Fabrication, Examination, Inspection And Test Requirements

During the expansion joint fabrication and tests, inspection may be made by OWNER or by OWNER designated third part, to determine work in progress and check specification compliance.

Bellows shall be formed from longitudinally buttwelded cylinders. The maximum number of bellows longitudinal buttwelds for the expansion joint concerning this specification shall be 4. Adjacent longitudinal welds shall be no closer than 130 mm apart.

The finished longitudinal welds are to be of the same thickness (-0% +10%) and same surface finish as the parent material. Circumferentially welded seams shall be prohibited.

All expansion joint welds shall be full penetration and smooth finished, with no undercut or lack of fusion.

All retaining pressure welds shall be submitted to 100% radiographic examination or, alternatively, 100% ultrasonic examination, where the ASME B31.3 Code allows.

All internal welds, fillet and attachment welds shall be submitted to dye penetrant examination.

Bellows longitudinal welds referred to in item 9.2 shall be 100% radiographed and liquid-penetrant examined on outside and inside surfaces, prior to forming. Liquid penetrant examination on all surfaces shall be repeated after forming.

When the surface examined is of austenitic alloy steel or nickel-iron-chromium alloy materials having a design metal temperature above 400 °C, the liquid penetrant material shall be tested for sulphur content and the surface shall be properly cleaned after completion of testing.

Welding procedure and qualification certificate shall be submitted for OWNER approval.

The fabricator shall scarf and otherwise prepare the welding ends that are to be welded by others.

All weld bevels on the ends of carbon or ferritic alloy steel piping components that are to be welded by others shall be coated on the inside and outside for a distance of 76 mm from the end of the component with a suitable protective product.

The welding process shall be according to ASME Section IX.

The fabricator shall provide heat treatment procedures, taking into account the risk of sensitization and sigmatization of the austenitic stainless steel parts.

Mill test reports shall be submitted for all materials and weld consumable.

Upon completion of all fabrication, the fabricator shall pressure test the expansion joint assembly.

Before pressure testing, all internal surfaces of the expansion joint shall be cleaned so that it will be free of welding slag and flux, weld rod studs, loose scale, dirt and debris. Potable water with less than 5 ppm chlorine shall be used for hydrostatic testing. The expansion joint shall be drained and dried.

After pressure testing all openings shall be closed, sealed or covered to prevent access of water, dirt or corrosive dusts and vapors during shipment and site storage.

All defects requiring repair shall be corrected in accordance with the applicable code.

4.7.8 Installation Requirements

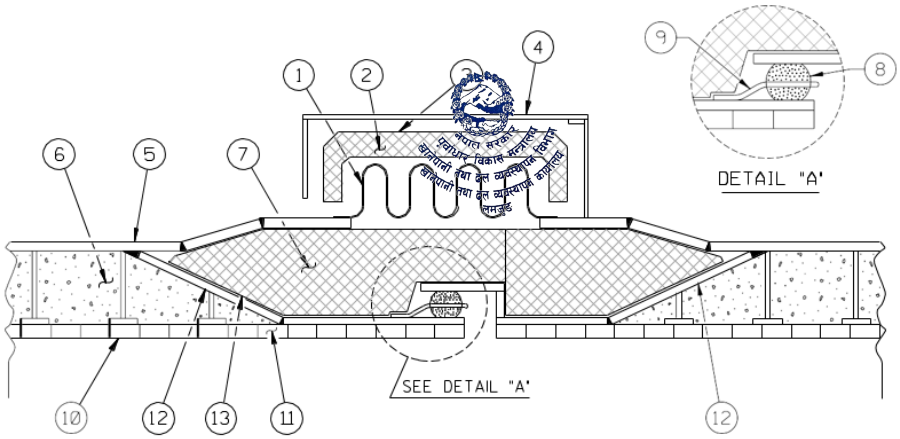
The expansion joint shall be delivered with shipping devices for transportation, temporary supports during installation, and field pressure test.

Spare parts shall be delivered clearly identified with name and part number.

The expansion joint shall have a name plate of corrosion resistant material informing: tag number, service, operating and design conditions, pressure test, manufacturer, purchase order number, year of fabrication and total weight.

Two flow direction indicators shall be placed on the external shell, 180° apart from each other.

Schematic Drawing – Refractory Lined Packed Metallic Bellows Expansion Joint



MATERIAL LIST

MATERIAL LIST

ITEM	*DESCRIPTION*	*MATERIAL*
1	*Bellows*	*ASTM B443 Alloy 625 LCF*
2	*Thermal insulation*	*By manufacturer*
3	*Woven wire mesh*	*AISI 304*
4	*Removable cover*	*Carbon steel*
5	*Pipe*	*ASTM A672 Gr. C60 Cl.12*
6	*76 mm thk. refractory lining*	*Class "A" insulating re fractory. Refractory anchor to be square head type studs, made of 304 SS.*
7	*Blanket insulation*	*Ceramic fiber*
8	*Heavy duty liner Seal*	*AISI 309*
9	*"U" clip*	*AISI 309*
10	*Hexagonal mesh*	*AISI 304*
11	*25 mm thk refractory lining*	*Class "A" antierosive re fractory.*
12	*10 mm thk internal sleeve*	*ASTM A240 TP304*
13	*Woven wire mesh*	*AISI 304*

4.8 Valves, Stop Cocks And Ferrules

4.8.1 General

All valves shall be manufactured to an internationally recognized standard and full details concerning such standards shall be provided by the manufacturer for approval before manufacture commences. Where British or Indian Standards are quoted in this specification an equivalent internationally recognized standard is acceptable.

Cast iron shall have properties not inferior to those specified for Grade 14 of BS 1452 or equivalent and shall withstand the test pressure specified. All castings shall be carefully cleaned and dressed off. No stopping or plugging will be permitted in the case of holes or flaws appearing therein, and casting shall be made from first running.

Gunmetal and bronze shall be of such compositions as have been proved in actual service to be the most suitable for the particular purpose. If any casting, forging, bearing or other part should prove to be defective, the Engineer shall have the power to reject it and the Supplier shall replace it at no extra expense to the Engineer.

4.8.2 Interchangeable Components

All similar equipment shall be strictly interchangeable as a whole and as regards their component parts.

4.8.3 Protection Against Climatic Conditions

Valves supplied shall be of the appropriate grade and quality for and shall be adequately protected against the tropical climatic conditions. The supplier shall take those conditions into account in deciding what grade, quality and protection is required. Cast iron and steel surfaces of all valves, hydrants, and fittings shall be painted with at least two coats of approved bituminous paint. Failure to comply with the requirements of the above will result in rejection by the Engineer. Valve bodies, protecting tubes, surface boxes and all other casting shall be coated in accordance with BS 5163 or equivalent, for tropical conditions. Where this is not applicable, they shall be thoroughly cleaned and given one coat of bituminous paint. Machined surfaces shall be covered by a suitable rust inhibitor, such as a high melting point grease of approved quality.

All submerged moving parts of the valves, or the pins and spindles etc of submerged moving parts, or faces etc in contact with them shall be of non-corrodible materials. Any parts that show signs of corrosion or wear during the Period of Liability shall be replaced by non-corrodible material of special quality for the purpose at no extra expense to the Engineer. Care shall be exercised in the choice of metals for use in the valves to reduce the effects of bi- metallic corrosion to a minimum. The foregoing shall apply also to the moving parts of valves exposed to the weather.

4.8.4 Works Tests

All valves shall be hydrostatically tested at the place of manufacture to the pressures specified and valves shall satisfactorily pass the specified tests before they are packed for delivery.

All valves shall be body tested to twice the working pressure stated in the Bill of Quantities. Seat tests to the working pressure stated in the Bill of Quantities shall be carried out on all sluice valves and stop valves.

All sluice valves and stop valves shall be subjected to "open end" test in accordance with BS 1218 or equivalent and each valve shall be subjected to three separate hydrostatic tests as follows:

(a)Seat Tests

(i) The tightness of seats shall be tested as follows: with the wedge closed and with the valve fixed at one end only the test pressure shall be applied to one face of the wedge, the other face being at atmospheric pressure. There shall be no visible leakage past the wedge at the hydrostatic test pressure (gauge) specified;
(ii) The above procedure shall be repeated but with the valve fixed at the other end and with the pressure applied to that end of the valve.

(b) Body Test

With the wedge open the test pressure (gauge) specified shall be applied to the whole body of the valve. There shall be no visible leakage. The test durations for all tests shall be as in the table below:

NOMINAL DIAMETER MM	MINIMUM TEST DURATION (MINUTES) FOR	
	BODY	SEAT (IF APPLICABLE)

50 and under	0.25	0.25
65 to 150	1	1
200 to 300	2	2

All valves shall be marked with cast-on or stamped lettering stating the body test pressure in meters head of water. The cost of testing shall be included in the contract rates.

4.8.5 Valves Generally

Valves shall have adequate provision for lubrication, shall cause the minimum of head loss in the open position and shall seal the water passage completely when shut.

All valves shall be closed in a clockwise direction unless otherwise specified. Direction of closing to be shown on the hand wheel.

All valves shall be suitable for use with water in the temperature range -10°C to 70°C and for working pressure of 10 bar or as otherwise specified.

Each flanged valve shall be supplied complete with nuts, bolts, washers, and joint rings. Joint rings shall be of that section complying with BS 4190 or equivalent and shall not extend beyond the inner edges of the bolt holes. Bolts and nuts shall be hexagonal complying with BS 4190 or equivalent.

All materials which may come in contact with raw or potable water shall be free from toxic substances and shall not foster microbiological growth or give rise to taste, cloudiness or discolouration of the water with which they are or could be in contact.

Rubber used in valves shall be ethylene propylene rubber (EPDM or EPM) or styrene butadiene rubber (SBR), which complies with the above requirements, and is suitable for making a long term flexible seal and is resistant to mechanical, chemical, or bacteriological attack leading to deterioration of the flexible seal.

4.8.6 Flanges

Flanges for pipe work connections shall in all respects be in accordance with BS 4504 PN 16 or equivalent unless otherwise specified.

4.8.7 Bib Cocks

Bib cocks shall be of brass and shall be nominal 15 mm diameter con- forming to BS 1020 or IS : 781 - 1984 or equivalent. Inlets shall be male screwed suitable for joining to 15 mm GI socket. Outlet shall be plain ended. Top shall be round turned crutch.

4.8.8 Globe Valves

Globe valves shall be gunmetal, rising stem, hand-wheel operated with screwed female ends; conforming to IS : 778 - 1984 Class 1 or equivalent.

4.8.9 Gate Valves

Stop valves shall be gunmetal wedge gate valves, rising stem, hand-wheel operated with screwed female ends; conforming to IS : 778 - 1984 Class 1 or equivalent.

4.8.10 Ferrule Cocks

Ferrule cocks shall be of gunmetal square head of 15 mm internal diameter swivel balancing screw down ferrules with male inlet and single male outlet; conforming to IS: 2692 - 1984 or equivalent.

4.8.11 Air Valves

Single orifice air valves shall be of cast iron body, reliable in action and shall operate in such a manner that the balls of the valves cannot be held against the orifice by air pressure alone. Each air valve shall be supplied with an approved isolating device. The inlet shall be male screwed 15 mm diameter suitable for connection to a GMS riser pipe. Maximum operating pressure will be 100 meters head of water.

4.8.12 Marking and Packing

Each valve shall be indelibly marked with the diameter, weight and pressure rating and shall in addition carry a unique reference number to enable each item to be clearly identified to works fabrication records, works test certificates, delivery notes and the like.

All valves shall bear the authorized Standard mark cast on showing to which Standard specification they have been manufactured.

Whenever possible the identification marks except for the "Standard mark" shall be painted on the outside of the item but where there is insufficient smooth surface area to accommodate the identification marks they shall be put on rust proofed metal tags secured to the item with galvanized wire.

Flanges shall be protected with wooden discs attached by service bolts or other approved means. Service bolts shall not be incorporated in the works.

All items shall be properly prepared and packed for delivery and shipping. In particular, small items such as small valves, parts of operating gear, bolts, nuts, gaskets, and other joint components shall be crated for delivery. Each crate shall contain a detailed packing list in a waterproof envelope. The outside of the crate shall bear a general description of the contents and identification mark relating it to the detailed packing list.

All valves and fittings shall be securely packed in crates or boxes for protection against damage during transit. The costs of packing shall be included in the contract rates. None of the packing will be returnable.

4.8.13 Unions

Unions shall either be brass or galvanized malleable iron, as specified in bill of quantities, manufactured in accordance with a recognized international standard. The manufacturer shall produce full details concerning the standards to which his goods are produced. All unions shall be suitable for joining GMS pipes manufactured to BS 1387 or IS: 1239(part 1) - 1990 or equivalent with threads to BS 21 or equivalent.

4.8.14 Flexible/Detachable Couplings

Flexible/detachable joints are required for repairs to existing GMS pipes of medium class manufactured to BS 1387 or equivalent specification. They shall be similar to 'Viking Johnson Couplings' without central register and shall be capable of withstanding a pressure of 250m head of water. They shall be supplied complete with all bolts and gaskets and shall be suitably protected against corrosion by an approved coating. Sizes required in the range of pipe sizes ND50 to ND100. Full details to be supplied for approval before manufacture.

4.8.15 Others

4.8.15.1 Float Valve

Float valve shall be of heavy duty type for break pressure chamber and conforming to standard IS: 1703- 1977 (horizontal plunger type or equivalent. The pressure rating shall be 14 Kg/m^2 and male thread shall be as per corresponding standard.

4.8.15.2 Nipples

Nipple of various length as required by the Engineer shall be manufactured of Medium/Heavy duty galvanized mild steel pipes conforming to IS : 1239 (Part I) - 1990 or equivalent. Threads to conform with IS : 554 - 1975 or equivalent. The standard lengths are :

- 100 mm upto 25mm nominal bore
- 150 mm for 32 mm & 65 mm nominal bore
- 200 mm for 80 mm & 100 mm nominal bore

4.8.15.3 Brass Union

Brass union shall be used to join HDP pipe and equivalent G.I. Pipe. Dimensions for HDP pipes are as per IS : 4987 - 1979 equivalent and GI pipes as per IS : 1239 (Part I)- 1990 or BS : 1387 - 1967 make threads or equivalent. Type of joint : Expansion joint consisting of :

a. union body
b. brass ring
c. brass expansion plunge (for insertion into the HDP pipe)
d. neoprene ring for insertion into union body &
e. flat rubber coaster. Each set to be supplied assembled.

4.8.15.4 Flange Set (For HDP - GI Jointing)

Flange set to join HDP pipe as per IS : 4984 - 1978 or equivalent to IS : 1239 (Part I) - 1990 or BS : 1387 - 1967 GI pipe (make threads) shall consist of :

a. female threaded flange
b. plain unthreaded flange
c. HDP flange adaptor
d. duty rubber gasket and
e. nuts, bolts and washers (adequately lightened)

4.8.15.5 GI Flange

Flanges shall be female threaded to join GI pipe and valves etc and shall be drilled in accordance with BS: 4504 PN 16 or equivalent. The supply shall be complete with nuts, bolts and washers, all adequately tightened.

4.8.15.6 GI Valve Box

GI Pipe Boxes shall be manufactured according to sample made available or the Drawing and GI pipe used must be medium duty conforming to NS: 199 -2046 or IS : 1239 (part) - 1990 or equivalent. As shown in the drawing one end of the GI pipe shall be fitted with one set of GI flange and GI blank flange complete with nuts and bolts. The bottom of the GI pipe shall be slotted to allow it to slip over the pipeline and locked into place with 300 mm long M.S. bar by passing through two 10 mm holes drilled near the base.

4.8.15.7 GI Valve Key

The Valve Box Keys shall be manufactured according to sample or drawing made available to the manufacturer. Valve Boxes Keys to be manufactured of light duty pipe conforming to Nepal Standard NS: 199 - 2046 or Indian Standard IS: 1239 (Part I) - 1990 or equivalent. Other required reducers shall conform to IS: 1879 - 1987 or equivalent.

4.8.15.8 CI Manhole Cover and Frame

CI Manhole cover and frame shall be manufactured as per drawing or samples made available to the manufacturer conforming to NS: 104 – 2042 or IS: 1726 of latest edition or equivalent.

CI manhole covers and frames are to be provided and fixed on the top RCC slab as per drawing with minimum 100mm thick M150 RCC.

The CI manhole cover shall be laid as such so that top of the manhole cover should be the same of the top of the road surface or finished level of Manhole shall match with the finished level of surrounding structure.

The CI manhole cover shall be measured in numbers unless otherwise mentioned in the BoQ.

The rate shall include cost of material, transportation, laying , fixing and other necessary associated parts including necessary form works, PCC, reinforcement, curing, etc. as instructed by the Engineer.

4.9 Household Connection Water meters

4.9.1 General

All meters to be supplied under this Contract shall be service proved products of specialised manufacturer's.

The Suppliers will be deemed to have obtained manufacturer's complete instructions with respect to the products to be supplied under this Contract. They shall adhere carefully to such instructions and shall wherever necessary employ manufacturer's specialist assistance in the performance of the works.
The provisions of this article shall not be construed as releasing the Supplier from his responsibility under the Contract.

4.9.2 Warranties and Certificates

The Supplier shall guarantee all materials and equipment furnished under this Contract in conformity with the stipulations in the Agreement, the General Conditions and these Specifications.
Before shipment of any consignment, the Supplier shall submit manufacturing certificates and third party inspector's showing the materials, workmanship, functions and performance to be in accordance with the reference standard and more specifically with the requirements of this Contract. Any form of certificates of the manufacturer or recognised agency may be submitted.
The certificates shall be accomplished by the manufacture/s design calculations and of the required test.
Factory Warranty of the meter shall be at least 1 year after successful delivery

4.9.3 Materials

Only the best quality and type of materials shall be used, which shall be suitable for the purpose intended. Unless otherwise specified, materials shall be selected by the Supplier. The materials shall be appropriate both mechanically and chemically to the operating conditions. In connecting units they shall be mechanically, chemically and electrochemically compatible with one another and with the environment.

Materials shall be selected to the adequate resistance against abrasion and corrosion. Where necessary protective coating and lining shall be applied.
Materials in contact with the water shall be non-toxic and shall not affect the quality of the water.

4.9.4 Design and Construction

Meters shall be designed for use in tropical climate and for measuring the water described in Project Information with temperatures up to 50 degree C and shall comply to the requirements of ISO 4064 or equivalent.
Meter shall have a modular design consisting of and outlet case and separate measuring chamber. The measuring chamber shall be removable and rapidly exchangeable without removing the body.
Registration shall be by direct reading digital counter, with a singly to show the smallest measurements.
Registration shall be in cubic meters. For ease and accuracy of calibration and adjustment, dials shall register or as to permit accurate readings of 0.05% of the nominal discharge.
Meters shall have a means of adjustment by a by-pass chamber side screw which adjusts the cross-section of the chamber. The adjustment screw shall be operable from outside the meter and shall be protected by a screw in sealed plug.
All meters shall be provided with wire and lead seals, both to the register and to the plug covering the adjustment screws.
All parts in contact with the rotor shall have smooth surfaces, protected where necessary to prevent encrustation.
A strainer shall be fitted to the inlet of each water meter. The strainer screen shall be rigid, fit snugly, be easily removable and have an effective straining area at least double that of the inlet.
Water meters shall be designed for a lifetime of 10 years under normal operating conditions.

4.9.5 Markings

The following markings shall be provided on the meters:

- at least one arrow cast onto the body indicating direction of flow.
- nominal size cast on the body.
- model identification, individual serial number, year of manufacture, engraved on the housing or indelibly marked on the dial.
- manufacturer's name and serial number, engraved on the lid or otherwise suitably marked.

4.9.6 Meter Performance

General Performance and accuracy shall be as indicated below. The range of measured flow rates is sub-divided into 3 reaches, the limits being defined by the following flow rates:

Qs = starting flow rate.
Below this flow rate the register will not show any reactions.
Qm = minimum flow rate for reliable registration. The error shall not exceed plus minus 5%.
Q1 = limiting flow rate for increased accuracy of registration. For flow rates above Q1, the error shall not exceed plus minus 2%.
Qn = nominal flow rate for continuous or intermittent function of the water meter. The error at Qn shall not exceed plus minus 2%,
Qmax = maximum flow rate at which the meter may function for limited time without exceeding a metering error of plus minus 2% and without exceeding permissible head loss.

For domestic type water meter Qmax should be 2 x Qn.
The Supplier shall include with his Bid the information in a format set out in the Technical Data Sheets regarding the above performance.

4.9.7 Specifications

Water meters in this category shall be of 11/2" (15mm) size or their nearest metric equivalent.
They shall be the **Rotary Piston Type** with completely waterproof encased gear train, magnetic couplings and register.
The inlet and outlet shall have a common axis.
The meters shall have the following minimum performance characteristics:

- Approx nominal flow rate Qn (m3/h) 1.5
- Minimum capacity of register (m3/h) 104
- Minimum readable quantity (litres) 1

Otherwise they should comply to Class C EEC or ISO standard.
Domestic water meters shall have a non-return valve on the outlet end to prevent back flow.
Domestic water meters shall have water tight dismantling coupling on each side to allow easy removal of the unit from the pipe work.
Their design and materials shall afford reasonable safeguards against destruction. Attention in this regard shall be given to the strength of the glass and the lid.
The pressure rating of domestic water meters shall be PN 10 (10 bar).
The meter housing (body) shall be manufactured from bronze.
Domestic water meters shall be suitable for mounting in both the horizontal and in the vertical positions.

4.9.8 Testing

It is required that the quality and the compliance with these specifications shall be demonstrated for all materials and equipment by appropriate tests performed during the various phases of the Work of production.
The minimum test pressure shall be the specified nominal pressure plus 50%. This pressure shall be applied increasing form 0 to maximum event over 15 minutes.
The test pressure shall be held without pressure drop for at least half an hour without any sign of leakage.
The measuring devices used in ship testing shall afford the following accuracy:

- Capacity : plus minus 0.1%
- Differential head : plus minus 1 %
- Time measurement : plus minus 0.03 %

Shop testing shall be run with water of not more than 40 degree C and not less than 10 degree C temperature. Shop testing shall sufficiently cover the entire range of the capacity to demonstrate that the characteristics are stable.
Each point shall have at least 3 (three) reading sand the arithmetic means shall be considered the proven value.

None of the individual readings shall differ from the specified limits more that in admissible by accuracy of measurement as defined above.

The arithmetic mean of all readings for one performance point shall be within the specified limits.

4.9.9 Spare Parts

The Supplier shall submit a duly detailed list of the spare parts of the meters to be offered.

Assembly Drawings, Operational and Repair Manuals for Water Meters

The Supplier shall submit Assembly drawings and other related information of meters. The assembly drawings shall contain all necessary information and construction. The assembly drawings shall be accompanied by instruction manuals and any other information which may assist in interpretation of the drawings and forming an appreciation of the materials offered.

The Supplier shall submit the operation and repair manual in 2 (two) copies in English Language. The manuals shall contain the data and meter assembly and then 57 (fifty seven) % copper.

Domestic water meters shall be suitable for mounting in both the horizontal and in the vertical positions.

4.9.10 Measurement and Payment

The supplied household connection water meters shall be measured in nos unless otherwise mentioned in the BoQ. The rate shall include cost of material, transportation, installation, testing & commissioning, necessary associated parts as instructed by the Engineer.

4.10 Bulk flow water meter

4.10.1 General Application

Water meters supplied and installation under this Contract must be of first quality and shall be designed to withstand the stated pressures and temperatures.

All water meters shall belong to a class which can withstand the stated maximum pressure, they will attain in service including any surge pressure.

Flanged joints of all water meters shall be provided with required numbers of bolts, nuts, washers and gaskets, which conform to DIN 2690, inside with steel ring, and the faces of all flanges shall be machined to give a true angle of 90° to the centre line of the pipe or fitting.

Before being dispatched from the place of manufacture the ends of the water meters, shall be suitably capped and covered to prevent any accumulation of dirt or damage.

Where the coating of water meters is damaged during delivery, the surface shall be cleaned and dried and the Contractor shall paint the damaged area with a minimum of three coats of paint and to the full thickness and specification as the original coating.

4.10.2 Reference to standards

In general, the relevant DIN, ISO or EN standards shall be applied. Reference to any other national standard or publication in these Specifications is intended to indicate general configuration, type and quality only.

The following general standards shall apply in addition to those specially indicated in the "Bill of Quantities" and other chapters of the Technical Specifications.

ISO 4064-1: Measurement of water flow in closed conduits - Meters for cold potable water- Specifications

ISO 4064-2: Measurement of water flow in closed conduits - Meters for cold potable water -Installation requirements

ISO 4064-3: Measurement of water flow in closed conduits - Meters for cold potable water-Test methods and equipment

DIN 3547 for testing and approving of appurtenances in water supply, and

DIN/ISO 9001 as quality assurance

Goods meeting other internationally accepted standards may be furnished, provided that overall quality will be at least equal to that required by the standards specified.

4.10.3 Shop testing and inspection

If required by the Engineer, the inspection of water meters will take place on the manufacturer's premises according to ISO 4064/3. The Contractor shall provide the testing equipment, the needed material, the checking devices and necessary trained personnel.

Inspection of external appearance, shape, dimensions and weight shall be carried out for each water meter, appurtenances and accessories. This includes inspection of external appearance, shape and dimensions for each type of water meter according to ISO 4064. All water meters, appurtenances and accessories shall be sound and free from surface defects.

Accuracy tests shall be performed on test water meters selected at random out of batches, grouped in different types of water meters, as follows:

DN 50 and above: 5% of the total quantity or at least one water meter per diameter and type. Each Successfully tested batch will be identified by a mark results of all such tests shall be submitted to the Engineer on a previously approved certificate or form certified by the manufacturer or by a recognized agency. Pieces of which the deviations from standard dimensions or accuracy exceed the tolerances shall be rejected.

4.10.4 Submittals

The Contractor shall furnish to the Engineer the following:

A sworn statement that the inspection and all of the specified tests have been made and the results

thereof comply with the applicable standard Results of tested water meters.

4.10.5 Handling and storage

Care shall be taken during loading, transporting, and unloading to prevent damage to the materials or coatings. Water meters that were examined and found to be defective shall not be accepted. Any damage to the water meter shall be repaired as directed by the Engineer.

Special handling of water meters shall be in accordance with the manufacturer's instructions.

Particular care shall be taken during loading, unloading, handling and transportation to avoid distortion, flattening, denting, scoring or any other damages to the water meters.

Any goods which, in the opinion of the Purchasers' representative are delivered damaged or are damaged by the Contractor in the process of stockpiling at the delivery site shall be promptly removed from the site. The Contractor shall receive no compensation for the damaged material or its removal untii it is either repaired to the satisfaction of the Engineer or completely replaced.

4.10.6 General Design and Construction

Meters shall be designed for use in climate ranging from -5°C to 45CC.

Meters shall have a modular design, consisting of an outlet case and separate measuring chamber. The measuring chamber shall be removable and rapidly exchangeable without removing the body.

Registration shall be by direct straight reading in cubic meters with single pointers to show the smallest measurements. The pointers shall move in clockwise direction.

For ease and accuracy of calibration and adjustment, dials shall register so as permit accurate readings of ±0.5% of the nominal discharge.

Dials cover for dry type water meters shall provide an air-tight seal.

All water meters shall be provided with a lid, which shall be recessed and shall overlap the registration box to protect the lens.

Meters shall have a means of adjustment by a by-pass chamber and screw which adjusts the cross-section of the chamber. The adjustment screw shall be operable from outside the meter, and shall be protected by a screw in sealed plug.

All meters shall be provided with wire and lead seals, both to the register and to the plug covering the adjustment screws.

All parts in contact with the water shall have smooth surfaces, protected where necessary to prevent incrustation.

Water meters shall be designed for a lifetime of 10 years under normal operating conditions.

4.10.7 Requirements

The bulk water meters shall be of sizes of DN 50, DN 100, DN 150 and DN 200 or their nearest equivalent and shall comply with ISO 4064 or BS 5728 Class B. They shall be of horizontal type with completely water proof encased gear train, magnetic transmission and registration, shielded against tampering or any external magnetic field.

Bulk water meters' bodies may be protective coated ductile or cast iron, but all internal mechanisms must be composed of corrosion free materials; viz. usually stainless steel or composite plastics. Meter bodies should preferably be epoxy powder coated for protection in all environments. All materials for internal parts like thrust pads and stud spindles should be of high quality like tungsten carbide for maximum life against wear.

An inline strainer is also recommended to protect the rotor and reduce the effect of turbulence.

Bulk water meter body connections must be flanged with flanges to ISO 7005 Part 2 PN 10 (identical to BS 4504 PN 10).

The ends of water meters to accommodate flange adapters and couplings shall be faced and sized to the tolerances recommended by the manufacturer of the coupling. The faces of flanges shall be machined to give a true angle of 90° to the centre line of the meter. The flanged inlet and outlet shall have a common axis

The required bulk water meters shall meet following requirements unless otherwise specified in the "Bill of Quantities".

- Bulk meter shall be equipped with counter-mechanism flood and moister proof (IP 68), glass-copper-capsule, counter-device turn able for 360°, 6 digits and 2 pointers.

- Range of temperature: up to 45 °C, overload for a short time up to 50 °C.
- Working pressure: up to 16 bar
- All meters shall be equipped so that an additional installation of pulsing equipments as integrated part of the water meter is possible.
- The transmitting head shall allow the connection of any optical electronic .pulse unit without breaking the meteorological seal
- Protection covers shall be made of special plastic, covers must be suitable for use of future impulse connection without later removal or replacement.
- All water meters must be supplied with corroded prove bolts, nuts and washers according to DIN 50976 and one set of flanged gaskets of NBR, steel reinforced and approved for drinking water.

4.10.8 Technical requirements

Each meter shall have following minimum technical requirements:

- horizontal counter-mechanism
- glass-copper-capsule
- counter-device horizontal turn able 360° for better read ability
- housing shielded against tampering or any external magnetic field and magnetic transmission and registration
- transmitting head shall allow the connection of any optical electronic pulse unit without breaking the meteorological seal
- measuring unit shall be exchangeable for exchange without removing the body of the meter from the line
- Regulation device must be placed under the counter-mechanism optimal corrosion-proof (secured by powder-coat)
- Means of adjustment by a by-pass chamber and screw which adjusts the cross-section of the chamber. The adjustment screw shall be operable from outside the meter and shall be protected by a screw in sealed plug.
- Wire and lead seals both to the register and to the plug covering the adjustment screws.
- Surfaces in contact with water shall have smooth surfaces, projected where necessary to prevent incrustation.

4.10.9 Markings

Each meter shall be marked on the casing or display with the following information:

- At least one arrow cast onto the body indicating direction of flow
- Nominal size
- Nominal flow rate (Qn) preferably on counter housing
- Model identification
- Year of manufacture
- Serial number
- Manufacturer's name
- In case not indicated differently the information shall be cast onto the body or engraved on the lid or painted onto the counter housing or otherwise suitably marked.

4.10.10 Characteristic flows

General performance and accuracy shall be as indicated below. The range of measured flow rated is subdivided into three reaches, the limits being defined by the following flow rates:

Qs = Starting flow rate.

Below this flow rate the register will not show any reactions.

Qmin = minimum flow rate for reliable registration ± 5%

Q1= limiting flow rate for increased accuracy of registration

Qn = nominal flow rate for continuous or intermittent function of the water meter ± 2% Qmax =maximum flow rate at which the meter may function for limited time without damage

Table 16.1: Recommended Standard Specifications (ISO 4064 Class B) for Bulk Meters

Meter Size	m	50	10	12	1	20
Starting Flow	m	<0	<0	<.	<	<1
Minimum Flow Qmin +/-	m	<.	<1	<.	<.	<.
Nominal Flow Qn +/- 2%	m	15	60	10	1	25

Maximum Flow Qmax +/-	m	30	12	20	3	50
Weight	K	>1	>1	>	>	>4

4.10.11 Accuracies:

Accuracy shall be as indicated below

- From Qmin to Qt : the error shall not exceed ±2%
- From Qt to Qmax: the error shall not exceed ± 1%
- At Qn: the error shall not exceed ± 0.5%

The supplier shall include with his Tender the information in a format set out in the Technical Data sheets regarding the above performance.

4.10.12 Packing:

Each meter shall be mounted on a pallet secured against movement with protection against damages; especially the housing of the counter shall be covered. In case there is sufficient space, more than one piece can be mounted.

Factory Warranty : Factory warranty shall be 18 months after successful test, however minimum 12months after the installation.

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5 ELECTRICAL INSTALLATIONS

5.1 Scope

This specification covers the general standards to be achieved when installing lighting and small power systems. i.e. guardhouse, operators quarters and site lighting. Details of the electrical works, including relocation of existing NEA lines etc. described in Appendix A; all materials and workmanship on the NEA power system shall be as per NEA practice.

5.1.1 Interpretations

5.1.2 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

a) 1 Item of General Application

b) 2.2 Earthworks

5.1.3 Application

This specification contains clauses that are generally applicable to electrical installations and associated work.

5.1.4 Abbreviations

Wherever the following abbreviations are used they shall have the meanings below:

Institutional:

AIEE-American Institute of Electrical Engineers

BSI-British Standards Institution

DIN-Deutsches Industrie Normen

IE-Indian Electricity Rules

IEC-International Electrotechnical Commission ISO-

International Organisation for Standardisation ISI-

Indian Standards Institute

NEA-Nepal Electricity Authority

NEC-US National Electrical Code

NEMA-National Electrical Manufacturers' Association

Technical:

R-red phase

Y-yellow phase

B-blue phase

ac-alternating current

dc-direct current

A-amp

mA-milliamp

V-volt

HRC-High Rupturing Capacity

kW-kilowatt

kVA-kilovolt amp

kWh-kilowatt hour

MVA-megavolt amp

Hz-hertz (cycles per second)

SP-single pole

SPN-single pole and neutral

DP-double pole

TP-triple pole

TPN-triple pole and neutral

SPSwN-single pole and switched neutral

TPSwN-triple pole and switched neutral

MCB-miniature circuit breaker

MCCB-moulded case circuit breaker

RCD-residual current device

GES-General Electric Standard

5.2 Materials

5.2.1 Low Voltage Distribution Boards

Low voltage distribution boards shall be of fabricated sheet metal construction, arranged for conduit and/or cable entry as required, fully rust-proofed, painted to an approved finish and protected against ingress of solid foreign bodies and liquid according to IEC Recommendation 144 Degree IP 32. All boards shall be rated as required and shall conform in all respects with IS 13947. Exterior boards shall be protected to IP 65.

Low voltage distribution boards shall have banks of fuses or miniature circuit breakers which are easily removable and readily accessible for easy wiring. All boards shall have 25% spare ways fitted within the case. Incoming supplies to the distribution board shall enter by means of a lockable isolator, switch fuse, residual current device or moulded case circuit breaker.

Boards which have feeders looped in or out at the busbars shall have double terminal blocks on each busbar. All boards

shall have insulating barriers installed between phases and between each phase and earth.

When required suitable holes/knockouts shall be provided to the top or bottom of the board to accommodate all incoming and outgoing cables through rubber washer glands.

Distribution boards shall be fitted with a permanent label giving details of fuses or miniature circuit breakers when their replacement by equipment of other makes or types would adversely affect the protection or discrimination provided.

5.2.2 Fuses

Fuses shall be Category AC 80, 660 volt to IS 13703. Fuse carriers and bases shall comply with IS 13703: Part 2.

5.2.3 Miniature and Moulded Case Circuit Breakers

Miniature and moulded case circuit breakers shall comply with IS 13032 and IS 13947 respectively. All breakers shall be selected in accordance with the Indian Standards with due regard to operating characteristics, current rating, calibration and discrimination. Adequate back-up protection by HRC fuses shall be provided.

Miniature circuit breakers shall be unconditionally rated at a category of duty M6 or higher. The effect of ambient temperatures, operating duty, and application shall be fully considered in applying de-rating factors for application at site.

Miniature and moulded case circuit breakers shall have means for preventing any one pole of a multi pole circuit breaker being operated or tripping independently of the other poles.

Miniature and moulded case circuit breakers shall have locking facilities and be supplied with all keys, or shall be enclosed in cases with locking facilities which shall be provided with keys.

Miniature and moulded case circuit breakers shall be of the same type throughout the Contract.

5.2.4 Residual Current Circuit Breakers

Residual current operated devices are to be either 3 phase and neutral or 1 phase and neutral. Both types will be of the circuit current rating and rated tripping current as stated elsewhere in this Specification or on the drawings. Either type must isolate all poles and neutral and be complete with a test button marked 'PUSH TO TEST'. The unit must be of robust construction and be mounted in an enclosure of pressed steel.

Where residual current circuit breakers are used they shall be of the ac/dc current operated type complying with IS 12640 when incorporated in fixed socket outlets, except that they shall be suitable for the service conditions as defined at site.

5.2.5 Cables

All cables shall be manufactured to Nepalese Standards

(i) Low voltage (600/1000 V grade)

5.2.5.1 PVC/SWA/PVC and XLPE/SWA/PVC multicore cable. Installed direct in the ground, in ducts, on tray or clipped direct. Aluminum wire armouring shall be used for single core cables.

(ii) Low voltage (600/1000 V grade)

5.2.5.2 PVC/PVC multicore cable to BS 6346. Installed in floor ducts, trunking or conduits.

5.2.5.3 PVC single core non-sheathed (450/750 V grade). Installed in conduit or trunking.

5.2.5.4 PVC single core non-sheathed (600/1 000 V). Installed as internal wiring within switchgear and control assemblies.

(iii) Instrumentation

5.2.5.5 PE/PSCR/OSCR/PE/SWA/PVC Plain annealed multistranded copper conductors, solid polyethylene insulation with aluminium-mylar pair screening including drain wire, with collective aluminium mylar screen including drain wire, solid polyethylene bedded steel wire armour with an outer sheath of flame retardant PVC. PVC sheath to be blue colour for intrinsically safe circuits, black for ac and dc non- intrinsically safe circuits, 300/500 V grade.

(iv) Control Digital

5.2.5.6 PE/OSCR/PE/SWA/PVC Plain annealed multistranded copper conductors, solid polyethylene insulation collective aluminium mylar screen including drain wire, solid polyethylene bedded steel wire armour with an outer sheath of flame retardant PVC. PVC sheath to be blue colour for intrinsically safe circuits, black for ac and dc non-intrinsically safe circuits, 300/500 V grade.

5.2.6 Site Lighting

Poles shall have:-

(i) A weatherproof access door to the base compartment, fitted with tamper proof lock, to provide easy access to the equipment. The doors shall be inter-changeable between poles without adaption, and keys shall be supplied. Doors shall be provided with an earthing terminal for connection of an earth continuity conductor to the earth terminal block installed in the base compartment.

(ii) A non-rusting earthing terminal bar near to the point of electrical supply and clearly marked 'earth'. This terminal shall be capable of accommodating an earth continuity conductor not less than 6 mm2 nominal cross sectional area.

(iii) Cable slot entries of not less than 150 mm long by 50 mm wide. The top of the slots shall be no more than 350 mm below ground level.

(iv) A treated base board, within the compartment, of suitable size to accommodate all necessary control gear, cable terminations and looping type fuse service cut out. The base board shall be securely fixed within the pole.

Cut-outs housed in the base compartments of lighting poles shall be designed primarily for use in street lighting poles and shall be suitable for termination or looping-in of the cables used. They shall consist of a substantial moulded plastic drip-proof enclosure with separate terminals for live, neutral and earth conductors, and incorporate a fuse carrier suitable for a fuse to IS 13703. Terminals shall be large enough to take the service cables used.

Three way type earth terminal block capable of accepting a cable size up to 6 mm2. shall be fixed to the base board adjacent to the cut-out. The terminal block may be incorporated within the cut-out.

Ballast units shall comply with IS 1534 and shall be drip-proof, totally enclosed, polyester filled, symmetrically wound type, silent in operation, and suitable for use on a 240 volt 50 Hz supply. Tappings shall be brought to suitable marked terminals to which lamp and supply connections can be made. Terminals shall be shrouded non-track type, and separate earth terminals shall be provided.

Capacitors shall comply with IS 1569 and shall be of the unfused type, totally enclosed and proofed against condensation and climatic conditions, complete with discharge resistor, with sealed-in PVC insulated cable tails. Capacitors shall be suitable for working with the lamps and associated equipment specified and shall correct the power factor to not less than 0.85 lagging. The capacitors shall be marked with the manufacturer's name, capacitance and working voltage. Ballasts and capacitors shall carry the ISI mark.

Wiring between the terminal block in the lantern and the components in the base of the pole shall be PVC insulated, PVC sheathed cable of 1000 V grade having a copper conductor of not less than 2.5 mm2 cross sectional area to IS 694. All cables shall be correctly colour coded. Unsupported lengths of wiring shall be kept to a minimum and taped such that they do not come into contact with components.

All metalwork other than current carrying parts shall be earthed.

Road lighting luminaries shall be die cast from aluminum alloy suitable for side entry spigot mounting. The luminaries shall be complete with polished aluminum reflector for use with the lamps and remotely mounted control gear. The impact resisting bowl shall be sealed to provide a totally weatherproof unit and hinged to facilitate revamping.

Discharge lamps shall carry a 6000 hour guarantee, and shall be controlled by ballasts and capacitors, as recommended by the lamp manufacturer. High pressure sodium discharge lamps shall be provided with an external ignitor unit.

5.2.7 Lighting Luminaries

All 'discharge' luminaries shall be provided with a capacitor for the purpose of power factor correction to a value in excess of 0.85 lagging.

Breakjoint rings or 'biscuit' rings of approved colour shall be provided by the Contractor for all suspended luminaries and fluorescent batten luminaries where the batten is of insufficient width to completely cover the conduit box and its associated clearance hole in the finished ceiling.

Heat resisting cables shall be installed as the final connection to all tungsten luminaries.

All flexible cords to be used in conjunction with lighting luminaries shall be white 3 core circular 300/500 volt grade PVC insulated and sheathed manufactured to IS 694. Conductors smaller than 0.75 mm2 cross sectional area shall not be used unless previously approved by the Engineer.

Fluorescent and incandescent luminaries shall be of the following types:

4.1.1.1 A. Tubular fluorescent luminaries:

4.1.1.1.1 Reflection

4.1.1.1.2 Diffuser

4.1.1.2 B. Incandescent type:

4.1.1.2.1 Reflection/Shade

4.1.1.2.2 Diffuser

4.1.1.2.3 Water proof

4.1.1.2.4 Bulk head

5.2.8 Lamps

Tungsten lamps shall be coiled coil pattern to IS 418 and IS 6702. Fluorescent lamps shall be manufactured to IS 2418. High pressure mercury lamps shall be manufactured to IS 9900. High pressure sodium lamps shall be manufactured to IS 9974.

Incandescent lamps shall have IEC type B22d caps. Tubular fluorescent lamps shall have bi-pin caps. Discharge lamps shall have type ES 40 caps (GES).

5.2.9 Lighting Switches

Lighting switches for domestic and office purposes shall comply with IS 3854. They shall be of approved manufacture with shuttered outlets.

5.2.10 Small Power Outlets

For domestic and office applications, 13 amp socket outlets which comply with IS 1293 shall be used. These shall be switched unless otherwise indicated and supplied with a plug fitted with a fuse rated according to IS 13703. The fuse shall suit the apparatus served.

Where cooker control units are installed, double pole switches of suitable rating shall be installed without a socket outlet.

Fused spur units shall be of approved manufacture, of the same type and finish as socket outlets installed. Fuses to IS 13703 shall be sized to suit the connected load.

5.2.11 Ceiling Fans

Propeller fans of the non-ducted ceiling mounting type together with their associated control units shall comply with IS 374 and IS 3588.

5.2.12 Conduits

Rigid conduit shall be super high impact heavy gauge PVC conduit (HIP) and PVC accessories complying in all respects with IS 9537 and IS 3419. Each length of conduit shall bear the manufacturer's name or trademark and be smooth inside and out and free from imperfections.

20 mm diameter conduit shall have minimum 1.8 mm wall thickness; 25 mm diameter conduit shall have a minimum 1.9 mm wall thickness.

Flexible conduit shall be of the waterproof galvanized type or PVC wire-wound type with cadmium plated mild steel couplings.

5.2.13 Earth Electrodes

Earth electrodes shall be 38 mm diameter galvanized iron rods made up in sections to the required length. Couplings joining rods shall be silicone bronze aluminum countersunk and of sufficient length to cover the rod thread.

Earth plates shall be of a minimum size of 600 x 600 x 6 mm copper or galvanised iron.

5.3 Plant And Equipment

Plant, equipment, and tools for the execution of electrical installations shall be sufficient in number and capacity, in good working order, and in accordance with the requirements of the applicable safety regulations.

5.4 Construction and Workmanship

5.4.1 Regulations and Standards

The electrical installation shall comply with all relevant IS regulations, statutory instruments and regulations current at date of Bid (unless otherwise indicated.

The Contractor shall be responsible for complying with all local byelaws, supply authority and local authority requirements. It shall be the Contractor's responsibility to determine the existence of these requirements and to comply with them.

5.4.2 Cable Installation

Cables to lighting and small power circuits shall be of one of the following sizes unless indicated otherwise:

i) 1.5 mm2 single core PVC for circuits loaded less than 1 kW.
ii) 2.5 mm2 single core PVC for circuits loaded up to 3 kW.
(iii) 4 mm2/6 mm2 2 core PVC for circuits loaded above 3 kW
iv) 1.0 mm2 light duty multicore PVC for control circuits.

Cables shall be segregated into the following categories:

i) power (less than 1 000 V phase to phase)
ii) instrumentation/telemetry
iii) control
iv) Telecommunications.

Cables shall be laid in a manner such that any electrical interference between cables shall not have a detrimental effect on the life and operation of equipment installed within the installation. As a general rule the following minimum clearances shall be adhered to wherever practical.

	HV power (mm)	MV/LV power (mm)	Instrumentation Telemetry Control (mm)	Telecommunications (mm)
HV power	-	-	-	-
MV/LV power	300	-	-	-
Instrumentation/ telemetry/control	300	150	-	-
Telecommunications local area network	300	150	150	-

LV power cables may be bundled together where allowance is made for any derating factors. Digital and

analogue signals shall be segregated within junction boxes.

Cables shall be drawn into conduits simultaneously without twists. Cables bunched into circular groups shall have the appropriate de-rating factor applied in accordance with Appendix 9 of the IEE Regulations.

Cables shall be installed on the 'loop-in' principle, no joints or junction boxes being permitted. Single core cables in conduit shall have the line conductors looped at switches and the neutral conductors looped at lighting points. Multicore cables, shall have the line and neutral conductors looped at the lighting point.

Wiring shall not be looped at terminal blocks internal to lighting luminaries. For fluorescent or similar luminaries having internal terminal blocks, the fixed wiring shall terminate at the conduit box with tails taken into the fitting. The arrangement shall be such that the fittings and tails may be removed without causing the other lighting luminaries on the circuit to be disconnected.

Wiring to 13 A socket outlet circuits shall be ring wired throughout. Spur circuits shall be used only where specified.

(i) General

Cables shall be installed in such a way that the minimum bending radii are not reduced when installed or during installation. Cables shall not be installed in ambient temperatures below that recommended by the cable manufacturer.

Cables grouped together shall have insulation capable of withstanding the highest voltage present in the group.

(ii) Direct in Ground

Buried cable up to 600/1000 V shall have a minimum cover of 500 mm measured to the top of the highest cable. On crossing roadways the cable shall be run through a PVC-U duct of minimum diameter 100 mm with a minimum of 1000 mm cover and encased on all sides by 150 mm of concrete.

The bottom of the cable trench shall be freed of sharp stones and such like and 75 mm of sieved sand laid below the cable. After cable laying 75 mm of sieved sand shall be laid above the cable.

Interlocking cable protective covers, minimum 1 m long x 150 mm wide, marked `Danger -Electric Cable' in English, and Nepali shall be laid on top of the sieved sand. Covers shall extend the whole length of the cable trench and shall overlap cables by a minimum of 50 mm.

Warning tape shall be laid a minimum of 200 mm above the protective covers.

Cables are to be installed without tees or through joints unless otherwise approved by the Engineer. Single core cables are to be run in trefoil formation.

(iii) In Underground Ducts

Underground ducts shall be constructed of impact resistant PVC-U, glazed earthenware or concrete and laid at a minimum depth of 500 mm. Ducts shall be surrounded by at least 75 mm of sieved sand except at road crossings where they shall be 1 m deep and encased on all sides by concrete.

The Contractor shall ensure that sufficient draw-in points have been provided and that adequate room has been allowed for installation of cables. Drawstrings shall be provided in all ducts to enable additional cables to be installed when required.

Where cables pass in or out of any duct entries into or within buildings such entries, together with any spare ducts shall be sealed against the ingress of moisture by means of duct stoppers and bituminous compounds or other method approved by the Engineer. The stopper shall have a fire resistance of at least 30 minutes. Single core cables in trefoil formation shall pass through the same duct and shall not be separated.

(iv) Conduit

Particular care shall be taken with the storage of conduit. A rack shall be provided for this purpose to ensure that the finish is not defaced. Conduit which is allowed to spread across the floor when stored so that the surface finish becomes damaged by being walked over or similar shall be rejected and removed from site.

All conduits shall be of sufficient size to permit the easy withdrawal and replacement of cables at a later date, no conduit smaller than 20 mm shall be used.

A space factor of 40% shall not be exceeded. The tubing shall be perfectly smooth inside and out and free from flaws and imperfections of any kind. Both ends of every length of tubing shall be properly reamed with all sharp edges removed before erection.

All bends shall be formed using bending springs in complete accordance with the manufacturer's instructions, and without alteration to the conduit section. Bends may be formed cold but in severe weather it may be necessary to warm the conduit slightly at the point where the bend is to be made. The inside radius of any bend shall not be less than 8 times of outside diameter of the conduit.

All conduit boxes on to which lighting fittings are to be affixed shall be capable of withstanding a dead weight of 10 kg and shall be fixed using two screws and washers. No weight shall be taken by any suspended ceiling.

For conduit boxes, couplers and all items of equipment that require adhesives, the manufacturer’s recommended adhesive shall be used. Connection to square or rectangular boxes shall be made using female threaded sockets and male screwed bushes. On no account shall the conduit protrude into such items as switch boxes or socket boxes. Inspection bends, elbows, couplings and tees shall not be used.

Circular PVC boxes, having spout entries, shall be used at the termination of all lighting points and as draw-in boxes on long runs. For 20 mm conduits round boxes shall be used as draw-in points, but for 25 mm and larger conduits, rectangular boxes shall be used. In each case heavy quality lids shall be used and secured by brass screws.

Sufficient draw-in boxes shall be installed to permit the re-wiring of the installation and they shall be positioned to ensure that all boxes are in accessible positions. The Contractor shall check all proposed positions with the Engineer before installation. In the case of flush draw-in boxes the Contractor shall fit a joint ring or spacer ring to finished plaster level.

Generally not more than two bends or offsets or one coupling will be permitted without a suitable inspection accessory. Fish wires shall not be left in conduits after erection. The whole of the installation shall be arranged for a loop-in type of system with joints being carried out at switches, isolators, etc. Intermediate joints in the cable will only be allowed by arrangement with the Engineer. Where terminal blocks are necessary, they shall be of the porcelain type with brass pinching screws.

For entry into trunking and any item requiring holes to be cut, the method shall be by bell mouth bushes and sleeves. For entry into sheet metal boxes and any item complete with pre-cut holes, the method shall be by threaded female sockets and male screwed bushes.

Ends of conduits which are liable to be left open for any length of time during building operations shall be plugged to prevent the ingress of dirt, cement, etc. and covers, either temporary or permanent, shall be fitted on all boxes.

The conduits shall be completely assembled, fixed and swabbed out before wiring is commenced.

Generally, conduits shall not cross expansion joints of buildings, but where they cannot be installed in any other manner then a flexible conduit shall be used across the expansion joint. A total 150 mm movement shall be allowed.

The Contractor shall provide a typical installation method drawing for all conduit installations, when requested by the Engineer.

Where conduits are taken through walls and/or floors, the holes shall be made good with incombustible material. All conduits

to the telephone, TV and radio systems shall be installed with draw wires.

All conduits to lighting and small power systems shall be installed with a circuit protective conductor.

(a) Surface Installation

All surface work, work in ducts or ceiling voids, etc., shall be secured by means of heavy quality spacer bar saddles secured by screws driven into rawlplugs, or equivalent fiber, PVC, metal or compound types. The spacing of fixings shall not exceed 1.25 m for 20 mm, 25 mm and 32 mm conduit or less in hot temperatures. It should be noted that saddles are designed to be a sliding fit for PVC conduits and it is important to ensure that all fixings are sliding due to the requirement for expansion.

Due to the materials used in PVC conduits a rise in temperature of 25^0 C would cause an increase of approximately 6 mm in a 4 m length of conduit. Where long straight runs in excess of 4 m occur in conditions of varying temperature, expansion couplers must be used in accordance with the manufacturer's installation instructions. A draw wire must be installed in runs where expansion couplings are used.

An efficient means shall be adopted to provide for the drainage of condensation and the runs shall be properly ventilated. All surface conduit runs shall be marked out for approval by the Engineer before the installation is carried out. Where large multiple parallel conduit runs would occur, use may be made of galvanized cable trunking.

(b) Concealed Installation

If the floor of any building is of solid concrete construction, conduits shall not be run in the screed rising to the outlets, etc., unless specifically instructed elsewhere in this Specification.

Where, due to the type of construction, it is necessary to cast conduits into concrete to serve lighting points, backed outlet boxes shall be used, using female threaded sockets and male screwed bushes, with the conduit installed in such a manner as to be self draining in accordance with the IEE Regulations.

Concealed conduits shall be securely fixed to prevent movement before laying of screeds, floating of plaster, casting of columns or other building operations necessary after the conduit installation. Crampets or similar fixings shall be used for attaching the conduit to blockwork, etc. Building nails will not be accepted.

At least 15 mm cover shall be allowed for finishes over the conduit. Where this cover cannot be maintained then expanded metal shall be fitted with the conduit. Conduit cast into reinforced concrete floors shall be fixed to the steel reinforcing with binding wire and the conduit boxes filled with expanded polystyrene or enclosed in a plastic bag to prevent the ingress of concrete when poured. Where possible, the conduit boxes shall be fixed to shuttering to give a flush finish.

Conduit installed in voids, false ceilings, and other concealed routes shall be installed as specified for the surface conduits. Wiring shall be carried out after the false ceiling or permanent ducts have been completed. Conduit installed in floors shall be sealed against ingress of moisture.

The conduit installation shall be inspected by the Engineer before the building operation conceals the work.

(c) Flexible Conduit

Flexible conduit shall be of the waterproof, galvanized type or PVC wire-wound type with cadmium plated mild steel couplings. Lengths of flexible conduits shall be sufficient to permit withdrawal, adjustment or movement of the equipment to which it is attached and shall have a minimum length of 300 mm. Flexible conduit shall not be used as a means of providing earth continuity. A single earth conductor of adequate size shall be installed external to the conduit complete with earth terminations.

Where conversion from rigid conduit to flexible metallic conduit is to be made, the rigid conduit shall terminate in a through type box and the flexible conduit shall extend from this box to the equipment. The earth continuity cable shall be secured to the box and to the piece of equipment by properly designed earthing screws. The use of lid facing screws, etc., will not be permitted. Adapters shall incorporate a grub screw or a gland to prevent the flexible conduit becoming loose.

(d) Clipped Direct

All cable hangers, clips, cleats and saddles shall be of an approved type and appropriate to the type and size of cable installed.

Their spacing shall be such as to ensure a neat appearance and prevent sagging of the cables at all times during their installed life.

(e) In Internal Floor Trenches

In shallow trenches used for electrical services only, cables may be laid in a neat and orderly manner on the floor of the trench. One layer only shall be allowed. Additional cables shall be installed on the walls of the trench in an approved manner.

Where the trench is shared by other services, cables shall be installed on the walls of the trench in an approved manner.

5.4.3 Distribution Boards

Where boards are fixed on steelwork or concrete columns, reinforced concrete or brick walls, they shall be mounted on the surface with conduits and/or trunking rising vertically from them.

Where boards are fixed on plaster finished walls, they shall be surface mounted on the finished face of the plaster with an adaptable galvanized metal box (minimum size 150 x 150 x 75 mm), recessed into the wall at the back of each board.

The adaptable box and fuse board shall be electrically and mechanically linked together, but independently fixed on the wall by bolts and expansion shields.

5.4.4 Small Power Outlets

Low voltage socket outlets for small power applications shall be fixed at a height of 300 mm from the finished floor level to the horizontal centre line of the switch.

Where recessed spur units control appliances such as incinerators, fans, water heaters, etc. a conduit shall be taken from the spur outlet box to an outlet box located immediately adjacent to the appliance in order to conceal the final connection to the appliances.

Wiring of spur units shall be carried out on 'ring' or 'radial' circuits as specified and shall conform to IEE Regulations.

5.4.5 Lighting Switches

Lighting switches of a single pole type shall be connected to the phase conductor. Switches shall be fixed at a height of 1410 mm from the finished floor level to the horizontal centre line of the switch. Where grouped switches are used, they shall be mounted in multi-gang boxes with plates.

All lighting switches shall be suitable for the power supply to which they are connected.

Lighting switches shall be mounted in separate boxes for separate circuits derived from different distribution boards.

Where multi-gang switches are supplied from opposite phases, phase barriers and warning labels shall be provided. Single gang switches connected to opposite phase polarity shall, in no case, be positioned less than 2 m apart.

5.4.6 Lighting Luminaries

The Contractor shall check final positions of all lighting points with the Engineer and obtain his approval before installation commences.

All lighting luminaries shall be mounted and located in such positions as to be readily accessible for maintenance purposes from ladders or steps.

Fixing and suspension plates shall be suitable for direct connection to conduit boxes or as otherwise specified. Luminaries having conduit suspensions shall be provided with earthed pattern ball and socket back plates. The rigid type of backplate will not be accepted. Tubular fluorescent luminaries shall have at least two separate fixings at the manufacturers recommended spacings.

5.4.7 Earthing and Bonding

The earthing system shall comply with Clause 67 of the Indian Electricity Rules.

All low voltage systems shall be properly and efficiently earthed in accordance with BS/IS 3043.

The Contractor shall ensure that complete earth continuity exists throughout the system and that the resistance of the earth parts complies with the IEE Regulations.

Each control room building shall have a main earth bar consisting of a hard drawn high conductivity copper bar of at least 150 x 25 x 6 mm, mounted on stand-off insulators. Connections to this bar shall be by brass bolts, flat washers, nuts and locknuts.

The system neutral, where applicable, earth bars of all switchboards and all earthing terminals of all transformers shall be securely bonded to the main earth bar. For bonding purposes, a galvanised iron earthing strip may be used, at least 25 x 6 mm in cross section.

Metal sheaths and armouring of all incoming, outgoing and interconnecting sub-station cables shall be securely bonded to the main earth bar. The sizes of bonding conductors shall be in accordance with IS 3043. Bonding conductors may be connected to the earth bar of the switchboard or other apparatus served.

All cables and conduits used throughout the installation shall be securely bonded to the associated equipment, and earthing straps shall be fitted. To facilitate such bonding, all cable glands shall be supplied with substantial armour clamps, having additional earthing lugs. Compression glands shall be fitted with earth tags and brass set screws.

Earthing terminals of every distribution board, isolator or switchgear item or other apparatus shall be securely bonded through 14 SWG copper conductor or 25 x 6 mm galvanised iron strip or by connecting the bonding conductors to the earth bar of the apparatus.

All electric motors and other items of electrical equipment within the Contract shall be bonded to earth by flexible copper cables, braids, or conductors of not less than 6mm2 equivalent size connected to the armouring of armoured cables unless stated otherwise.

All bonding of motors shall be to the stator frame of the motor. Bonding to end-shields, terminal boxes etc. is not acceptable.

Incoming gas, water, piped services and ducting shall be bonded in accordance with the requirements of IEE Regulation 413-2. The minimum size of the bonding conductor shall be 6mm2. Copper strip of green and yellow PVC insulated single core copper cables shall be used.

Earth clamps shall comply with IS 3043. In dry areas tinned brass clamps shall be installed. In areas where dampness is to be expected phosphor bronze clamps shall be used.

Where electrical components are mounted on custom built frames, each of the above earth bonds shall include the metalwork of the support structure.

Conduit or trunking shall not be used as the sole circuit protective conductor.

5.4.8 Earth Electrodes

Where connections to the mass of earth are specified for lightning protection or system earthing, the Contractor shall supply, install and test the connection in accordance with the following Clauses.

The Contractor shall, at the commencement of the Contract, carry out soil resistivity tests over the area of the Site indicated on the Drawings. A minimum of two tests of different spacings shall be carried out at each test location.

The results of these tests shall be used to determine the type and number of rods, plates or strips required.

The top end of rods shall be terminated at least 300 mm below finished ground level. Where rods are installed in areas accessible to persons or animals this depth shall be increased.

The position of earth rods shall be indicated by pre-cast concrete inspection pits.

Where multiple earth rods are installed, interconnections shall be made using bare galvanized iron strips. The strip shall be buried at a minimum of 600 mm below finished ground level.

The earth electrodes shall be connected to the main earth bar through test links. The earth electrode installation shall be tested in the presence of the Engineer when disconnected from the main system, using the method shown in Appendix 15 of the IEE Regulations.

Where the earth connection forms a link between a high voltage system and a low voltage system the earth connection resistance to earth when disconnected from the earth bar shall not exceed one ohm.

Where earth plates are required to carry the system fault current these shall be buried at a depth of at least 2 m. Connection of copper tapes to earth plates shall be brazed and protected against corrosion.

Marker posts and plates shall be provided to mark the position of all electrodes and buried conductors.

5.4.9 Site Lighting

The installation shall be in accordance with layouts with exact positions of control equipment, poles and lighting points determined on site to the approval of the Engineer, prior to starting erection.

The equipment shall be supplied in new and unused condition, having been tested in the course of manufacture and stored in weatherproof accommodation on site.

The Contractor shall carry out all unloading, slinging, stacking, erection and fixing of poles and brackets in accordance with the manufacturer's instructions.

Excavation for poles shall not be by mechanical means unless agreed by the Engineer. The bottom portion of pole shall be fixed in a solid precast concrete block not less than 450 mm square for the full depth of the block. Final adjustment shall be carried out using aluminum or hardwood wedges and the remaining annulus packed with sand. A cable duct shall pass through the concrete block into the column cable entry. Precast blocks shall be supplied and installed by the Contractor. The cable entry slot shall be temporarily plugged to ensure that it is maintained free from material during the backfilling process. The block shall be bedded on a 100 mm thick concrete base.

Poles shall be erected in a truly vertical position. The Contractor shall be responsible, until the expiry of the Defect Liability Period for correcting the alignment of any column which he has erected which has departed from the vertical position, excepting where it is established that such departure is due to an event outside the control of the Contractor.

Poles shall have their lanterns fixed and aligned in accordance with the manufacturer's instructions to prevent rotation in service. All joints shall be resistant to the ingress of moisture into the column and lantern.

5.5 Test and Acceptance

Tests shall be carried out on site and witnessed by the Engineer or his representatives as follows for LV cables:-

(i) Insulation resistance at 500 V dc shall not be less than 0.5 mega ohm.

(ii) Earth continuity and earth resistance.

(iii) Phasing and polarity (every fuse and single pole control and protective device shall be connected in phase conductors only).

5.6 Measurement and Payment

Work shall be measured according to types as an all inclusive rate or as specified on the BOQ.

6 PLUMBING

6.1 Scope

These Specifications cover the general requirements for plumbing services including fixing of pipes, fittings and sanitary appliances in buildings and general requirements external (outside buildings) water supply and sewerage works.

For the purpose of water supply arrangements inside buildings, the work can be considered as to start from ferrules and service pipes.

All the items under this group shall conform to the detailed Specifications given for each of the items, in addition to the bye-laws of the local bodies within whose jurisdiction the items are executed. Where the bye-laws of the local bodies differ from the detailed specification for an item, the bye-laws shall override these Specifications.

6.2 Interpretations

6.2.1 Supporting Specifications

The following specifications shall, inter alia, form part of and shall be read in conjunction with this specification:

a) 1 Item of General Application
b) 2.1 Site Clearance
c) 2.2 Earthworks
d) 2.3 Concrete Works
e) 2.4 Brickworks
f) 2.4 Cement Plaster Works

6.2.2 Application

This specification contains clauses that are generally applicable to plumbing and associated work.

6.2.3 Applicable codes

All materials used in the construction of any of the works or any of the appliances shall conform to the relevant Indian Standards where applicable. Where no such standards exit, the materials shall be of the quality and workmanship acceptable to Authority, and shall be open to inspection at the manufacturer's works before dispatch.

The following Indian Standard codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to:

IS:458	Concrete pipes (with and without reinforcement)
IS:651	Salt Glazed stoneware pipes and fittings
IS:771 (Part I to IV)	Glazed fireclay Sanitary appliances
IS:772	CI Sanitary Appliances
IS:774	Flushing Cisterns For W/C And Urinals
IS:775	CI Brackets And Supports For Wash Basins And Sinks
IS:778	Gunmetal Gate, Globe and Check valves for general purposes
IS:779	Water Meters (Domestic Type)
IS:781	Sand-cast brass screw down bib and stop taps for water services
IS:782	Caulking lead
IS:783	Code of practice for laying of concrete pipes
IS:784	Prestressed concrete pipes
IS:804	Rectangular prestressed steel tanks
IS:1200 (Part XVI)	Method of measurement for Building and Civil Engineering works - Laying of water, sewer lines including appurtenant items
IS:1239	Mild steel tubes, tubular and other wrought steel fittings
IS:1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage
IS:1538 (Part I to XIII)	Cast Iron fittings for pressure pipes for water, gas and sewage
IS:1545	Solid drawn copper alloy tubes
IS:1700	Drinking fountains
IS:1703	Ball valves (horizontal plunzer type) including floats for water supply purposes
IS:1711	Method for simple torsion testing of steel wire
IS:1729	Nahani Trap

IS:1742	Code of practice for building drainage
IS:1795	Pillar Taps
IS:1916	Steel cylinder reinforced concrete pipes
IS:2064	Code of practice for selection, installation and maintenance of sanitary appliances
IS:2065	Code of Practice for Water Supply in buildings
IS:2104	Water meter boxes (domestic type)
IS:2326	Automatic Flushing Cisterns For Urinals
IS:2379	Color code for identification of pipe lines
IS:2401	Code of practice for selection, installation and maintenance of domestic water meters
IS:2470	Code of practice for design and construction of septic tanks
IS:2548	Plastic water closet seats and covers
IS:2556 (Part I to XV)	Vitreous sanitary appliances
IS:2692	Ferrules for water services
IS:3076	LDPE pipes for Potable Water Supplies
IS:3114	Code of practice for laying of cast iron pipes
IS:3438	Silvered glass mirror for general purpose
IS:3589	Electrically welded steel pipes for water, gas and sewage (200 to 2000 mm nominal diameter)
IS:3950	Surface boxes for sluice valves
IS:4111	Code of practice for ancillary structures in sewerage system
IS:4127	Code of practice for laying of Glazed stoneware pipes
IS:4827	Tower Rail
IS:5329	Code of practice for sanitary pipe work above ground for buildings
IS:5455	Cast Iron steps for manholes
IS:5822	Code of practice for laying of welded steel pipes for water supply
IS:6295	Code of practice for water supply and drainage in high altitudes and or sub-zero temperature regions
IS:7231	Plastic Flushing Cisterns For W/C And Urinals
IS:10067	Material constants in building works

Other IS codes not specifically mentioned herein but pertaining to the work of internal water supply form part of these Specifications.

6.2.4 General Requirements

The following general requirements are applicable, though these are not explicitly specified / stated in the Drawings or designs given by the Engineer.

All work shall be done with skilled workmen experienced in the trade. All water supply installation work shall be carried through licensed plumbers.

All work shall be adequately protected, to the satisfaction of the Engineer, so that the whole work is free from damage throughout the period of construction upto the time of handing over.

No work shall be covered without the approval of the Engineer.

The Contractor shall be responsible for coordinating this work with works of other trades sufficiently ahead of time to avoid unnecessary hold-ups. Hangers, sleeves, recesses etc., shall be left in time as the work proceeds.

The Contractor shall submit as directed by the Engineer, samples, shop Drawings, manufacturer's Drawings, equipment characteristics and capacity data etc., of all equipment, accessories, devices etc., that he proposes to use in the installation, to the Engineer for approval.

Any damage caused to the building or to electric, sanitary, water supply or other installations etc., therein either due to negligence on the part of the Contractor, or due to actual requirements of the work, shall be made good and the building or the installations shall be restored to its original condition by the Contractor.

It is most important to ensure that the wholesome water supply provided for drinking and culinary purposes, is in no way liable to contamination from any less satisfactory water. There shall, therefore, be no cross connection whatsoever between a pipe or fitting for conveying or containing wholesome water and a pipe or fitting for conveying or containing

impure water or water liable to contamination or of uncertain quality of water which has been used for any purpose. The provision of reflux or non-return valves or closed and sealed valves shall not be construed a permissible substitute for complete absence of cross-connection.

No piping shall be laid or fixed so as to pass into, through or adjoining any sewer, scour outlet or drain or any manhole connected therewith nor through any ashpit or ashpit-pit or any material of such nature that would be likely to cause undue deterioration of the pipe, except as permitted in the next paragraph.

Where the laying of any pipe through fouled or corrosive soil or pervious material is unavoidable, the piping shall be properly protected from contact with such soil or material by being carried through an exterior cast iron tube or by some other suitable means approved by the Engineer. Any piping or fitting laid or fixed, which does not comply with the above requirements, shall be removed and relaid in conformity with the above requirements and to the satisfaction of the Engineer.

Where lines are to be laid in close proximity to electric cables or in corrosive soils, adequate precautions should be taken to avoid electrical accidents and corrosion.

To reduce the frictional losses, piping shall be as smooth as possible inside. Methods of jointing shall be such as to avoid internal roughness and projection at the joints, whether of the jointing material or otherwise.

Change in diameter and in direction shall preferably be gradual rather than abrupt to avoid undue loss of head. No bend or curve in piping shall be made which is likely to materially diminish or alter the cross-section.

All pipe work shall be so laid or fixed, and maintained as to be and to remain completely watertight, thereby avoiding waste of water, damage to property and the risk of contamination of the water conveyed.

Underground piping shall be laid at such a depth that it is unlikely to be damaged by frost or traffic loads and vibrations. It shall not be laid in ground liable to subsidence, but where such ground cannot be avoided, special precautions shall be taken to avoid damage to the piping. Where piping has to be laid across recently disturbed ground, the ground shall be thoroughly consolidated so as to provide a continuous and even support.

The bottom of water service pipe, at all points, shall be at least 30 cm above the top of the sewer line at its highest point. Water for drinking or for culinary purposes as far as possible shall be on branch pipes connected directly to the service.

In flats and tenements supplied by a common service pipe a stop tap shall be fixed to control the branch each separately occupied part. In large buildings a sufficient number of stop valves shall be fixed on branch pipes, and to control groups or ball valves and draw off taps, so as to minimize interruption of the supply during repairs, all such stop valves shall be fixed in accessible positions and properly protected from being tampered with, they may be of the gate type to minimize loss of head of friction.

Where the service pipe is of diameter less than 50 mm the stop valves shall be of the screw down type and shall have loose washer plates to act as non-return valves. Other stop valves in the service line may be of the gate type.

Service pipes shall be so constructed as to avoid air-locks, so that all piping and fittings above ground can be completely emptied of water to facilitate repairs. There shall be draining taps or draw-off taps (not underground) at the lowest points, from which the piping shall rise continuously to draw-off taps, ball valves, cisterns, or vents (where provided at the high points).

Piping shall be confined, as far as possible, to rooms where appliances are fixed, it shall have easy bends, and where quietness is particularly desired, holder bats or clamps shall be insulated from the piping by suitable pads.

The rising pipe to the storage cistern, if any, of any feed cistern shall be taken as directly as possible to the cistern and shall be fixed away from windows or ventilators.

Piping shall not be buried in walls or solid floors. Where unavoidable, piping may be buried for short distance provided that adequate protection is given against damage and that no joints are buried. If piping is laid in ducts or chases, these shall be roomy enough to facilitate repairs and shall be so constructed as to prevent the entry of vermin. To facilitate removal of pipe casing, floor boards covering piping shall be fixed with screws or bolts.

When it is necessary for a pipe to pass through a wall or floor, sleeves shall be fixed therein for reception of the pipe and to allow freedom for expansion and contraction and other movement. Piping laid in wooden floors shall, where possible, be parallel with the joist.

Where storage tanks are provided to meet over all requirements of water, connection of service pipe with any distributing pipe shall not be permitted except one direct connection for culinary or drinking requirements.

No service pipe shall be connected to any water closet or urinal. All such supplies shall be from flushing cisterns which shall be supplied form storage tank.

No service or supply pipe shall be connected directly to any hot water system or to any apparatus used for heating other than through a feed cistern thereof.

The service pipe shall pass into or beneath the building at a depth below the external ground level of not less than 0.75 m (provided the foundation is deeper than 0.75 m) and at its point of entry through the structure, it should be accommodated in a sleeve which should have previously been solidly built in the space between the pipe and the sleeve shall be filled with bituminous or other suitable material for a minimum length of 25 cm at both ends.

6.3 Pipes and fittings

In order to supply water inside and premises of the building, piping arrangements of Galvanized Iron (GI) pipes, medium class, conforming to IS: 1239 or NS 199-2046, shall be used. For sewerage works uPVC or Reinforced Cement Concrete (RCC) pipes shall be used as specified. Specifications for laying of these pipes are given in Clauses 3 .

6.4 Material, fittings, appliances and structures for water supply

6.4.1 General

All pipes, fittings and appliances shall be free from cracks and other flaws before fixing and shall be undamaged in all respects during and after fixing. Any damages shall have to be rectified satisfactorily.

All the pipes, fittings and appliances shall be thoroughly cleaned before fixing and particular care shall be taken to see that no extraneous material gets into them during fixing. All items required for ensuring leak proof jointing and efficient functioning of the pipes and appliances shall be carried out without extra claim. The pipes shall be carefully cleared of all foreign matter before being laid. They shall be thoroughly brushed out internally with a well-fitting hard brush, and after laying the open end shall be temporarily plugged to prevent ingress of water, soil etc., precaution shall be taken to prevent floatation of the plugged pipes.

All cutting and waste of pipes involved in fitting them shall be included in the rate.

All diameters of pipes shall be the diameters of the inside bore. All the pipes, appliances, fixtures and all other materials to be used shall be new and of good quality. Pipes and fittings

6.4.2 Fixtures and Appliances

6.4.2.1 Brass or Gunmetal water fittings

All brass or gunmetal fittings shall be of heavy quality and of approved manufacture and pattern. The fittings shall conform to IS: 778 and IS: 781. A sample of fittings shall be got approved by the Engineer and all fittings shall be provided according to the approved samples.

The standard size of bronze or gun metal fittings shall be designated by the nominal bore of the pipe outlet to which the fittings are attached. A sample of each kind of fittings shall be got approved from the Engineer and all supplies made according to the approved samples.

All cast fittings shall be sound and free from laps, blow holes and pittings. Both internal and external surfaces shall be clean, smooth and free from sand etc. Burning, plugging stopping or patching of the casting shall not be permissible. The bodies, bonnet, spindles and other parts shall be truly machined so that when assembled the parts shall be axial, parallel and cylindrical with surfaces smoothly finished. The area of the water way of the fittings shall not be less than the area of the nominal bore. Chromium plating wherever specified shall be of 0.3 micron thick, conforming to IS:4827. The chromium shall never be deposited on brass unless a heavy coating of nickel is interposed. In the case of iron fittings, a thick coat of copper shall first be applied, then one coat of nickel and finally the coat of chromium shall be applied. In finish and appearance the plated article, when inspected, shall be free from plating defects such as blisters, pits, roughness and unplated areas and shall not be stained or discoloured. Before fitting is plated the washer plate shall be removed from the fittings, the gland packing shall be protected from the plating solution.

6.4.2.2 Bib cock (tap)s and stop cock (tap)

Bib cock and stop cock shall be of specified size and shall be of screw down type and shall conform to IS 781. The handle shall be either crutch or butterfly type, securely fixed to the spindle. Valve shall be of the loose leather seated pattern. The cocks (taps) shall open in anti-clockwise direction.

The bib cock and stop cock shall be polished bright. The minimum finished weights of bib tap and stop tap shall be as specified in the following table:

Size (mm)	Minimum finished weight	
	Bib tap (kg)	Stop tap (kg)
8	0.25	0.25
10	0.30	0.35

15	0.40	0.40
20	0.75	0.75

6.4.2.3 Screw Down Wheeled Sto

The item shall conform to the Specifications covered in Clause 6.5.2.2 in all respects except that it shall have an operating wheel. The material of the wheeled stop valve shall be gun metal or brass as specified in the item.

6.4.2.4 Self closing taps and other special fittings

Self closing taps and other special fittings of approved makes are to be used on direct pipes and distributing pipes from tanks. Self-closing taps shall be of non-concussion type and shall comply with IS: 1711.

6.4.2.5 Valves for Plumbing

6.4.2.5.1 Wheel Valves (Globe valves)

The wheel valves shall be of size as specified and conforming to IS: 778 (Globe Valves).

6.4.2.5.2 Gate Valves

The gate valve shall be of size as specified and conforming to IS: 778.

6.4.2.5.3 Non-Return valve (Brass)

The valves shall be of quality approved by the Engineer and shall generally conform to IS: 778. Weights of these valves shall be as prescribed in the following table with a tolerance of 5 percent.

Diameter (mm)	Weight (kg)	
	Horizontal type	Vertical type
15	0.30	0.25
20	0.55	0.25
25	0.90	0.75

6.4.2.5.4 Non-Return valve (Gunmetal)

The valves shall be of quality approved by the Engineer and shall generally conform to IS: 778.

6.4.2.5.5 Float / Ball valves

The float valves or ball valves shall be of specified size as per Specification conforming to IS: 1703. The valve shall be of Brass or Gunmetal of specified size conforming to IS: 1703. The valve shall be of following two classes:

- High Pressure (HP) for use on mains having pressure of 1.75 kg/cm^2 and above. These shall remain closed at a test pressure of 10.5 kg/cm2.
- Low Pressure (LP) for use on mains having a pressure up to 1.75 kg/cm^2. These shall remain closed at a test pressure of 3.5 kg/cm2.

The ball valves shall be of the nominal sizes 15 mm, 20 mm and 25 mm. The nominal size shall correspond with the nominal bore of the inlet shanks. Polyethylene floats shall conform to IS 9762. These valves shall be of the following dimensions and weights:

Sr. No.	Item	Nominal Size of valve (mm)		
		15	20	25
1.	Diameter of Spherical float (mm)			
	High pressure	127	152	203
	Low pressure	114	127	178
2.	Minimum weight of ball valve including back nut, body and piston	283	446	823

6.4.2.5.6 Landing Valves

Landing valves shall be of the specified size and class and shall in all respects conform to the requirements of IS: 5290, type B.

6.4.2.5.7 Full Way Valve (Brass)

The valve shall be of brass fitted with a cast iron wheel and shall be of gate valve type conforming to IS:780, opening full way and of the size as specified. The valve shall be of best quality as approved by the Engineer.

6.4.3 Water Storage Tanks on terraces

These tanks shall of HDPE circular tanks of required capacity and shall be as per approved by the Engineer and as per drawing Drawings.

For inlet, outlet and other connections fully threaded GI connections with hexagonal check nuts and washers on either side of the tank wall shall be provided. Holes for threaded connections shall be drilled and not punched. Pipes entering / leaving the tank shall be provided with unions and suitably supported on a firm basis to avoid damage to the tank walls. No separate payment shall be done for fixing of inlet, outlet, washout arrangement and associate work.

6.4.4 Underground Water Storage Tanks

Underground Storage tanks shall be of RCC, as per the Specifications given for RCC storage tanks The following requirements shall also be complied with:

- The tank shall project at least 30 cm above the highest flood level. Where this is not possible the manhole cover shall be raised 30 cm above the highest flood level of the locality or ground level whichever is higher.
- The construction of the tank shall be such as to provide for the draining of the tank when necessary and water shall not be allowed to collect round about the tank.
- The tank shall be perfectly watertight.
- The inner surface of the tank shall be rendered smooth as far as possible.
- The top of the tank shall be so leveled as to prevent accumulation of water thereon.
- The tank shall have complete cement concrete cover leaving a manhole opening provided with a properly fitting mosquito-proof hinged cast iron cover fitted with a leak proof cast iron frame. Where tank is of a large size, adequate number of manholes shall be provided.
- No gap shall be allowed to remain round the suction pipe and arrangement shall be provided for proper discharge of spill water from the electric pump by connecting the pump cabin to the water drain, or by providing a small hole which will enable the water to flow out

The overflow pipes or vent shafts, if provided, shall have a wire gauge cover of 1.5 mm mesh properly screwed tightly to the opening.

6.4.5 Fittings and accessories for RCC Water Reservoirs

Where necessary, the pipes etc., shall be embedded during the casting of concrete. Where not so necessary in the opinion of the Engineer, holes may be left while casting of the concrete and the accessories fixed later. All these holes shall be made good and waterproofed after fixing of the accessories. The frame of the manhole shall be embedded into the concrete while casting.

The following fittings and accessories are included under this item as given elsewhere:

- Ball cock of the diameter of the supply pipe.
- Galvanized iron overflow pipe with mosquito proof coupling.
- Required number of 45 cm diameter manholes with cover and frame,
- Connecting galvanised iron pipes,
- 45 cm wide mild steel ladder of 40 mm x 6 mm mild steel flat stringers and stops of 20 mm diameter mild steel bars,

The intake and outtake pipes shall be as provided separately and shall not be included in this item.

6.5 Sanitary fittings and appliances

6.5.1 General

All porcelain sanitary ware shall be of approved make. All fittings shall be of first quality, free from warps, cracks and glazing defects. All sanitary ware, fittings and fixtures shall be as shown in Drawings and as described in detail in Bill of Quantities.

6.5.2 Protection

Fixtures shall be protected throughout the progress of the work from damage. Special care shall be taken to prevent damage and scratching of chromium plated fittings. Tool marks on chromium fixtures etc., shall not be accepted.

All fixtures shall be fixed with chromium plated brass screws with washers wherever necessary. Protective paper on fixtures shall be removed with hot water only at the final completion of work.

6.5.3 Workmanship

All sanitary ware shall be fixed in a neat workmanlike manner, true to level and plumb. Manufacturer's instructions shall be followed closely regarding installation and connections.

6.5.4 Testing

When the installation has been completed to the satisfaction of the Engineer, it shall be tested in the following manner:

- The entire system shall be slowly filled with water, allowing any trapped air to escape.
- When all outlets are closed the system shall be checked for water tightness.
- Each outlet shall then be checked for rate of flow and correct operations.

6.5.5 Bath, Lavatory and Mixing Taps

Bath, lavatory and mixing taps shall generally comply with the requirements specified for bib taps in Clause 6.5.2.2. Combination taps, mixing valves or blenders shall conform to IS : 1701. For mixing hot and cold water and discharging the mixture through a single outlet shall be fed with both hot water and cold water under pressure only from cisterns at the same level or from the same cistern.

6.5.6 Wash basins

The item pertains to the provision and fixing of wash basin of the specified size including all necessary fixtures and pipe connections upto the outside face of the wall.

The basin shall be fixed and supported on a pair of rolled steel or cast iron cantilever brackets embedded in wall or fixed to wall with wooden cleats and screws. The height of the top of the basin from the floor shall be 75 cm unless other heights are ordered by the Engineer. All the pipe connections shall be made as shown on the plan or as found necessary and ordered by the Engineer for the item. Chromium plated brass screw down stop tap shall be fixed on the supply pipe. The pipe connections shall conform to IS: 1742. The waste pipe shall be provided with a C.P. Brass bottle trap. All the exposed pipes and brackets shall be painted with one coat of red lead and two coats of good oil paint of approved shade.

Wash basins shall be of white vitreous china conforming to IS: 2556 (Part -I) and IS: 2556 (Part IV). Wash basins either of flat back or angle back as specified shall be of one piece construction, including a combined over-flow. All internal angles shall be designed so as to facilitate cleaning. Each basin shall have a rim on all sides, except sides in contact with the walls and shall have a skirting at the back. Basins shall be provided with single or double tap holes as specified. The tap holes shall be 28 mm square or 30 mm round or 25 mm round for pop up hole. A suitable tap hole button shall be supplied if one tap hole is not required in installation. Each basin shall have circular waste hole to which the interior of basin shall drain. The waste hole shall be either rebated or bevelled internally with 65 mm diameter at top. Each basin shall be provided with non-ferrous 32 mm waste fitting. Stud slots to receive the brackets on the underside of the wash basin shall be suitable for a bracket with stud not exceeding 13 mm diameter, 5 mm high and 305 mm from the back of basin to the centre of the stud. The stud slots shall be of depth sufficient to take 5 mm stud. Every basin shall have an
integral soap holder recess or recesses, which shall fully drain into the bowl. A slot type of overflow having an area of not less than 5 cm^2 shall be provided and shall be so designed as to facilitate cleaning of the overflow.

Wash basins shall be enumerated. Rate shall include the cost of all the materials and labour involved in all the operations described above.

6.5.7 Mirror

The mirror shall be of superior sheet glass with edges rounded off or bevelled, as specified. It shall be uniformly silver plated at the back and shall be free from silvering defects and with marine plywood back. Mirror shall conform to the Specifications of IS:3438.

Mirror shall be fixed in position by means of 4 Chromium Plated (C.P) brass screws and C.P brass washers, over rubber washers and wooden plugs firmly embedded in walls. C.P brass clamps with C.P brass screws may be an alternative method of fixing, where so directed. Unless specified otherwise the longer side shall be fixed horizontally.

The item, if measured separately, will be by number. It may be included in other items it so specified in BOQ.

6.5.8 Sink

Kitchen sink shall be provided at the location shown in the Drawing and as per the size mentioned.

Kitchen sink shall be of white glazed fire clay conforming to IS 771 (part II) and shall have combined overflow of weir type and their inverts shall be 30 mm below the top edge. Each sink shall be provided with a non-ferrous 50 mm diameter waste fitting. The waste fitting shall be of brass with chromium plated (CP).

The sink shall be provided with 40 mm CP brass union. CI brackets for supporting sink shall conform to IS:775. Installation of sink shall consist of assembly of sink C.I brackets, union and GI waste pipe. The sink shall be supported on CI cantilever brackets, embedded in cement concrete (1:2:4) block of size 100 X 75 X 150 mm. Brackets shall be fixed in position before the dado work is done. The CP brass union shall be connected to 40 mm nominal bore GI waste pipe which shall discharge into a floor trap. The height of front edge of sink from the floor level shall be 80 cm. This item shall be measured by number including all items stated above and shall include cost of all the labour, material.

Sinks shall be enumerated. Rate shall include the cost of all the materials (bottle trap, waste pipe, washers, CI brackets, unions, other fittings and etc) and labour involved in all the operations described above.

6.5.9 Floor Trap

Floor Traps shall be of CI and self cleaning and deep water seal type with a 50 mm water seal. It shall have a 100 mm diameter grating. These shall be fixed in cement concrete blocks 1:2:4, to the required level and position. The gratings shall be got approved before use in work.

6.5.10 Water closet

6.5.10.1 Orissa Pattern Water Closet

Squatting pans shall be of white vitreous china conforming to IS: 2556 (Part-I) for general requirements and IS: 2556 (Part-III) for Orissa pattern water closet

This item pertains to provision and fixing of Orissa type white glazed earthenware Water Closet pan of specified dimensions with cast iron high level flushing cistern of 12.5 litres capacity, and other accessories and necessary pipe connections upto the soil and vent pipes fixed on the outside of walls.

Each pan shall have an integral flushing rim of suitable type. It shall also have art inlet or supply horn for connecting the flush pipes. The flushing rim and inlet shall be of the self draining type. It shall have weep hole at the flushing inlet to the pan. The flushing inlet shall be in the front unless otherwise specified or ordered by the Engineer The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and the surface shall be uniform and smooth to enable easy and quick disposal while flushing. The exterior surface of the outlet below the flange shall be an unglazed surface which shall have grooves at right angles to the axis of the outlet. In all cases a pan shall be provided with a (100 mm) S.C.I. trap with 'P' or 'S' type with approximately 50 mm water seal and 50 mm diameter vent horn, where required by the Engineer.

The pan shall be placed into position with the trap joined in cement mortar 1:1 and the connecting pipes duly connected including the lead pipe from the flushing cistern. The jointing of various pipes shall conform to IS: 1742.

The jointing of cast iron pipes shall be with 1:1 cement mortar with hemp yarn caulking.

The pan shall be sunk into the floor and embedded in a cushion of average 15 cm thick cement concrete 1:5:10 (1 cement : 5 fine and : 10 graded brick ballast 40 mm nominal size). The concrete shall be left 115 mm below the top level of the pan so and to allow flooring and its bed concrete. The joint between the pan and the trap shall be made leak proof with cement mortar 1:1 (1 cement : 1 fine sand). The pan shall be fixed slightly at a lower level than the level of the general flooring, which should slope on all sides towards the pan. If the pan is damaged in handling or fixing, it shall be replaced by the Contractor at his own expenses.

The flushing cistern shall be fixed on two iron or mild steel cantilever brackets fixed in the wall at the height indicated on the Drawing or as ordered by the Engineer. The inlet end shall be connected to the distribution pipe through a stop tap, pipe and bends. The lead flushing pipe shall be connected to the outlet nipple and tail pipe with a coupling brass nut. The 20 mm diameter overflow pipe shall be slightly bent downwards and shall be fixed with a mosquito proof coupling.

The C.P. flushing pipe shall be bent leaving a straight length of about 30 cm at the top and the lower portion after the bend shall be housed into the recess cut in the wall and shall be concealed with plaster.

The whole installation shall be tested for leak proof joints and satisfactory functioning.

The cistern, brackets and all the exposed pipes shall be painted with a base coat of red lead oil paint and the two coats of approved shade of good oil paint.

6.5.10.2 European type white glazed earthenware water-closet

The item pertains to the provision and fixing of European type white glazed earthenware water-closet pan, with 12.5 liters white steel enameled low level flushing cistern and other flushing accessories and necessary pipe connections up to the soil and vent pipes fixed on the outside of the wall. The pan shall be fixed into position in 1:1 cement mortar with the connecting pipes duly connected including the flushing cistern, piping etc., and the test shall be done as in previous Clause. The seat and lid shall be fixed to the pan with chromium plated brass hinges.

6.5.10.3 Measurement

Water closets shall be enumerated. Rate shall include the cost of all the materials and labour involved in all the operations described above.

6.5.11 Urinals

6.5.11.1 Half stall Urinals

The item pertains to the provision and fixing of a half stall type urinal with 10 litre auto flushing cistern (or any other type as defined in the BOQ) including all fittings and soil pipe connections upto the outside face of the wall. The installation of the urinal shall conform to paragraph 6.6 of IS 2064.

The urinal shall be securely fixed to the wall with the top of the bowl at 65 cm., from the floor or such distance as may be directed by the Engineer. All the pipe connections shall be made as shown on the Drawings or as necessary for the item.

The jointing shall confirm to paragraph 5 of IS: 1742. A 32 mm diameter GI pipe shall be provided with C.P. bottle trap.

The flushing cistern, its fixing and the pipe connections shall conform to the details given in Clause 6.6.10 above. All the exposed lead and ferrous pipes and the bracket for the flushing cistern shall be painted with one coat of red lead and two coats of good anti-corrosive oil paint of approved shade.

Half stall urinals shall be of white vitreous china conforming to IS 2556 (Part VI Sec 2). They shall be of one piece construction with or without an integral flushing box rim provided with slots or alternative fixing arrangement at the flat back end. They shall be provided with ridges where integral flushing is not provided in the sides of the interior of the bowl, to divert the water towards the front line of the urinal where integral flushing box rim is specified, water spreaders provided shall conform to IS:2556 Part VI: Sec 6. These shall be vitreous china of one piece construction with one integral flush inlet.

6.5.11.2 Squatting Plate Urinal

The Squatting Plate Urinal shall be of vitreous china conforming to IS 2556 (Part I) and IS 2556 (Part VI / Sec 3) with internal flushing rim with front or side inlet. Squatting plate shall be of one piece construction. Each urinal shall have integral longitudinal flushing pipe of suitable type which may be connected to flush pipe. There shall be 100 mm diameter white glazed vitreous china channel with stop and outlet piece in front.

6.5.11.3 Measurement

Urinals shall be enumerated. Rate shall include the cost of all the materials and labour involved in all the operations described above.

6.5.12 Toilet Requisites

6.5.12.1 Towel Rail

It shall be of anodised aluminum with two aluminum anodised brackets. The size of the rail shall be 75 cm x 20 mm diameter or 60 cm x 20 mm diameter, 1.25 mm thick as specified. The bracket shall be fixed by means of CP 1 brass screws to wooden cleats firmly embedded in wall.

6.5.12.2 Toilet paper holder

The toilet paper holder shall be of CP brass or vitreous china as specified and of size and design as approved by the Engineer-in charge. It shall be fixed in position by means of CP brass screws and plugs embedded in the wall.

6.5.12.3 Shower

These shall be of CP finish swivel type as specified.

6.5.12.4 Towel pipe and towel cloth stand etc.

These shall be of CP / anodized aluminum as specified. These shall be fixed by means of CP brass screws to wooden cleats firmly embedded in the wall.

6.5.12.5 Measurement

All the items mentioned above under Clause 'Toilet Requisites' shall be measured per number and the quoted rates shall be on this basis which shall include the cost of respective materials, necessary fixtures, fixing in position.

6.5.13 Water Heaters

These shall be of best approved make, type and capacity as per BOQ. They shall be mounted on the wall / lift with necessary bolts of approved type. They shall have a 8 mm PVC inlet pipe, 12 mm lead pipe outlet and 15 mm non-return valve.

These shall be measured per number basis and the quoted rates shall include:

- Cost of water heater with all the built-in electrical accessories like pilot lamp, thermostat, standard length of cable and three pin plug,
- PVC inlet lead outlet pipe and non-return valve,
- Fixing accessories like bolts, nuts etc.

6.5.14 Soil, Water and Vent Pipes

Unless otherwise mentioned in BOQ, soil, waster and vent pipes shall be of Cast Iron conforming to IS: 1729 or IS:3989. Pipes and fittings with irregular bore, blow holes and other manufacturing defects shall not be allowed to be used for work. All the fittings shall be of the degree specified or as required at site.

6.5.14.1 Cast Iron Rain Water Pipes

Cast Iron pipes shall be treated with Dr. Angus Smith's solution before use. Cast Iron grating shall be of a slightly bigger diameter than that of the pipe.

In the case of terraced roof, the cast iron grating shall be fixed at the inlet end of the pipes properly secured in the parapet wall to receive the rain water. The cast iron grating shall be recessed at a slightly lower level than the adjacent terrace floor.

The joints shall be sealed with a few turns of spun yarn soaked in bitumen or tar. It shall be pressed home with a caulking tool for 1/3rd the depth of the joint. More skein yarn shall be wrapped if necessary and well rammed home. The joint shall then be filled with cement mortar 1:3. At the ground level, they shall be supported on a 1:2:4 cement concrete block of 30 cm x 30 cm and of sufficient height.

All the necessary fittings shall be included in the pipeline at proper places. The inlet end shall be carefully fixed to admit water from the roof. The outlet shall be with a shoe.

The pipe shall be painted with one coat of red lead oil paint and two coats of good anticorrosive oil paint of approved shade.

Pipes, fittings and joints shall be tested for leakage, any defects noticed shall be rectified without any extra cost to the corporation.

6.5.14.2 Cast Iron Soil Vent Pipes

Cast iron pipes of specified diameter shall have sockets for underground and sockets with lugs for fixing on walls. They shall be treated with Dr. Angus Smith's solution. All the pipes, fittings, etc., should be free from cracks and flaws. The interior of the pipes and fittings shall be clean and smooth. All the fittings shall be of the same quality as that of the pipes. The fittings shall have cleaning eyes with plugs where necessary.

The socket end shall be the inlet end for the soil or waste pipes. In vent pipes the socket shall face up. The joints shall be filled with lead. The joining shall conform to IS: 1742. Where the cast iron pipes are fixed on the wall they shall be supported on a 1:2:4 cement block of 30x30 cm and of sufficient height in the ground. The pipes shall be fixed on the wall with nails driven through the lugs to the holder battens. Necessary fittings shall be included in the pipes. The exposed pipes shall be painted with a base coat of red lead and two coats of good anti corrosive oil paint of approved shade. For pipes fixed on the walls, smoke test shall be carried out.

6.5.15 Gully traps

Gully traps shall be of salt glazed stoneware conforming to IS 651. Each gully trap shall have one CI grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight CI cover with frame inside dimensions 300x300 mm the cover weighing not less than 4.50 kg and the frame not less than 2.70 kg. The grating cover and the frame shall be of sound and good casting and shall have truly square machined seating faces. These shall be housed in masonry chambers of 300 mm x 300 mm internal size.

The masonry chambers shall be constructed in first class bricks in cement mortar 1:5 with a 10 cm brick work round the gully trap from the top of the bed concrete upto ground level. The space between the chamber walls and the gully trap shall be filled with cement concrete 1:5:10. It shall be plastered with cement mortar 1:3 finished with a floating coat of neat cement.

CI cover with frame shall be fixed on the top of brick masonry with cement concrete 1:2:4 and rendered smooth. Cement concrete in bed shall be 10 cm thick and in 1:5:10 mix (40 mm nominal size stone aggregate), projecting 7.5 cm outside the chamber walls.

6.5.16 Cast iron Nahani trap

Nahani trap shall be P or S type with minimum 50 mm seal. However if the plumbing is in two pipe system and with a gully trap at the ground level the minimum water seal shall be 35 mm. The traps shall be of self cleansing design and shall have exit of same size as that of waste pipe. These shall conform to IS 1729.

7 FILTRATION MEDIA

7.1 Scope

This specification covers the requirements of fine filter sand and for gravel used in filtration of water.

7.2 Terminology

For the purpose of this standard, the following definitions shall apply.

Effective Size (E. S.) - Particle diameter corresponding to 10 percent finer on the grain size curve [determined according to IS: 2720 (Part IV)-1975].

Uniformity Coefficient - The ratio D60/D10 where D60 is the particle diameter corresponding to 60 percent finer on the grain size curve, and D10 is the particle diameter corresponding to 10 percent finer on the grain size curve.

7.3 Filter Sand

7.3.1 Quality Requirements

Filter sand shall consist of hard, durable grains of silica and shall have a specific gravity of not less than 2.5. All grains of sand shall preferably be water worn.

The minimum silica content in sand as determined by method given in 7 of IS: 2000-1962 shall be 90 percent.

Any sample of filter sand shall not contain more than 5 percent by volume of impurities, such as clay, loam, silt, etc, in one hour settlement after shaking in water in accordance with procedure described in Appendix A of the IS 8419 (Part 1) 1977.

Sand for Slow Sand Filter

It should be hard, rounded grains and free from clay, fine particles, soft grains and dirt. Any sample of filter sand shall not contain more than 5 percent by volume of impurities, such as clay, loam, silt, etc, in one hour settlement after shaking a 1000 ml calibrated measuring cylinder half filled with filter sand to be tested and add filled with water until up to three-fourths of the cylinder.Ignition loss should not exceed 0.7% by weight.The specific gravity should be in the range of 2.55 to 2.65.Its silica content should be 90% or higher.Acid loss in hydrochloric acid should not exceed 5% by weight in 24 hours.Wearing loss should not exceed 3%.Effective size (d10) shall be between 0.15-0.35 mm.The uniformity coefficient (d60/d10) should be preferably between 2 to 3.5 and shall not exceed 5.

The sand shall not contain more than 5 percent of acid soluble matter as determined by solubility test described in Appendix B of IS 8419 (Part 1) 1977.

The loss on ignition, which is a measure of the organic matter present in sand, and determined by the procedure given in Appendix C of IS 8419 (Part 1) 1977 and shall not be more than 0.7 percent.

7.3.2 Grain Shape, Shape Variation and Sampling

The Grain Shape, Shape Variation and sampling of the sand shall be according to IS 8419 (Part 1) 1977.

7.4 Filter Gravel

7.4.1 Quality Requirements

Filter gravel shall consist of hard, preferably rounded stones with an average specific gravity of not less than 2.5 and shall be free from clay, sand, loam and organic impurities of any kind.

The gravel shall contain not more than 2 percent by mass of thin, flat or elongated pieces (in which the largest dimension exceeds three times the smallest dimension) determined by hand picking.

Gravel should be free from excessive amount of limestone or shells and acid solubility determined in accordance with procedure given in Appendix B of the of IS 8419 (Part 1) 1977 and should not exceed the following limits:

a) For gravel sizes 10 mm or larger 10 percent solubility

b) For sizes smaller than 10 mm 5 percent solubility

7.4.2 Sampling

Sampling and criteria for conformity for gravel shall be in accordance with 4.2.1 to 4.2.4 of the of IS 8419 (Part 1) 1977.

8 SLOW SAND FILTERS AND ACCESSORIES

8.1 Slow Sand Filer

Filter Beds of RCC open to sky shall be provided for a maximum capacity of 6.1MLD. All filters shall be identical in internal dimensions.

Filtration shall be by gravity, through [illegible] filter sand supported by layers of suitably graded filter gravel on. The filter sand shall consist of hard durable grains of silica and shall have a specific gravity of not less than 2.6. All grains of sand shall preferably be water worn. The filter gravel shall consist of hard, preferably rounded stones with an average specific gravity not less than 2.6, shall be free from clay, sand, loam and organic impurities of any kind and shall be such as to ensure adequate and uniform distribution of wash water and air after leaving the orifices with the minimum risk of mixing sand with the gravel of the supporting media.

The filter media (sand and gravel) shall conform to IS: 8419 (part I) amended up to date filter sand when immersed in 40% hydrochloric acid for 24 hours, the soluble matter shall not be more than 5% by weight. Any sample of filter sand shall not contain more than 5 percent by volume of impurities, such as clay, loam, silt, etc, in one hour settlement after shaking in water in accordance with procedure described. [Fill a 1000 ml calibrated measuring cylinder with filter sand to be tested to half its volume and add water until the cylinder is three-fourths full. Shake up the mixture vigorously and allow it to settle for one hour.] It shall not contain more than 1.5% of calcium and magnesium calculated as $CaCO_3$. Ignition loss should not exceed 0.7% of the weight. The solubility of supporting gravels in 40 % hydrochloric acid after 24 hours shall not exceed 10% for 10 mm or larger size gravel and 5 % for smaller than 10 mm size.

All filter media shall be supplied in polythene bags. Suitable care should be taken to protect the media from spillage or contamination. Storage on site shall only be in an approved area, well drained and free of mud and silt. The filter media shall be carefully placed in the filter beds and shall not be dropped or dumped or machine handled so as to be detrimental to the floor media, nozzles or sealant. Etc.

It shall be deemed that the Contractor has investigated all potential sources and verified that sufficient quantities of satisfactory filter sand can be obtained, packed and stored on site.

The under drain system shall be a pipe grid type consisting a central pipe/channel with lateral system of PE -100 or PVC Class 15 pipes having perforations or nozzles. The holes drilled in the pipes shall be according to drawing and properly bushed. Alternatively, "Tee pee type" i.e. reinforced concrete slabs with plastic or glass tube orifice may be provided. This "Tee pee type" of under drainage will be preferred subject to satisfying other design considerations. Both types of under drainage system shall confirm to IS: 8419 (Part 2). The under drain system shall be designed to provide uniform draw-off of filtered water and uniform distribution of wash water and air over the whole area of the filter. Particular provisions have to be made for the handling of the high air velocities at the inlet zone of the manifold.

Before filling the supporting layers and the sand of the filter beds the whole under drain system shall be thoroughly cleaned and tested for equal distribution of water. The Contractor shall take all necessary measures to ensure that false floor if used containing nozzles and the water conveying system of pipes of channels connected to the floor are free from any debris, concrete, sand or other material which could otherwise block or partially block nozzles or any openings orifices.

Such requirements shall also apply in the case of piped laterals with nozzles or orifices. It shall be the responsibility of the Contractor to remove any such debris before the commissions laying filter floors or laterals and shall continue to remain his responsibility for excluding unwanted materials, which could block the filters until the end of the defect liability period.

Each filter shall have a central and lateral wash water trough made, which shall be connected with adequate slope to the wash water outlet to prevent deposits of silt. They shall allow an equal withdrawal of the wash water during backwashing the filter.

The inner dimension of trough shall be as per drawing. However, thin Concrete channel of ≥M-20 grade or Steel or MS section with galvanizing can be provided with appropriate support. The section material and support shall be as per the Engineer decision.

Parameters:

Filters	
Filtration rate	6 cum/sq m./hour
Free board	0.5
Airflow for air scouring.	800 to 1000 LPM/sq.m.
Backwash water flow for backwashing.	600 lpm/sq m.
Filter media:	
Depth of sand bed > 600mm	600 mm
Effective size of sand particles	0.45 – 0.7 mm
Uniformity coefficient of sand	1.3 – 1.7
Minimum Silica Content.	90%
Depth of Gravel bed	Multi layers (Refer Drawing)
Maximum Permissible velocities (m/s)	
Filter Inlet.	0.6
Filter Outlet.	1.25
Backwash Inlet.	3.5
Backwash Out let.	3.0
Air for scouring	25

8.2 Air Blower and Motor

Supply, Installation, commissioning and testing of Twin lobe air blower shall consisting of CI body and drive motor mounted on common platform to make a complete running operational assembly for delivering compressed air to the rapid sand Filter backwashing system with the following specifications: -

8.2.1 Air Blower

Flow Rate: 800 to 1000 LPM/sq.m

Pressure outlet: 0.5 kg/ sq. cm MOC:

lobes CI grade 25.

Main casing side plate CI grade 25

Shaft: Alloy steel EN 24

Gear 20Mn Cr 5, bearing set of 4 + 4

Belt: V type belt with 3 grooved pulley of equivalent size

Base Frame: MS channels shall be as per recommendation of supplier and support for air blower and Motor assembly to give minimal vibration.

Silencer: MS sheet tubular silencer to minimize sound below 70 dB

NRV: Cast Iron NRV of dia ≥110mm duly mounted on supply line to the ETP tank complete with flanges nuts bolts and gaskets 3mm thick neoprene material.

8.2.2 Motor

Capacity for above Air blower, 4 pole, 3 phase, 415 volts, F class insulation, TEFC motor with CI casing, rain proof body and connecting plate duly tested as per standard norms applicable.

Supply, Installation, commissioning and testing of vibration pads (Cast Iron with rubber sheet packing & spring based) to be mounted at the base of the base frame of complete air blower and motor assembly as mentioned in Sr. No. 1 and 2 above.

Installation of air blower assembly to be done as per the site condition which shall include:

Modification of existing pipe line dia 300mm by cutting, welding, painting, supply and installation of NRV, flange dismantling and fixing to match with the air blower assembly height and in between distance etc. All masonry work like cutting of walls, plastering, colour washing as per site condition are in the scope of the work.

Supply, Installation, commissioning and testing of PVC insulated flexible cabling duly covered with PVC baten/ flexible pipe and clamped to wall, for connection with motor and main panel as per site conditions complete with valve mounted PVC batten of size 50 x 20 mm duly fixed with SS pins.

9 PUMPS AND RELATED ACCESSORIES

The submersible pump is used for pumping of clean, cold water, non-corrosive and non-abrasive to the pumpset material in the drinking water purpose.

Pumps supplied and installed shall be capable of satisfying the performance requirements in the relevant technical specification. However, the offered submersible pump must be operated at optimum efficiency and well perform in its duty load point. Low maintenance costs, reliability and trouble free operation will be the prime consideration when selecting pumps.

Pumps shall be quiet in operation and free from vibration. Pump speed shall not exceed 1450/2900 RPM. The pump should have the maximum efficiency at the specified duty point. Approximate power inputs[1] are given in Schedule of Requirements; however, the minimum efficiency of the pump shall not less than 70%, and should meet the stipulated design discharge and head.

Pumps shall be designed to handle the described liquids and shall run unattended for long periods (15 – 22 hr/day). A corrosion resistant metal nameplate shall be permanently attached to the pump. Pumps shall have stable characteristic curve, the characteristic of continuously rising head with decreasing capacity from rated capacity to shut-off, unless otherwise specified. Pumps shall have in-built dry-running protection and shall be started by motor control switch panels or electric starters as specified in section 9.14. Pump characteristic curves showing head/discharge, efficiency and power absorbed shall be submitted with the contractor's Tender.

9.1 Pumps

The pump set in general shall confirm to IS: 8034 or equivalent British and other International Standard. In case of the proposal for Indian Production the pump set shall bear ISI mark. The manufacturer shall be certified as per ISO 9001.

9.2 Components of Submersible Pumps

Submersible pump set shall be a compact unit made up of a submersible pump and a submersible motor with shafts connected by a sleeve and operates beneath the surface of water. This low maintenance pump set is suspended vertically/ horizontally as per pumpset design configuration from raising main when installed.

9.3 Submersible Pumps

The submersible pumps shall be multistage centrifugal pumps with radial or mixed flow impellers. The casing of the radial flow impeller pumps shall be clamped together by flat steel hook bolts, whereas that of mixed flow impeller pumps by studs. Between the pump and the motor is the suction casing, a non-return valve shall be fitted to the pump discharge.

9.4 Submersible Motors

Submersible motors shall be water filled, water lubricated squirrel cage type. The axial thrust generated by the pump is absorbed by a trust bearing fitted at the bottom of the motor. The diaphragm below the thrust bearing compensates the overpressure which arises as a result of the thermal expansion of the water filled, when the temperature of the winding rises. Refer detail in section 9.11.

9.5 Bearings

The pump shall be provided with radial bearings. The motor has radial as well as axial thrust bearings. All the bearings shall be water lubricated and protected to a large degree against the ingress of sand by suitable structural elements.

9.6 Pump Set/Assembly Components

Submersible pump set shall have the following minimum components with the following specifications: -

a) Pump Head Assembly
b) Riser pipe
c) Pump Bowl Assembly
d) Suction case with Strainer
e) Submersible motor
f) Electric cable (submersible and armoured)
g) Motor Control panel

9.7 Pump Head Assembly

Pump head assembly shall comprise of a minimum of the following:

a) Surface Discharge Plate (refer Section 14.1)

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[1] Approximate power required for a submersible pump-set is calculated by using minimum overall efficiency as 60% and 1.15 as safety factor (excess factor). However, offered pump-set should be as energy efficient and effective as possible and should meet the stipulated design discharge and head.

b) Gate Valve (refer Section 3.3.2.7.1.2)
c) Air Valve (refer Section 3.3.2.7.2)
d) Non Return Valve (refer Section 3.3.2.7.4)
e) Mechanical Coupling (refer Section 3.3.2.6)
f) Water Meter (refer Section 3.3.2.1)
g) Other accessories like pressure gauges, bends, tail pieces etc. (refer section 3.3.2)

9.8 Riser Pipe and Fittings

Riser or column pipe shall be made of minimum medium class galvanized mild steel pipe and shall confirm to IS 1239 (Part-1) 2004, BS: 1387 or equivalent standards. It may be ERW or seamless. Each riser pipe shall be 3 m in length except the top and lowest pipe, which shall be 1 m long or as defined by the Engineer considering the site conditions. The pipes shall be flanged ended with welded flange in each end. Flanges which meet with pipes shall be drilled as per BS EN 1092-2 (ISO 2531). The flange should have two cuttings of the size of the cable with sufficient depth and shall be galvanized. The maximum size of the flange should be at least 2 cm less than the inner diameter of the tube-well. Nipple of various lengths as required by the Employer shall be manufactured of Medium/Heavy duty galvanized mild steel pipes conforming to IS: 1239 (Part I) - 1990 or equivalent and threads to conform with IS: 554 - 1975 or equivalent. Bolts and nuts shall be hexagonal, galvanized and shall be in accordance with BS 4190 or equivalent. Washer shall be of proper quality and strength. Each set of flange jointing materials shall be supplied complete with nuts, bolts, washers and joint rings with an additional 10% as spares.

9.9 Pump Bowl Assembly

The pump bowl Assembly shall made of close-grained cast iron, free from blowholes, sand holes or other detrimental defects. The bowl unit shall be capable of withstanding a hydraulic pressure equal to twice the pressure at the rated capacity or, 1.5 times the shot off head, whichever is greater. The pump shall be equipped with replaceable bearing, whichever provided. The pump shaft shall be made of stainless steel. Impeller may be of enclose or semi open type and shall be properly balanced. Impeller shall be made of bronze or Noryl i.e. modified Ppo as per IS: 8034-1984 or equivalent British Standard. Each impeller shall be securely fastened to the shaft. The delivery outlet of the bowl assembly shall comprise of a spring loaded Non-Return Valve.

The pump must be manufactured with non-corrosive materials, Ceramic or equivalent non corrodible materials must be used for bearing. For submersible Pump, Pump body and rotors and impellers must be made of stainless steel with a minimum grade of AISI 304 or higher. In the pump set/assembly, materials having higher grade or better performance may also be considered provided that there is a sufficient reason and documentary proof of the materials in the present operating conditions.

The bowl assembly shall bear a nameplate giving the following information:

a) Manufacturer's name or trade-mark (if any)
b) Model
c) Serial No.
d) No of stages
e) Head, at specified duty point
f) Discharge, as specified duty point

9.10 Suction Case with Strainer

The opening of the suction case for the entrance of the liquid shall be of proper size and shape to avoid eddy currents. The suction case shall be fitted with a strainer made of corrosion resistant material. Suitable sand guard shall be provided just above the suction case bearing to prevent the entry of foreign matter into the suction case.

9.11 Submersible Motor

Submersible Motor shall confirm IS 9283-1979 or equivalent British or International Standard and squirrel case induction type suitable for operation on 415± 10% Volt A.C. with 50 HZ frequency. The motor should be water filled and water lubricated. The thrust bearing design is to be Mitchell type with self-adjusting thrust pads resting on individual steel balls to absorb axial thrust under adverse conditions. The thrust bearing shall be of adequate size to withstand the weight of all rotating parts as well as the imposed hydraulic thrust. It shall have sufficient capacity to permit the pump to operate for short periods with discharge valve closed. The starter should be fully rewindable with special PVC insulated winding wire with overhang design to facilitate easy maintenance and repair; the starter stampings are to be suitably locked both in horizontal and circumferential directions to insure positive locking. The motor shall be protected by means of cable glands; rubber seals etc. from ingress of borehole water, sand and other foreign matters. The thrust bearing housing shall be provided with a drain plug to empty the pure water filled into the thrust bearing housing/motor. The rotor shaft shall be provided with a breathing attachment like bellows, diaphragm, etc to compensate the volumetric variations due to the change in temperature. The motor (casing, shaft, bolts/nuts etc.) shall be made of corrosion resisting materials or suitably treated materials to resist corrosion under normal conditions. The motor should have at least 10% margin at duty point as well as should not get overloaded in the entire range of operation. The motor shall have following information:

Name of manufacturer
Motor rating (KW or HP)

Nominal speed
Rated current (A) Rate
Voltage (V) Frequency (Hz) Connection system
Starting system
Type of duty (continuous)
Materials of casing, shaft, bolts/nuts

There shall be an indication to identify the motor with its pump. A suitable Coupling arrangement shall be provided to couple the pump-set directly, which shall be capable of transmitting the total torque of the unit regardless of direction of the rotation.

9.12 Submersible Cable (Cable for Submersible pumps)

The electric cables must be well connected and sealed into the motor and delivered with a length of minimum 3 meters. Submersible cable shall confirm to 4.4 of IS 9283-1979 or equivalent British or International Standard. Submersible cable shall be sized not less than 4mm^2 up to 20 HP and 6-10 mm^2 for 30-40 HP motor, unless otherwise specified in Schedule of Requirements. The offered cable must meet the important parameter like starting current and continuous full load current. It shall be sized to limit the voltage drop to 5% at the motor's terminals. They shall be made of copper conductors. The conductor insulation shall be water and oil resistant, suitable for continuous immersion. The submersible cable will be joined by a watertight joint in the submersible motor cable. The connection shall be a permanent type and non-possibility for separation after installation. The Contractor shall for each of the submersible pump, supply adequate faster. The fastener shall be reusable and robust.

9.13 Armoured Power Cable

Suitable sizes of LT power cables for connecting the autotransformer starter to motor shall be supplied and delivered. The power cables shall 3.5-core Copper/Aluminium armoured power cables of 1.1 KV grade and suitable for 415 V, 3-phase, 50Hz, LT electric system. The sizes of the power cables are given in Schedule of Requirements. The offered cable must meet the important parameter like starting current and continuous full load current. The electric power cable shall be manufactured and tested in full compliance with latest version of NS, BS, IS, ISO or equivalent international standard.
Control wiring shall be done by 1.1 KV grade PVC wires with minimum 2.5 mm^2 copper conductor. Suitable size of control cables for connecting the starter to motor shall be also be supplied.

9.14 Motor Control Panel

The Motor Control Panel Board may be either self supported or wall mounted type made of mild steel sheet of thickness at least 1.6 mm and suitable shape and size. The board shall be painted with one coat of priming and two coats of anti corrosion paint. The switch panel might be installed outside at the well or under a shelter on an ambient temperature of 0 ^{o}C and 50 ^{o}C and in a sealable weatherproof cover.

The motor control panel must be safe to operate the pump motor. Provisions for the protection of motor against over loading, dry running, single phasing and opposite phasing should be provided.

In general, use DOL starter for maximum up to 7.5 HP, STAR/ DELTA: for above 7.5 HP to 40 HP and Autotransformer/Soft Starter: above 40 HP motor unless otherwise specified in the technical specification, suitable for the submersible pumps, 415 Volts and 50 Hz, 3 phases. Specifications must be according to IP54 or equivalent standards.

The motor control panel must be compatible with the pump-motor set, to be manufactured by same manufacturer or certified by pump-motor manufacturer or their authorized supplier adds an extra layer of assurance that the system will function correctly and meet the necessary standards.

The motor controller shall be equipped with all the required components and features for its proper functioning and safety requirements that included, but not limited to the following: -

a. Molded case Circuit Breaker (MCCB) of suitable capacity - AT /AF = 1.5 x line current / 3 x line current
b. Fully automatic air break type Starter with magnetic contactors of capacity: 3 X line current for DOL and line current rating for Star-Delta, Bi-metallic overload relay (phase current ± 20%) and electronic timer.
c. Low Water Level Guard/ Float- less Switch
d. Single Phase Preventer and Phase Sequence Relay.
e. Voltmeter with Selector Switch between all phases.
f. C/T Ammeter with Selector Switch.
g. Push Button Switches for 'START' and 'STOP' the motor.
h. Indicating Lamps for various actions.
i. Cable connector (2 x full current capacity)
j. Proper earthing should be provided to all electrical devices like, motor control panel, distribution box (DB), pump prime mover etc.

The details of technical specification may vary depending on types of motor control panel selected. The detailed information for the selected types of motor control panels should include specific to each type control panel.

Major items in one Auto-Transformer Starter (ATS) shall consist, but may not be limited, of the following unless otherwise specified in the technical specifications:

S. No	Descriptions	Quantity
1	Auto transformer a tap setting 65%, 80% and 100% air cooled	One set
2	Heater 100w, 230 V A.C.	One set
3	Thermostat 0 to 110 degree centigrade	One set
4	Hour meter	One set
5	Ammeter with Selector Switch (200/5 operated)	One set
6	200/5 Current Transformers	Three sets
7	Time delay relay	One set
8	Contactor (about 2.5 times the fall load current) & Ampere TP, (coil voltage 230V, 50 Hz)	Three sets
9	Overload Relay (of suitable range) or as required Ampere rating	One set
10	Control Terminals	One set
11	Auxiliary Contact Blocks (mechanical latching type)	One set
12	Insulation/Moister/Thermister relay	One set
13	Voltage monitoring relay having phase failure and under voltage release	One set
14	ON/Trip indication	Two set
15	Push buttons (on/off)	One set
16	Control fuses	One set
17	Push button for mute of alarm hooter	One set
18	Control relay for alarm hooter with control fuses	One set
19	Indicating lamps with control fuses	One set
20	Earth fault relays	One set
21	Probe for water level	One set
22	Phase indicating lamps with fuse	One set
23	Water lever controller	One set

The indication Lamps are as following:

- ON green
- OFF red
- Fault red
- Alarms yellow

Each indicating lamp shall be of illuminated push-button type; centralized lamp test is not accepted. All the instruments, devises and parts of the panel shall be facing the front of the panels. Writing on the panel must be in English language.

The motor must be protected by a thermal overload relay of suitable adjustable range and shall be installed between the running conductor and motor. The overload range shall be approximately from 80% to 120% of the nominal current rating of the motor. The starter shall be rated to stand a minimum of four starts per hour at an ambient temperature.

Motor thermal protection relay to protect motor from overheating. The sensor provided in the motor starter winding resistor sensor as following:

- Digital indication
- Adjustable from 0 to 100 trip
- Change over contacts
- Resistor sensor
- Supply voltage of 220 Volts

Separate current transformer to be provided for protection and instrumental duties. Fuses and links shall be grouped where appropriated according to the functions and must be clearly marked both on panels and the associated wiring diagrams. All cable and piping shall be made through glands in a plate covering the base of the switchboard.

The Auto Transformer Starter (ATS) shall have the following features:

- Air cooled design
- The core and coil shall be impregnated under vacuum in high temperature grade
- Designed and tested to meet the requirement of IEC 292-4.
- Tap setting at 65%, 80% and 100%
- Insulation class F

The Auto Starter must be fully assembled by the manufacturer and where modifications such as additions of extra protection devises or indications are required; these modifications shall be performed in a similar manner by the manufactures. In this case full details of modifications and circuits diagrams shall be provided. The manufacturer should conduct the required tests on each starter as per IEC 439-1 1990.

9.15 Documentation

The following information/documents to be furnished by the Contractor for the offered model pump-motor set with their technical offer:

- Certification for relevant Standards
- Performance Curves
- Discharge vs. overall efficiency
- Head V/s Discharge Curve
- BHP (power input) V/s Discharge Curve
- Efficiency V/s Discharge Curve
- NPSH V/s Discharge Curve

Besides, following additional information the Contractor shall also be furnished from the Supplier:

- No of stages
- Discharge in l/s or l/m or m^3/hr
- Total pumping or duty head in meter
- Shut-off head
- Pump-input at duty point in KW or HP
- Efficiency of the pump at rated Duty Point
- Details of motor
    - Rating in KW or HP
    - Type
    - Details of power supply
    - Rated speed

On delivery of the pump-motor set, Contractor shall furnish following documents:

- Test certificate from the manufacturer
- Guarantee of workmanship and materials

Documentation for the cables and Auto Transformer Starter (ATS)/ motor control panel shall be furnished as per the technical specifications, along with wiring diagram of the electric panel board.

9.16 Guarantee of Performance

The pump-set shall be guaranteed for their performance of the pumping rate, head, overall efficiency and overall power input. The pump-set shall be guaranteed by the manufacturer against the defects in material and workmanship under the normal use and service for at least 12 months from the date of delivery to the purchaser or as specified in the Conditions of Contract.

9.17 Operation Maintenance Manual and Spare Part List

The Contractor must provide with each submersible pump-motor set and electric control panel board in English language:

- Installation manual
- Operating and maintenance instruction manual
- Works manual for repair and maintenance works
- Spare parts list/ manual

Contractor shall submit with their tender sufficient information to show the Contracting Authority that the proposed pumps will comply with the performance requirements.

10 TRANSFORMERS, ELECTRICAL FEEDER LINES AND INSTALLATIONS

The Scope of works includes specification of all requirements for electricity feeder line including transformers, poles, conductors, insulators, fittings and control equipment. The specifications and associated drawings mentioned in this contract shall be according to the latest specification and construction drawing standards adopted by Nepal Electricity Authority (NEA).

10.1 Transformer

10.1.1 Distribution Transformer

10.1.1.1 Scope

These specifications cover the requirements of oil-immersed, natural-cooled single and three- phase distribution transformers suitable for outdoors installation on 11kV, 50 Hz distribution systems.

10.1.1.2 Service Condition

The transformers shall be designed and constructed for outdoor installation and operation under the following conditions:

Ambient temperature: -5 deg. C to 50 deg. C

Relative humidity: up to 99%

Altitude: up to 3000m above the mean sea level

10.1.1.3 Standards and Quality Certification

10.1.1.3.1 The equipment specified in this Section of the Contract shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular:

IEC 60076 Power transformers

IEC 60137 Insulating Bushings for alternating voltages above 1 kV

IEC 60156 Insulating liquids-Determination of the breakdown voltage at power frequency- test method

IEC 60296 Specification for unused mineral insulating oils for transformers and switchgear

IEC 60551 Determination of transformer and reactor sound levels

IEC 60616 Terminal and tapping materials for power transformer

IEC 60722 Guide to lightning and switching impulse testing of power transformers and reactors

IEC 60733 Determination of water in insulating oils.

10.1.1.3.2 The manufacturer of the offered transformers must have been accredited with the latest edition of ISO 9001 (including design in the scope of registration) quality certification.

Item	Description	Units	11/0.4KV, Rated KVA as per rated
1.	Applicable Standards		
2.	Rated Power Output	KVA	As per BOQ
3	Number of Phases		3
4	Rated Frequency	Hz	50
5	Rated Primary Voltage	V,	11000
6	Rated Secondary Voltage	V	400
7	Vector Group		Dyn 11
8	Type		
	-Duty		Outdoor
	-Cooling		ONAN
9	Off-Load Tapping, Primary	%	+5,0,-3 X 5%
10	Temperature Rise in	0C	
	-Winding		55
	-Top Oil		50
11	Applied Test Voltage 1min, 50Hz	KV	
	-Primary winding		28
	-Secondary Winding		3
12	Impulse Test Voltage	KV	
	Full wave, primary winding		75
13	No Load Losses	Watts	As per NEA Standard
14	Load Losses	Watts	As per NEA Standard
15	Impedance Voltage	%	4
16	Material of Windings		
	-High Voltages		Copper
	-Low Voltages		Copper

17	Approximate Dimensions		
	-Length		
	-Height		
	-Width		
18	Total Weight		As per NEA Standard
19	Oil Quantity		As per NEA Standard

10.2 Diesel Generator

Genset Specification	
Genset rating	Prime
Genset output (KVA/KW)	As per BOQ
Aspiration/Cooling	TCAC
No. of cylinders/arrangement	4/ Inline
Displacement	4.87
Bore x stroke (mm)	108 x 133
Compression ratio	17.2
Rated RPM	1500
Overspeed trip (RPM)	1650
Governor type/DG Performance Class	Mech/G2
Frequency regulation	Isochronous
Air cleaner type/qty	Dry/01

Alternator Specification	
Voltage (3P)	415
Frequency (Hz)	50
Current (Amps)	As per rating of DG
Type	4P, rotating field
Voltage regulator	Solid State
Voltage regulation (%)	+ or – 1%
Insulation Class	H
Temperature rise (Deg C)	125
Bearing (qty/type)	1, sealed
Coupling	Flex disc
One step load acceptance	100% of rating
Unbalanced load acceptance	25% of rated amps

Cooling System	
Max ambient capacity (Deg C)	50
Coolant capacity (Eng+Rad) (L)	25

Exhaust System	
Max allowable backpressure (kPa)	5.5
Exhaust temperature (Deg C)	500
Silencer type	Residential

Engine Electrical System	
Charging Alternator VDC/Amps	12V /35A
Starter motor rated voltage (DC)	12
Battery Voltage (DC) / Capacity (AH)	12V/88AH

Standard Scope of Supply
Engine: Direct injection, water cooled, four-cylinder, 4 stroke, rated at 1500RPM, confirming to ISO 3046/BS 5514 with the following: -Radiator cooling -Mechanical Governor -Exhaust manifold with SS exhaust flexible - Flywheel and flywheel housing - Fuel and lube oil filters -Dry type air cleaner -Starter motor, battery charger
Alternator: Meccalte/Leroy somer/Stamford/CG
Acoustic Enclosure: Power coated weather proof canopy. Engine and alternator mounted on AV mounts, with silencer and SS exhaust bellow optimized to meet stringent MOEF/CPCB norms for sound and emission -Base rail with draw out type fuel tank, drain plug, inlet and outlet connections, air vent, level gauge
Control Panel: Fabricated from CRCA Sheet and powder coated with RAL 9003 with the following: -MCCB of suitable rating with short circuit protection -Controller with multi feature display - Load on and set running indication lamps - Copper conductor cables between alternator and control panel
Literature:

-Operation and spare parts manual in CD format	-
Installation and general maintenance guidelines	-
Foundation drawings	-Alternator and control
panel wiring drawings	
-Test Certificate	

10.3 Voltage Stabilizer

Capacity	As per BOQ
Input Voltage	300 to 470 V.AC
Output Voltage (Normal)	400V Ac ± 1% (Adjustable
Supply	3-Phase- 4 Wire System
Supply Frequency	47 to 53 Hz
Load and Line Regulation	1%
Ambient Temperature	0 to 45° C
Effect of Load Power Factor	None
Correction Speed	30-45 V/Sec
Efficiency	Better than 90%
Duty Cycle	100% continuous
Cooling	Air/Oil as per site condition
Panel Control: -Input/ output select switch, Auto/Manual select switch - Buck / Boost Switch to adjust the output Voltage in manual mode. -Volts adjust program to set required output voltage in auto mode	
Panel Indication: Output -on/input- Low/Input-High and Digital Display	

10.4 11 KV AAAC XLPE Insulated Covered Conductor

10.4.1 Scope

This specification covers details of All Aluminum Alloy Stranded XLPE Insulated Covered Conductors for use on 11KV transmission system. The conductor covered insulation shall mark EN 50397-1:2006 by embossing/printing on it at every meter throughout the length.

10.4.2 Service Conditions

The conductor to be supplied against these specifications shall be suitable for satisfactory continuous operation under the following tropical conditions.

a) Maximum ambient temperature (Degree C) ----------50
b) Maximum temperature of air in shade (Degree C) ----------3.5
c) Relative Humidity (%) ----------10 to 100
d) Maximum Annual Rainfall (mm) ----------1450
e) Maximum Wind Pressure (kg/sq.m) ----------150
f) Maximum altitude above mean sea level (meter) ----------1000
g) Isoceraunic Level (days/year) ----------50
h) Seimic Level (Horizontal acceleration) ----------0.3g

10.4.3 Conductor Sizes

a) 7/2.00mm (22 sq.mm)
b) 7/2.50mm (34 sq.mm)
c) 7/3.15mm (55 sq.mm)
d) 7/3.15mm (80 sq.mm)
e) 7/4.26mm (100 sq.mm)
f) 19/3.15mm (148sq.mm)
g) 19/3.94mm (232sq.mm)

10.4.4 Application Standards:

Unless otherwise stipulated in this specification, the conductor shall conform to the following Indian/International Standards.

S.No.	INDIAN/INTERNATIONAL STANDARDS	
1.	IS:398 (Part IV) / 1994	Specification for aluminium conductors for overhead transmission purpose
2.	EN 50397-1:2006	XLPE Insulation covered conductor Specification for Voltage 1KV to 33KV
3.	IS: 10418	Reels and drums for bare conductors.

10.4.5 Properties of Conductor

The properties of stranded all aluminium alloy conductors of Various sizes shall be as in Table-I.

Table-I All Aluminium Alloy Stranded Conductor

Actual Area	Stranding & Wire dia.	Approx. overall dia.	Approx. mass	Calculated resistance at 20	Approx. calculated	Reactance per Km	Current Rating

				d.c. (max)	Breaking Load		
1	2	3	4	5	6	7	8
Sq.mm	mm	mm	Kg/km	Ohm/km	kN	Ohms	Amps
22	7/2.00	6.0	60.16	1.5410	6.45	0.3556	115
34	7/2.50	7.5	94.00	0.9900	10.11	0.3556	150
55	7/3.15	9.45	149.20	0.6210	16.03	0.3556	234
80	7/3.81	11.43	218.26	0.4250	23.41	0.3394	270
100	7/4.26	12.78	272.86	0.3390	29.26	0.3394	325

10.5 Disc Insulator Fittings

10.5.1 Scope

This specification covers the fabrication and supply of tension type disc insulator fittings.

10.5.2 Description

10.5.2.1 The disc insulator fittings shall be supplied with ball and socket couplings (socket eye, ball eye/ball clevis etc.), twisted straps, and bolted type tension clamps. Number of U-bolts in tension set shall be 3 (three).

10.5.2.2 Tension clamp shall be suitable for ACSR conductor, diameter ranging from 5 mm. to 16.5 mm.

10.5.2.3 The ultimate strength of disc insulator fittings shall be more than 45 kN.

10.5.2.4 All components of disc insulator fittings shall be such that they fulfill all requirements of this specification and compatible with disc insulator specified in SPECIFICATION: SP-11.0

10.5.2.5 All parts of different fittings, which provide for interconnection, shall be made such that sufficient clearance is provided at the connection point to ensure free movement of insulator assembly.

10.5.2.6 The twisted strap shall be suitable for 50×100×50 mm. cross arm. Size of the holes for bolt, which anchors twisted strap with cross arm shall be suitable for insulator pins specified in SPECIFICATION: SP-11.0 and width of the twisted strap shall be designed accordingly. Diameter of nuts and bolts of strap shall be equal to shank diameter of insulator pins. Nuts and bolts shall also be provided with spring washer and split pin.

10.5.2.7 Unless otherwise specified in these specifications, disc insulator fittings shall be in accordance with IS: 2486 (Part I & II) or any other equivalent national or international standards.
2.8 The manufacturer of the disc insulator fittings must have been accredited with ISO 9001:2000 with design and manufacturing quality certification.

10.5.3 Material

10.5.3.1 The tension clamp shall be made of the aluminium alloy type. Other accessories like ball eye/ball clevis, socket eye, nuts, and bolts shall be made of hot rolled steel and obtained preferably by process of forging. Twisted cross arm strap shall be made of MS sheet metal. Cotter bolts and U-bolts shall be of galvanized steel. Cotter pins shall be stainless steel. Chapter 2. Specification of Electrical Equipment and Line Materials 2-199

10.5.3.2 All forging and castings shall be of good finish and free from flaws and other defects. The edges on the outside of fittings, such as at the eye, socket and holes, shall be rounded.

10.5.4 Galvanizing

10.5.4.1 All ferrous fittings and the parts other than those of aluminium alloy and stainless steel, shall be hot dip galvanized in accordance with IS: 2629-1985 or the latest version thereof or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable.

10.5.5 Tests

10.5.5.1 The disc insulator fittings shall comply with the following tests as per IS: 2486 (Part I) or any other equivalent national or international standards.

1. Type Test:

- Verification of Dimensions,
- Visual Examination Test
- Slip Strength Test
- Mechanical Test
- Electrical Resistance Test

- Heating Cycle Test
- Galvanizing Test

2. Acceptance Tests:

- Verification of dimensions
- Galvanizing Test
- Mechanical Tests

3. Routine Tests:
- Visual Examination Tests
- Routine Mechanical Test

10.5.6 Marking

10.5.6.1 The tension clamp shall be marked on it following:

a) Name or trademark of manufacturer
b) Name of the Purchaser as follows: "NEA-NEC''

10.6 Galvanised Steel Bolts, Nuts And Miscellaneous Fastening Components

10.6.1 Scope

This Specification covers the fabrication and supply of galvanized steel bolts and nuts, as specified herein, for use in overhead electric line construction.

10.6.2 Material

10.6.2.1 The bolts and nuts shall be manufactured and tested in accordance with IS: 1363 (Part I)-1984 or the latest version thereof or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable.

10.6.3 General

10.6.3.1 Bolts and nuts shall be furnished in the types, diameters and lengths specified in the Schedules of Rates and Prices. However, the dimensions and length of threading of bolt must be confirmed with the Project prior to manufacture.

10.6.3.2 Thread forms shall be consistent with all material/items listed herein and shall not strip or slip under sustained tensile loading equal to the design tensile strength of the threaded material item.

10.6.3.3 The manufacturer must have been accredited with ISO 9001:2000 with design and manufacturing quality certification.

10.6.4 Machine Bolt and Nut

10.6.4.1 Each machine bolt shall be furnished with two (2) hexagonal nuts and two (2) plain washers assembled thereon.

10.6.5 Double-Arming Bolt and Nut

10.6.5.1 Each double-arming bolt shall be furnished with four (4) hexagonal nuts and two (2) washers assembled thereon.

10.6.6 Galvanizing

10.6.6.1 The stranded stay wire shall be galvanized after fabrication in accordance with IS: 2629-1985 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable.

10.6.7 Tests

10.6.7.1 The bolt and nut shall undergo type and routine tests in accordance with the relevant governing standard.

10.7 Crossarms And Bracing Angles

10.7.1 Scope

This Specification covers the fabrication and supply of galvanized steel cross-arms and bracing members commonly used in overhead power line construction.

10.7.2 Material

10.7.2.1 The steel cross-arms shall be fabricated from hot rolled channels and angles.

10.7.2.2 The steel channels and angles shall be fabricated and tested in accordance with Indian Standards IS: 226-1975 and IS-808-1964 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable. The minimum tensile strength of the steel shall be 4200 kg/cm^2.

10.7.3 Description

10.7.3.1 The steel cross-arms and bracing angles shall be of sizes shown in the Table 1: Cross-arms and bracing angles, contained herein.

10.7.3.2 Conceptual hole pattern and size of holes on cross-arm channels are shown in appropriate drawings herein, however, the Supplier must confirm with the Project the locations and sizes of holes prior to the manufacture.

10.7.3.3 The surface of the steel shall be flat after drilling or (punching) and free of dimpling or imperfections. The hole edges shall be broken by reaming. The holes shall be full dimension after galvanizing and no minus tolerance of specified hole size will be accepted.

10.7.3.4 The steel cross-arm and bracing angles shall be furnished reasonably smooth on all surfaces and free of burrs or sharp projections.

10.7.4 Galvanizing

The steel cross-arms and bracing angles shall be galvanized after fabrication in accordance with IS: 2629-1985 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable.

10.7.5 Tests

Apart from the tests indicated herein in the referenced standards, the channels and angles shall undergo following tests:
- Visual Inspection;
- Verification of Dimensions

S.No.	Description	Type	Dimension in mm
1.	11KV, Single Pole, Triangular: 1.1 Pole Top 1.2 Standard	 Channel Channel	 100 x 50 x 6.4 x 5 x 300 100 x 50 x 6.4 x 5 x 1200
	11KV, Double Pole: 4.1 Standard 4.2 Bracing Member 4.3 Bracing Member	 Channel Angle Angle	100×50×6.4×5×2390 40×40×5×2071 40×40×5×2719
3.	Transformer Platform Complete set	Channel Channel	100 x 50 x 6.4 x 5 x2500 100 x 50 x 6.4 x 5 x 1200
4.	Lightening Arrester and Cut-out Support (at Transformer Platform): 5.1 Support	Channel	100 50 x 6.4 x 5 x 2348

10.8 Flat Crossarm Brace

10.8.1 Scope

This Specification covers the fabrication, testing and supply of flat, galvanized steel cross-arm braces.

10.8.2 Material

10.8.2.1 The flat cross-arms brace shall be fabricated out of hot rolled steel flat.

10.8.2.2 The steel flat for cross-arms brace shall be fabricated and tested in accordance with Indian Standards IS: 226-1975, and IS-1731-1971 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable. The minimum tensile strength of the steel shall be 4200 kg/cm^2.

10.8.3 Description

10.8.3.1 The brace shall be furnished reasonably smooth on all surfaces and free of burrs or sharp projections.

10.8.3.2 The surface of the steel shall be flat after drilling or (punching) and free of dimpling or imperfections. The hole edges shall be broken by reaming. The holes shall be full dimension after galvanizing and no minus tolerance of specified hole size will be accepted.

10.8.3.3 The brace shall have a minimum tensile strength of 3182 kg at the bolt-hole and bolt slot.

10.8.3.4 The brace shall be capable of being bent 10 degrees at the bolt hole or slot and 140 degrees at any point between hole and slot without cracking of the base metal on the outside of bent portion.

10.8.3.5 The brace shall be drilled and dimensioned in accordance with Dwg. CA10 attached herein.

10.8.4 Galvanizing

The flat cross arm brace shall be hot dipped galvanized after fabrication in accordance with IS: 2629-1985 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable.

10.8.5 Tests

Apart from the tests indicated herein in the referenced standards, the flat cross arm brace shall undergo following tests: - Visual Inspection; - Verification of Dimensions

10.9 Pole Clamps

10.9.1 Scope

This Specification covers the fabrication and supply of galvanized steel pole clamps with nuts, bolts and washers for use on overhead power line construction.

10.9.2 Material

10.9.2.1 The pole clamp shall be fabricated out of hot-rolled steel flat.

10.9.2.2 The steel flat for pole clamp shall be fabricated and tested in accordance with Indian Standards IS: 226-1975, and IS-1731-1971 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable. The minimum tensile strength of the steel shall be 4200 kg/cm^2.

10.9.3 Description

10.9.3.1 Outline details of pole clamps are shown in the drawings Dwg: CA13. Dimensions may be changed to comply with the final pole sizes selected. Therefore, the dimensions must be confirmed with the Project prior to manufacture.

10.9.3.2 Two (2) numbers of galvanized, 16 mm. (dia.) × 60mm. (length), fully threaded bolts with two (2) nuts and washers shall be provided with each pole clamp.

10.9.3.3 The fittings shall be free of burrs, splinters, splits, sharp points and edges, which may damage conductors or show evidence of poor workmanship.

10.9.3.4 The surface of the steel shall be flat after drilling or (punching) and free of dimpling or imperfections. The hole edges shall be broken by reaming. The holes shall be full dimension after galvanizing and no minus tolerance of specified hole size will be accepted.

10.9.3.5 The pole clamps shall have a minimum tensile strength of 3182 kg at the bolt-hole and bolt slot.

10.9.4 Galvanizing

The pole clamps and nut, bolts and washers shall be galvanized after fabrication in accordance with IS: 2629-1985 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable.

10.9.5 Tests

Apart from the tests indicated herein in the referenced standards, the pole clamps shall undergo following tests:
- Visual Inspection;
- Verification of Dimensions

10.10 Surge Arrester

10.10.1 Scope

This specification covers the general requirements of the design, manufacture, testing, supply and delivery of Surge Arrester of Gapless Metal-Oxide type commonly installed on overhead
11kV power lines of the Nepal Electricity Authority.

10.10.2 System Parameters

a)	Nominal Voltage	11kV
b)	System Highest Voltage	12kV
c)	System frequency	50Hz
d)	No. of Phases	3
e)	Neutral Earthing	Effective
f)	System fault current	20kA rms

10.10.3 Service Condition

a)	Ambient temperature	-5 to 55 deg. C
b)	Annual average ambient temperature	30 deg. C
c)	Maximum relative humidity	99%
d)	Environmental condition	Humid Tropical climate
e)	Operational altitude	Up to 3000m above msl
f)	Isokeraunic (Thunder Day) level	90 days
g)	Solar Radiation	1.6kW/m2

10.10.4 Applicable Standards

The equipment and components supplied shall be in accordance with the latest editions of the standards specified below and amendments thereof and the NEA Specifications specified hereafter.

a)	IEC 60099-4 Part 4 Surge Arresters	Metal-oxide surge arresters without gaps for a.c. systems
b)	IEC 60099-5 Part 5	Selection and application recommendations
c)	IEC 61109	Composite insulator for a.c. over headlines with a nominal voltage greater than 1000V - Definitions, test methods and acceptance criteria
d)	IEC 60507	Artificial pollution tests on high voltage insulators to be used on a.c. Systems

10.10.5 Technical Parameters

10.10.5.1 Minimum Technical Requirements

	Description	Unit	**Required ratings/features**
1	Voltage rating	kV	9
2	Nominal system voltage	kV	11
3	Maximum system voltage	kV	12
4	System frequency	Hz	50
5	Nominal discharge current	kA	10
6	Type of Housing Insulator		Polymeric
7	Creepage distance (terminal to base)	mm	390
8	Minimum power-frequency withstand Voltage		
8.1	Wet	kV	50
8.2	Dry	kV	70
9	Impulse withstand (1.2/50□sec) Voltage	kV (Peak)	95
10	Maximum discharge (residual) voltage at 10kA lighting impulse current	kV (Peak)	29
11	Steep current residual voltage	kV (Peak)	32
12	Line Discharge Class		1
13	Energy absorption Capability with (4/10	kJ/kV	Not less than 3.2
	wave)		
14	Pressure relief class		B

15	High current		for 0.2s 20 kA
16	Low current		for 0.5s 0.8 kA
17	One Second TOV withstand capability	kV	>1.15x12
1	Voltage rating	kV	9
2	Nominal system voltage	kV	11
3	Maximum system voltage	kV	12
4	System frequency	Hz	50
5	Nominal discharge current	kA	10
6	Type of Housing Insulator		Polymeric
7	Creepage distance (terminal to base)	mm	390
8	Minimum power-frequency withstand Voltage		
8.1	Wet	kV	50
8.2	Dry	kV	70
9	Impulse withstand (1.2/50 sec) Voltage	kV (Peak)	95
10	Maximum discharge (residual) voltage at 10kA lighting impulse current	kV (Peak)	29
11	Steep current residual voltage	kV (Peak)	32
12	Line Discharge Class		1
13	Energy absorption Capability with (4/10	kJ/kV	Not less than 3.2
	wave)		
14	Pressure relief class		B
15	High current		for 0.2s 20 kA
16	Low current		for 0.5s 0.8 kA
17	One Second TOV withstand capability	kV	>1.15x12

10.10.5.2 Power Frequency Voltage vs Time Characteristics

The manufacturer shall provide the power frequency voltage vs time characteristics, preheated to 60°C with no prior energy and with prior energy (specified by the manufacturer) in order to verify the TOV capability of the Arrester.

If a particular manufacturer is unable to meet the TOV condition of 1.15Ur (rated voltage of the Arrester) for 1 sec. duration, has the option of offering of an Arrester of a higher rating.

10.10.6 Basic Features

10.10.6.1 Design

The Surge Arresters shall be designed for outdoor service conditions stipulated above. They will be connected between phase and earth to protect distribution transformers and switchgear. It shall be complete with the following:

a) Clamps suitable to receive Copper/Aluminum (Line) Conductors from 4 mm-16mm
b) The mounting clamps suitable for bracket mounting on a structure made out of 100x50x6mm Channel Iron.

10.10.6.2 Manufacture

The Surge Arrester shall be of the non-linear metal-oxide resister type without spark gaps and the non-linear metal-oxide resister shall be housed in a hermetically sealed insulator casing to prevent ingress of moisture.

10.10.6.3 Insulator Details

The housing insulator of the surge arrester shall be of polymeric type and the insulator sheds shall be designed to minimize trapping of contamination.

The complete arrester shall withstand a 1000h salt fog test at continuous voltage as described in IEC 61109/IEC 60507. Additional cycle tests as described in IEC 61109 shall also be passed satisfactorily.

10.10.6.4 Moisture Sealing

The manufacturing procedure shall include an effective leak test and the manufacturers shall carry out the Special Thermal Stability Test as specified in IEC 60099-4.

10.10.6.5 Partial Discharge

Each surge arrester shall be tested to prove absence of partial discharge contact noise as specified in IEC 60099-4.

10.10.6.6 Arrester Disconnector

The Surge Arrester shall have a device for disconnecting it from the system in the event of arrester failure to prevent a persistent fault in the system and it shall give a visible indication when the arrester has failed. The arrester disconnector shall be tested as per IEC 60099-1.

10.10.6.7 Insulating Bracket

A robust insulating bracket together with suitable mounting clamps to mount the Surge Arrester to 100x50x6mm Channel Iron Cross Arms shall be supplied with the Surge Arrester. The power frequency withstand voltage of the insulating bracket shall not be less than 20kV.

10.10.7 Additional Requirements

10.10.7.1 Rating Plate Markings

The following ratings and data of the arresters shall be provided and it shall be weather proof and corrosion proof. The plate shall be positioned at the bottom flange base and visible from the ground level.

(a) Number and year of the standard adopted
(b) Rated voltage / frequency
(c) Continuous operating voltage
(d) Arrester type and discharge class
(e) Nominal discharge current
(f) Manufacturer's identification
(g) Year of manufacture
(h) Serial number
(i) Contract No.

10.10.7.2 Packing

Each set of Surge Arrester shall be packed in a suitable box. Number of these boxes shall be held together in a firm position and measures shall be taken to avoid damage against jerks and collision between adjacent units during transportation.

Each packing shall contain a copy of installation instruction in English Language. The voltage rating, manufacturer's name/identification, Country of Origin, and the quantity shall be clearly marked on each packing.

10.10.8 Inspection And Testing

10.10.8.1 Acceptance Test

The successful Bidder shall make necessary arrangements for pre-shipment inspection and tests by the nominated NEA Inspectors to carry out in his presence the necessary Sample/Acceptance tests conforming to the relevant IEC on equipment and materials offered. Routine test report for all the items shall be furnished for the observation of the Inspector.

The acceptance tests as per IEC shall be witnessed by the NEA Inspector. (a) Power frequency

reference voltage test
(b) Partial discharge test.
(c) Lightning Impulse Residual voltage test. (d) Thermal
Stability test

10.10.8.2 Routine Test

The Routine Tests shall be carried out on all the arresters as per the relevant IEC and the test report shall be made available for the observation of the NEA Inspector at the time of inspection.

(a) Power frequency reference voltage test.
(b) Residual voltage tests.
(c) Partial discharge test.
(d) Leakage test

10.10.9 Bid Documentation

10.10.9.1 The following shall be furnished with the offer.

(a) Product Catalogues/Technical literature describing the constructional features, materials used for components, operational feature of the equipment, indicating the model number etc.
(b) Energy withstand capability & a description of the test carried out to measure the same.
(c) Power frequency withstand voltage versus time characteristic curve covering the time range from 0.1 sec. to 24 minutes.
(d) Dimensional drawings of the bracket mounting base, live conductor clamps, earth lead and automatic earth disconnecting device and overall dimensional drawing.
(e) Drawing of name plate to scale incorporating the particulars called for.
(f) Completed Schedule of Guaranteed Technical Particulars
(g) A copy of the Manufacturer's ISO 9001 Certificate conforming to design and manufacture
(h) Type Test Certificates: The Type Test Certificates shall be from an Accredited Independent Testing Authority acceptable to the Purchaser.
(i) Copy of the Governing Standards

(j) Technical Literature in English Language on installation, operation and maintenance with necessary circuit diagrams and drawings.

10.10.9.2 Type Test Certificates

Following Type Test certificates conforming to IEC 60099-4, IEC 60507 and IEC 61109 shall also be submitted with the offer.

(a) Insulation withstand test,
(b) Residual voltage tests,
(c) Long duration current impulse
(d) Operation duty test
(e) Tests of arrester disconnector,
(f) Partial discharge test,
(g) Seal leakage test,
(h) Tracking & erosion test for polymeric insulation

Test Certificates shall clearly identify the equipment concerned showing the manufacturer's identity, Type, Model and Serial Number of the equipment tested. Type Test Report shall include complete drawings and the model/type of the offered Arrester. Type Test Report shall be from a recognized accredited independent testing authority acceptable to the purchaser.

10.11 Distribution Cutout (Drop-Out Fuses)

10.11.1 Scope

This Specification covers the general requirements of the design, manufacture, testing, supply and delivery of drop out fuse complete with fuse carriers and mounting brackets commonly used on the primary side of 11 kV distribution transformers as protective device.

10.11.2 System Parameters

a)	Nominal Voltage	11kV
b)	System Highest Voltage	12kV
c)	System frequency	50Hz
d)	No. of Phases	3
e)	Neutral Earthing	Effective
f)	System fault current	20kA rms

10.11.3 Service Condition

a)	Ambient temperature	-5 to 55 deg. C
b)	Annual average ambient temperature	30 deg. C
c)	Maximum relative humidity	99%
d)	Environmental condition	Humid Tropical climate
e)	Operational altitude	Up to 3000m above msl
f)	Isokeraunic (Thunder day) level	90 days
g)	Solar Radiation	1.6kW/m2

10.11.4 Applicable Standards

The equipment and components supplied shall be in accordance with the latest editions of the standards specified below and amendments thereof and the NEA Specifications specified hereafter.

a)	IEC 60282-2	H.V. Fuses - Expulsion and similar fuses
b)	IEC 60071-1	Insulation co-ordination.- Part I Definitions, principles and rules
c)	IEC 60071-2	Insulation co-ordination - Part 2 - Application guide
d)	IEC 60273	Characteristic of indoor & outdoor post insulators for systems with nominal voltages greater than 1000V
e)	IEC 60694	Common Specifications for high-voltage switchgear & control gear standards
f)	IEC 60060-2	High-voltage test techniques -Part 2 Measuring systems

10.11.5 Technical Parameters

10.11.5.1 Minimum Technical Requirements

S.N.	Description	Unit	Required ratings/features
1	Rated Voltage	kV	12

2	Rated Frequency	Hz	50
3	Rated Continuous Current	A	100
4	Dry Impulse withstand voltage (peak)		
4.1	Across isolating distance of the fuse base	kV	85
4.2	To earth and between poles	kV	75
5	Power Frequency withstand voltage (Wet 1min)		
5.1	Across isolating distance of the fuse base	kV	32
5.2	To earth and between poles	kV	28
6	Minimum power frequency withstand voltage		
6.1	Dry	kV	35
6.2	Wet	kV	30
7	Mounting Angle (to vertical plane)	deg	~15-20
8	Interrupting Rating		
8.1	Symmetrical Interrupting rating (min) rms	kA	8.0
8.2	Asymmetrical Interrupting rating (min) rms	kA	9.6
8.3	X/R ratio		4.0
9	Interrupting capacity	kA	10
10	Temperature Rise Limit (In air)		
10.1	Copper contacts silver faced	deg. C	40
10.2	Terminals	deg C	30

10.11.6 Basic Features

10.11.6.1 Design

The Dropout Fuse shall be of Class A as per IEC 60282-2. It shall be suitable for use in outdoor circuits under tropical conditions. The Dropout Fuse shall be complying with the minimum technical requirements stipulated above.

10.11.6.2 Manufacture

a) The Dropout Fuse shall be designed with a solid core, bird proof, one-piece Porcelain Insulator and should robust enough to withstand shocks due to frequent operations. The fuse carrier shall drop-out immediately following the blowing of the fuse.

b) Dropout Fuse within the same voltage class shall be so designed that fuse carrier together with mounting assembly shall be dimensionally compatible to facilitate the interchange of fuse carriers of the cutouts of corresponding rating.

c) The Dropout fuse shall be able to mount on a single channel iron cross arm (100mm x 50mm x 6mm) at an angle of 15 to 20 degrees to the vertical. The whole unit shall be complete with long mounting bracket, bolts, nuts & washers.

d) Fuse carrier shall be made of high strength fiberglass filament wound tube or suitable insulating material and it shall be protected from weather and environment by ultraviolet resistant coating. Inside liner of the fuse tube shall be constructed of a synthetic arc quenching material.

e) Copper Arc Shortening rod shall be attached to the cap of the fuse tube to obtain higher interrupting rating. A removable button head type fuse link having M6x1 thread shall be able to fix to the arc shortening tube.

f) The installation and removal of the fuse carrier shall be facilitated by inserting the operating rod into a lifting eye at the hinge end (lower) of the fuse carrier when it is in the dropped-out position. An operating lever eye shall be provided at the top of the carrier to facilitate a downward pull by the operating rod to release the latch incorporated in the stationary upper contact.

g) All castings such as upper and lower moving and fixed contacts, clamp type terminals, toggle mechanism shall be of phosphor bronze, silicon bronze, aluminum bronze or Silver- plated brass.

10.11.6.3 Stationary and Movable Contacts

a) The Stationary and Movable Contact surfaces shall be silver plated to minimize the contact resistance.

b) The upper stationary contact assembly shall be provided with a safety latch to prevent the fuse carrier from dropping due to vibration and the upper contacts shall be protected from any airborne contaminants.

c) A back up spring made out of stainless steel or phosphor bronze shall be provided to ensure constant pressure between the upper stationary contact and the upper movable contact of the fuse carrier.

d) The lower stationary contact support and the fuse carrier shall be machined at the swiveling or axle point to enable the fuse carrier with the fuse link to be correctly guided into the latching position by an operating rod. The hinge at the stationary contact shall be so designed to prevent the dropping off of the fuse carrier in the drop-out position, due to shock and vibration.

e) A suitable guiding arrangement shall be provided in the upper contact to ensure easy engagement of the fuse carrier.

f) The Asymmetrical breaking current ratings shall be permanently marked on the upper metal part.

10.11.6.4 Terminals

a) The upper and lower terminals shall be of Bi-metallic type, suitable to accommodate Copper/Aluminum Conductors of Sizes from 5mm to 14mm diameter.

b) The upper terminal shall be positioned to receive the conductor from either side or upward direction while the lower terminal shall be able to receive the conductor from either side or downward direction.

c) The maximum temperature rise for contacts (movable and stationary) shall not be more than 40°.C and, for terminals the

temperature rise shall not be more than 30° C.

10.11.6.5 Galvanizing

All iron and steel parts such as mounting and support brackets, bolts and nuts, washers etc. shall be galvanized after processes such as sawing, shearing, drilling, punching, filling, bending and machining are completed. Galvanizing shall be the hot-dip process to comply with the standard ISO 1461.

10.11.7 Additional Requirements

10.11.7.1 Rating Plate Markings

The ratings and data of the Dropout Fuse shall be provided in the rating plate, which shall be weather and corrosion proof. The main rating plate near the supporting bracket of the insulator base shall carry the following information:

a) Number and year of the Standard adopted
b) Rated voltage/Rated maximum current
c) Class designation/Manufacturer's name or trademark,
d) Asymmetrical current rating/Symmetrical current rating/X/R Ratio.
e) Year of manufacture
f) Contract No.

The following information shall be marked on the fuse carrier.

a) Manufacturer's name or trademark
b) Rated Voltage/Rated frequency
c) Rated maximum current
d) Rated breaking capacity (Asymmetrical/Symmetrical current rating & X/R Ratio).

10.11.7.2 Packing

The pre-assembled dropout fuse unit (Dropout Fuse Base, Fuse Carrier and Mounting Bracket) shall be packed in a suitable hardboard box and the rated voltage of the unit shall be clearly marked on the box. Spare fuse carrier shall be supplied in suitable hardboard boxes, the quantity and the voltage rating applicable shall be clearly marked on the boxes.

10.11.8 Inspection And Testing

10.11.8.1 Acceptance Test

The successful Bidder shall make necessary arrangements for pre-shipment inspection and tests by the nominated NEA Inspectors to carry out in his presence the necessary Sample/Acceptance tests conforming to the relevant IEC on equipment and materials offered. Routine test report for all the items shall be furnished for the observation of the Inspector.

The acceptance tests as per IEC shall be witnessed by the NEA Inspector.

(a) Dimensional Verification
(b) Dielectric tests
(c) Mechanical Tests
(d) Measurement of resistance of fuse-links

10.11.9 Bid Documentation

10.11.9.1 The following shall be furnished with the offer.

(a) Product Catalogues/Technical literature describing the constructional features, materials used for components, operational feature of the equipment, indicating the model number etc.
(b) Energy withstand capability & a description of the test carried out to measure the same.
(c) Power frequency withstand voltage versus time characteristic curve covering the time range from 0.1 sec. to 24 minutes.
(d) Dimensional drawings of the bracket mounting base, live conductor clamps, earth lead and automatic earth disconnecting device and overall dimensional drawing.
(e) Drawing of name plate to scale incorporating the particulars called for.
(f) Completed Schedule of Guaranteed Technical Particulars
(g) A copy of the Manufacturer's ISO 9001 Certificate conforming to design and manufacture
(h) Type Test Certificates. The Type Test Certificates shall be from an Accredited Independent Testing Authority acceptable to the Purchaser.
(i) Copy of the Governing Standards
(j) Technical Literature in English Language on installation, operation and maintenance with necessary circuit diagrams and drawings.

10.11.9.2 Type Test Certificates

Following Type Test certificates conforming to IEC 60282-2, IEC 60060 at a reference frequency of 50 Hz. where applicable shall also be submitted with the offer.

a) Dielectric Tests
b) Temperature Rise Tests

c) Artificial Pollution Tests
d) Mechanical Tests
e) Breaking Tests
f) Interrupting Tests
g) Beam Strength of Porcelain Fuse

Test Certificates shall clearly identify the equipment concerned showing the manufacturer's identity, Type, Model and Serial Number of the equipment tested. Type Test Report shall include complete drawings and the model/type of the offered Arrester. Type Test Report shall be from a recognized accredited independent testing authority acceptable to the purchaser.

10.12 Fuse Link

10.12.1 Scope

This Specification covers the supply of button head fuse links commonly used in the protection of distribution transformers with the Distribution Cutouts above.

10.12.2 Description

The button-head fuse link shall be fabricated in full compliance with the relevant IEC, or latest revision thereof or any other international standards that ensures at least a substantially equal quality to the standard mentioned above, will also be acceptable.

The fuse link shall have fast characteristics and shall be suitable for protection of distribution transformers. The fuse link shall be supplied in accordance with the type and ratings shown in the bid package.

10.12.3 Tests

The distribution cutout and surge arrester shall be tested in accordance with the relevant provisions of the governing standard.

10.12.4 Bid Documentation

The Bidder shall furnish copies of governing standards for fabrication and testing of fuse links
The Bidder shall furnish copies of catalogue of fuse links.
The Bidder shall furnish a clause-by-clause commentary on specification, specifying compliance and deviations, if any.
The Bidder shall also furnish with the Bid copies of the following data with respect to the fuse links furnished:

a) Time-Current (TC) characteristic curves at 30°C, including minimum melting time and total clearing time.
b) Preloading adjustment factors or curves.
c) Ambient temperature adjustment factors or curve

All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents

10.13 Distribution Panel Board

10.13.1 Scope

This Specification covers the design, fabrication, testing and supply of Distribution Panel Boards to be used in the Low Voltage Overhead Distribution system of the Nepal Electricity Authority (NEA) to provide overload and short circuit protection for Distribution lines up to Customer Distribution Panel.

10.13.2 Description

The panel board shall be pole-mounted and used in conjunction with pole-mounted distribution transformers to house moulded case circuit breaker (MCCB) feeding 400/230 Volt circuits.

The panel board shall be rectangular in shape with an entrance door in the front of the panel board. The panel board shall be equipped with interior standoffs suitable for mounting MCCB and for supporting cables. The panel board will be fixed to the pole by exterior mounting brackets attached to the back of the panel board. Details of these components shall be as specified in the following text.

The panel board shall be fabricated to prevent ingress of moisture due to rainfall and dripping. The panel board shall be provided with means for natural ventilation.

10.13.2.1 Material

The panel board case and door shall be fabricated out of steel sheet of minimum 2 mm. in thickness and pole mounting brackets shall be fabricated out of mild steel flat of 6 mm. in thickness. The interior standoffs shall be fabricated of steel sheet of sufficient thickness to support installed circuit breaker and cables without lateral movements.

10.13.2.2 Construction

The panel board case and all interior and exterior attachment shall be spot-welded. All welding shall be of the highest quality. The panel boards shall be formed and welded square and all attachments to the interior and exterior surfaces shall be welded square and perpendicular to the panel attached.

The panel board shall be so constructed as to be water tight from blowing of free-falling rain. There shall be no apertures in the panel board case other than those provided for the entrance door, cable fittings, or ventilation. The top extension and bottom shall be so formed to provide a drip edge and prevent water from flowing on the respective under-surfaces.

All individual pieces of metal shall be edge finished prior to assembly to provide surfaces and edges which are free from sharp points and edges. After welding in place, all welds shall be finished to smooth condition.

10.13.2.3 Panel board Front

The front panel shall be fabricated as a separate piece containing the panel board door and doorframe. The front shall be attached to the panel board housing by suitable bolting arrangements to provide a watertight and dust tight seal at the perimeter.
The door shall be equipped with a gasketed removable door, door-handle lock, and suitable hinges. The door and panel frame shall be so fabricated to provide an integrated structure which is warp-resistant and which will maintain dust-tight and watertight seal. Gasketing material shall be heat-resistant and shall retain its resilience over time to precluded degradation of dust-tight and watertight properties.
The insertable (and removable) door handle shall provide a door a locking function. The handle shall be insulated.
The door hinge may be continuous type or separate hinge units. However, the type of hinge furnished must accommodate, and not degrade, the dust-tight and watertight characteristics and must provide adequate door alignment and support over time.

10.13.2.4 MCCB Standoffs

The standoffs shall be shaped and dimensioned to accommodate the MCCBs as required by Bid Packages. The standoffs shall be precisely located.

10.13.2.5 Cable Standoffs

The cable standoffs shall be properly shaped and dimensioned. The standoff shall have the metal edges contoured and smoothed to prevent abrasion of applied cable serving. The standoff shall be located within the panel board to make allowance for cable bending radii and the location of other components.

10.13.2.6 Bus bars

The neutral and phase bus bars shall consist of copper bus bar insulated from the panel board by 600 V porcelain insulators. The copper bus bar shall be of proper size (ampere capacity) and properly dimensioned. The bus bars shall be located within the panel board to provide adequate clearance for the installation and correct functioning of all items.

If it is required to drill or penetrate the panel board back to install 600 V insulators, the outside of the panel board shall be permanently sealed over the attachment to retain water-tightness.

10.13.2.7 Cable Entrance Fittings and Knockouts

Knockouts for cable entrance fittings (bushings) shall be provided in the bottom of the panel board. All necessary cable entrance fittings shall be supplied for proper connection of all circuits to fulfil the requirement of the Bid Package. The fittings shall be designed to be suitable for exposed cables entering the panel board from below and shall secure the cable with inserts to prevent lateral and longitudinal movement of the cables.

The fittings shall be threaded multi-piece construction which when installed securely locks the fittings to the panel board. The fittings may be of metal or polymer material. Metal fittings shall be galvanized or plated as appropriate. The fitting inserts may be single or multi pieces and shall be of material sufficiently elastic and resilient to securely grip the PVC cable sheath without damage. The fitting components shall enable capturing of the inserts to preclude insert creep and fallout due to clamping pressure.

10.13.2.8 Ventilation

The panel board shall be provided with apertures for natural draft ventilation in the panel board bottom and in the top overhang. The ventilation apertures shall be covered with bronze screen materials of a mesh sufficiently to preclude passage of small insects. The edges of the bronze screening shall be surely fastened to the panel board by means of soldering or epoxy adhesive. The mesh shall be protected during panel board fittings to preclude clogging of mesh openings by finished materials.

10.13.2.9 Pole Mounting Bracket

The panel board shall be provided with two (2) pole mounting brackets. The size of poles will be confirmed by the purchaser before manufacturing.

10.13.2.10 Grounding Stud

The panel board shall be provided with a brass grounding stud located in an approved location. The grounding stud shall be fitted to the panel board to insure low resistivity and water tightness of the installation. The grounding stud shall be complete with pressure washer, lock washer, and nuts.

10.13.2.11 Finish

After fabrication, the panel board shall be thoroughly cleaned of all dirt, grease, mill scale, and weld slag on all interior and exterior surfaces and all surfaces of all component. After thorough cleaning of panel board one (1) coat of red oxide metal priming paint and

two (2) finish coats of paint color shall be thoroughly applied. The paint color shall be of light grey (RAL 7032). The finish coats shall be of oil based or epoxy paint. Alternatively, powder coating of panel board may also be acceptable.

The bronzed screen ventilation holes, working surfaces of door hinge and door lock, and outside face of grounding stud shall be free from all finishing materials.

10.13.3 Bid Documentation

The following shall be furnished with the offer.

(a) The Bidder shall furnish fabrication drawings showing all views, section, and dimensions of individual components and assembled panel board.
(b) The Bidder shall furnish complete description of all materials to be used, including cable entrance fittings and finishing materials.
(c) The Bidder shall furnish a clause-by-clause commentary on specification, specifying compliance and deviations, if any.
(d) All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.
(e) Completed Schedule of Guaranteed Technical Particulars
(f) A copy of the Manufacturer's ISO 9001 Certificate conforming to design and manufacture
(g) Technical Literature in English Language on installation, operation and maintenance with necessary circuit diagrams and drawings.

10.14 Moulded-Case Circuit Breakers (MCCB)

10.14.1 Scope

This specification covers the design, manufacture and testing of Moulded Case Circuit Breakers (MCCB) used with Distribution Panel Board in the Low Voltage Overhead Distribution system of the Nepal Electricity Authority (NEA) to provide overload and short circuit protection for Distribution lines up to Customer Distribution Panel

10.14.2 System Parameters

a)	Nominal Voltage	400/230V, 3 Phase and Neutral
b)	System Highest Voltage	440/250V, 3 Phase and Neutral
c)	System frequency	50Hz
d)	Method of Earthing	Solidly earthed neutral
e)	System fault current	25kA

10.14.3 Service Condition

a)	Ambient temperature	-5 to 55 deg. C
b)	Annual average ambient temperature	30 deg. C
c)	Maximum relative humidity	99%
d)	Environmental condition	Humid Tropical climate
e)	Operational altitude	Up to 3000m above msl
f)	Isokeraunic (Thunder day) level	90 days
g)	Solar Radiation	1.6kW/m2

10.14.4 Applicable Standards

The equipment and components supplied shall be in accordance with the latest editions of the standards IEC 60947 and amendments thereof and the NEA Specifications specified hereafter.

10.14.5 Technical Parameters

10.14.5.1 Minimum Technical Requirements

S.N.	Description	Unit	Requirements
1	No. of Poles		3
2	Rated frequency	Hz	50
3	Rated operational voltage (Ue)	V	400/230
4	Rated insulation voltage (Ui)	V	750
5	Impulse withstand voltage (Uimp)	kV	8
6	Continuous Current Rating (In)	A	80, 160, 250, 320, 500
7	Ultimate Short Circuit Breaking Capacity (Icu) (up to 100 A)	kA	25
8	Ultimate Short Circuit Breaking Capacity (Icu) (above 100 A)	kA	50

9	Operating Short Circuit Breaking Capacity (Ics)		50 % of Icu
10	Utilization Category		A
11	Rated duty		uninterrupted
12	Trip device		Thermal adjustable magnetic
13	Rated current adjustment		(0.8-1)In
14	Instant opening current adjustment		10 x In
15	Mechanical Life Operation		>15000
16	Electrical Life Operation		>10000
17	Line load reversibility features		Yes
18	Interrupting Capability		(IEC category P2)
19	Thermal Rating declared at 50 deg C		Yes
20	Operating Range		-5 to 55 deg. C
21	Creepage distance suitable for		Pollution Degree 3 and suitable for isolation
22	Suitable for isolation		Yes
23	Trip Characteristics		inverse time and instantaneous
24	Universal Accessory Fitting		Yes
25	External Accessory		Rotary Operating Handle (Extended for >200A) Suitable Extended Terminals Phase Barriers Mounting Screws

10.15 Steel Tubular Pole

10.15.1 Scope

This Specification covers the design, fabrication, testing and supply of swaged type galvanized steel tubular poles to be used to support overhead electric lines and equipment.

10.15.2 Description

10.15.2.1 The steel tubular pole shall be manufactured and tested in accordance with IS:2713. The poles shall be fabricated of seamless tubes of suitable lengths as specified in **Table 1** made out of welded tubes, swaged and joined together. The diameters of various sections of the fabricated pole shall be as specified therein. A bid not conforming to the requirements of **Table 1** shall be rejected as being non responsive.

10.15.2.2 There are some numbers of poles which shall be of folding type. The folding type poles shall be fabricated in such a way that the bottom section and middle section of the poles could be securely fixed by two sets of galvanized nuts/bolts of suitable size and length at 90^0 each other. All other design requirements and parameters for folding type poles shall be as per section above and IS:2713.

10.15.2.3 The separate galvanized steel pole cap shall be provided with top section of the pole. The bottom section of the pole shall be provided with a base plate. The base plate shall be square of size 300x300 mm and 10 mm thick and it shall be welded at the bottom of the pole. The base plate shall have a hole of dia. approx. 50 mm in the center, for draining out of water.

10.15.2.4 The total supply quantity of steel tubular poles (total of non-folding type and folding type) are given in the Price Schedule. Supply quantity of folding type poles shall be finalized after pre- construction survey.

10.15.3 Material

10.15.3.1 The poles shall be fabricated from steel having tensile strength not less than 410 N/mm^2. The pole shall be composed of three sections in diminishing diameters and minimum diameter and thickness and lengths of poles shall be as shown in **Table below.**

10.15.3.2 The steel tubes shall confirm to the requirements of IS:2713, or latest revision thereof or other recognized international standards that ensures at least a substantially equal quality to the standard mentioned above.

10.15.4 Manufacture

10.15.4.1 All tubes forming the part of the pole shall be made from hot finished seamless or continuously welded steel in accordance with IS 2713, or equivalent international standards. Following tolerances shall be maintained.

a) Tolerance on outside diameter: +/- 1%

b) Tolerance on length: +/- 40mm on any section

+/-25mm on overall length c) Tolerance on weight: No negative tolerance

d) Tolerance on thickness: No negative tolerance

e) The out-of-straightness of the finished pole shall not exceed 1/600 of its length.

10.15.4.2 All welding of the poles shall be carried out at the manufacturers' plant.

10.15.4.3 Each section of the pole shall have only one longitudinal weld. No circumferential joints/welds of the tubes are permitted. All welds shall be capable of withstanding, without failure or cracking the stresses in a pole when subjected to its ultimate design loads.

10.15.4.4 The pole shall have hole configurations and sizes as shown in the drawings attached to this specification. The hole sizes and the locations of the hole must however be confirmed with the Project prior to manufacture.

10.15.5 Corrosion Protection

10.15.5.1 All sections of the pole shall be galvanized both internally and externally. Galvanizing shall be applied by the hot dip process, and shall be done in single bath (single dip) to result in a uniform thickness both internally and externally. Galvanizing of the poles shall be done after completion of fabrication process. Drilling, punching, cutting, bending and removal of burrs shall be completed before galvanizing. The preparation for galvanizing and the galvanizing process shall not adversely affect the mechanical properties of the material being coated. All galvanizing shall be in accordance with ISO 1461 or IS:4736 or an equivalent international

standard, and shall result in uniform thickness galvanization and be free from defects. The pole cap and the base plate shall also be galvanized.

10.15.5.2 The minimum thickness of the zinc coating shall not be less than 500 g/m^2 (equivalent to 70 microns) of zinc for all surfaces of steel including the base plate and the pole cover.

10.15.6 Marking of Pole

10.15.6.1 The pole shall have an identification marked with indelible paint on the pole at a position approximately 3.5 m. from the butt end, which is clearly and indelibly marked with:

a) Date of manufacture and identification mark of manufacture.
b) Length of pole in meters and its design working loads as defined in this specification. c) Name of the Employer
d) Contract Number.

10.15.6.2 The pole shall be marked with a permanent horizontal line at a point 1/6th of the pole height from the butt end of the assembled pole.

10.15.7 Earthing Lug, Base Plate and Pole Cap

Each pole shall be provided with earthing lug at 300 mm above the ground level. Separate pole cap shall be provided for each pole. The plate for pole cap shall be of 3 mm. minimum thickness.

10.15.8 Tests

10.15.8.1 The following test(s) shall be performed on finished poles. All testing shall be fully documented and certified test reports shall be provided to the Project.

- Test for dimensional and structural properties, and for the physical requirements of the finished poles
- Test for galvanization
- Tensile test and chemical analysis test
- Deflection test
- Permanent set test, and
- Drop test.

10.15.8.2 Poles selected for tests shall be a representative sample from each lot. The number of poles selected for conducting deflection, permanent set and drop tests shall be as follows.

S.N.	Lot size	No. of poles
1.	Up to 500	5
2.	501-1000	8
3.	1001-2000	13
4.	2001-3000	18
5.	3001 and above	20

10.15.8.3 The number of poles selected for conducting tensile test and chemical analysis tests shall be as follows:

S.N.	Lot size	No. of poles
1.	Up to 500	1
2.	501-1000	2
3.	1001-2000	3
4.	2001-3000	4
5.	3001 and above	5

10.15.8.4 The above test shall be performed as per IS:2713 or other recognized international standards. The following particulars shall be recorded:

a) Manufacturer's name and plant location;
b) Batch No. of steel plate or tubing;
c) Test date;
d) Pole type;
e) Dimensions of pole;
f) Increments of load and the deflections at each increment of load;
g) Permanent deflection;
h) Load of failure;

10.15.8.5 For deflection test, each pole shall be rigidly supported for a distance from the butt end equal to the length the depth to which it to be planted in the ground. It shall then be loaded as cantilever and the appropriate deflection load applied at right angle of the axis of pole 300 mm from the top of the poles for poles up to 9m length and 600 mm for poles over 9m length. The temporary deflection at the point of application of the applied load shall not exceed 157.5 mm

10.15.8.6 The permanent set test shall be carried out immediately after the deflection test, on the same test sample. After application of the proper load, the permanent set measured from the zero position at the point of application of load after the release of the applied load shall not exceed 13 mm.

10.15.8.7 To perform the drop test, the pole shall be dropped vertically with the bud end downward, three times in succession from a height of 2 m onto a hardwood block 150 mm thick laid on a concrete foundation. The pole shall not show any signs of telescoping or loosening of joints.

10.15.8.8 Should any of the poles first selected fail to pass any of the tests specified above, two further poles shall be selected for testing from the same batch i.e. same pole length manufactured on the same day from the same steel plate or tubing in respect of each failure. Should one or both these additional poles fail, the test material represented by the test samples shall be deemed as not complying with this specification.

11 Quality Assurance Program

11.1 Quality Assurance Plan

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization;
ii. The duties and responsibilities assigned to staff ensuring quality of works;
iv. The system for purchasing, taking delivery and verification of materials;
v. The system for ensuring quality of workmanship;
vi. The quality assurance arrangement shall conform to relevant requirements of ISO9000;
vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
vii. List of manufacturing facilities available;
viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

11.2 Material Testing

The manufacturer shall perform, among others, the following inspections/test on each consignment of raw steel, prior to fabrication. A certificate shall be provided to the Employer showing the test results:

i. Visual, dimensional and mechanical tests, to identify the steel meets the required strength/grade ensure compliance with the relevant Standards, and to ensure the absence of rust and surface imperfections. If the steel does meet the strength or grade required, the batch shall be rejected.

ii. Dimensional tests to ensure that the material is within the production tolerances of IS 2713 or BS 4360 and BS 6323 or equivalent Standards. One sample shall be taken from each batch for which a certificate is

provided. If the first sample fails the test, a second sample shall be taken. If the second sample fails the test, the batch shall be rejected.

12 Packing

Poles shall be stacked together and banded securely to ensure that each individual bundle does not break or the shifting of individual poles does not take place during transportation and handling. Any loose items shall be suitably banded together or packed to avoid loss during transportation and storage.

13 Bid Documentation

13.1 The Bidder shall provide with the Bid copies of the governing standards for selection of tubing, fabrication and testing of Steel Tubular Poles and copies of all other relevant standards referenced therein.
13.2 The Bidder shall provide a complete design, description and certified dimensional drawings of each type of pole.
13.3 A clause-by-clause commentary on specification, specifying compliance and deviations, if any.
13.4 All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

Table 1: Pole Attributes

S.N.	Description	Unit	Value	
			For 11m Pole	For 9m Pole
1	Overall Length	m	11	9
2	Pole Designation		410 SP-52	410 SP-31
3	Section Length			
3.1	Top (h1)	m	2.7	2.0
3.2	Middle (h2)	m	2.7	2.0
3.3	Bottom (h3)	m	5.6	5.0
4	Outside Diameter			
4.1	Top (h1)	mm	114.3	114.3
4.2	Middle (h2)	mm	139.7	139.7
4.3	Bottom (h3)	mm	165.1	165.1
5	Thickness			
5.1	Top (h1)	mm	3.65	3.65
5.2	Middle (h2)	mm	4.50	4.50
5.3	Bottom (h3)	mm	4.50	4.50
6	Crippling Load	kgf	307	367
7	Approximate Weight (excluding the weight of galvanization, base plate and pole cap)	kg	175	147
8	Application of load from top of pole	m	0.6	0.3
9	Planting Depth	m	1.8	1.5

14 Pre-Stressed Concrete (PSC) Pole

14.1 Scope

These specifications apply to design, manufacture, and testing of rectangular pre-stressed concrete poles for use in electrical distribution.

14.1.1 Description

The pre-stressed concrete pole shall be designed and fabricated in full compliance with IS:1678-1978, or latest revision thereof or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable.

14.1.2 Load

The working loads of various pole categories are as per the design parameters. The design ultimate strength shall be calculated using a safety factor of 2.5. Pole Attributes are listed in the design parameters.

14.1.3 Materials

14.1.3.1 **Cement**

Cement to be used in the manufacture of pre-stressed concrete poles shall be ordinary for rapid hardening Portland cement confirming to IS: 269-1976 (Specification for ordinary and low heat Portland cement) or IS: 8041 E-1978 (Specification for rapid hardening Portland cement).

14.1.3.2 Aggregates

Aggregates to be used for the manufacture of pre-stressed concrete poles shall confirm to IS:383 (Specification for coarse and fine aggregates from natural sources for concrete). The nominal maximum sizes of aggregates shall in no case exceed 12 mm.

14.1.3.3 Water

Water should be free from chlorides, sulphates, other salts and organic matter. Potable water will be generally suitable.

14.1.3.4 Admixture

Admixture should not contain Calcium Chloride or other chlorides and salts which are likely to promote corrosion of pre-stressing steel. The admixture shall conform to IS: 9103.

14.1.3.5 Pre-stressing Steel

The pre-stressing steel wires should confirm to the IS 1785 OR IS 6003. The plain wire should be of 4 mm in diameter with a guaranteed ultimate strength of 175 kg/mm^2. The strands shall be made from cold-drawn non-alloy steel (high carbon content) wires. The seven-wire strand consists of a group of wires arranged in stranded formation and shall have the following properties. The seven-wire strands shall confirm to IS:6006-1983, or latest revision thereof or any other equivalent national or international standards.

Geometrical Properties:

Type of material:	Seven-wire strand
Nominal diameter of strand	7.9 mm (7/2.6mm)
Nominal cross-sectional area of strands	37.4 mm^2

Mechanical Properties:

Nominal mass of strand:	64.50kN Minimum
breaking load:	294 g/m
0.2% proof load	54.70 kN

Long Term Behavior:

Maximum relaxation after 1000 h of operation at initial load equivalent to 60%, 70% and 80% of breaking load shall not be higher than 1.0%, 2.5% and 4.5% respectively.

14.1.3.6 Concrete Mix

Concrete mix shall be designed to the requirements laid down for controlled concrete (also called design mix concrete) in IS: 1343-1980 (Code of practice for pre-stressed concrete) and IS: 456 – 1978 (Code of practice for plain and reinforced concrete).

14.1.4 Design

14.1.4.1 The poles shall be as per following design parameters and the dimensions shall be shown in Drawing.

Design Parameters:

Concrete mix:	M40
Minimum diameter of pre-stressing wire:	Refer Table 2
Working Load:	Refer Table 1
Depth of Plantation:	Refer Table 2
Point of Application of Load	Refer Table 2

14.1.4.2 The minimum strength of concrete in the pole shall meet the requirements laid down in IS:1343-1960 and IS:456-1964 or in any other equivalent national or international standards.

14.1.4.3 The pre-stressing strands shall be accurately positioned and satisfactorily protected against the formation of rust or other corrosion prior to the placement of the concrete. All pre-stressing strands shall be free from loose rust, dirt, grease, oil and other lubricants or substance that might impair their bond with the concrete.

14.1.4.4 The cement employed shall be the Ordinary Portland Cement (OPC), which shall conform to the chemical and physical requirements as set forth in IS 269, or any other equivalent national or international standards.

14.1.4.5 The amount of concrete cover on the outside of the pre-stressed reinforcement shall be not less than 20 mm.

14.1.4.6 Concrete shall be compacted by spinning, vibrating, shocking or other suitable mechanical means. Hand compacting shall not be permitted.

14.1.4.7 The concrete shall be covered with a layer of sacking, canvass, Hessian or similar absorbent material and kept constantly wet up to the time when the strength of concrete is at least equal to the minimum strength of concrete at transfer of pre-stress. Thereafter, the pole may be removed from the mould and watered at intervals to prevent surface cracking of the unit the interval should depend on the atmospheric humidity and temperature.

The pre-stressing wires shall be detentioned only after the concrete has attained the specified strength at transfer (i.e. 200 or 210 kg/cm² as applicable). The cubes cast for the purpose of determining the strength at transfer should be coursed, a sear as possible, under condition similar to those under which the poles are cured. The transfer stage shall be determined based on the daily tests carried out on concrete cubes till the specified strength indicated above is reached. Thereafter the test on concrete shall be carried out as detailed in IS: 1343(code of practice for prestressed concrete). The manufacture shall supply, when required by the owner or his representative, results of compressive test conducted in accordance with IS: 456 (Code of practice for plain and reinforced concrete) on concrete cubes made from the concrete used for the poles. If the manufacture so desired, the manufacture shall supply cubes for test purpose and such cubes shall be tested in accordance with IS: 456 (Code of practice for plain and reinforced concrete).

14.1.4.8 The pole shall include cast-in holes. Typical hole patterns are shown in the drawings. Hole patterns must be confirmed with the NEA prior to manufacture.

14.1.4.9 All poles shall be unpolished but free of roughness, chips, excess cements, and other surface irregularities. All poles shall present a straight and symmetrical appearance after erection. The corners of all the poles shall be rounded so that they do not present a dangerously sharp edge, which could cause tearing or excessive wearing of safety belts.

14.1.4.10 All poles shall be provided with lifting hooks at two points for loading and unloading of poles.

Table 1

Working Load

S.N.	Pole Length (m)	Design Load (kgf)
1	11	350
2	9	200

Table 2

Pole Attributes

S.N.	Description	Unit	9m PSC Pole	11m PSC Pole
1	Standard		IS 1678	IS 1678
2	Length of PSC Pole	m	9	11
3	Size	mm	300*150*140	400*180*150
4	Approximate Weight	kg	680	1150
5	Working Load	kgf	200	350
6	Ultimate Load	kgf	500	875
7	Concrete Grade		M40	M40
8	Pre-stressing Wire			
8.1	Diameter	mm	7.9 mm (7/2.6mm)	7.9 mm (7/2.6mm)
8.2	Standard		IS 1785	IS 1785
9	Factor of Safety		2.5	2.5
10	No of tensioned wire		6	8
11	No of stirrups (6mm MS)		12	12
12	Depth of Plantation	m	1.5	1.8

13	Point of Application of load from pole top	m	0.6	0.6

14.1.5 Tests

Definition of various types of loads

Working load = Expected Load

Design Working Load = Expected Load x Factor of Safety (FOS)

Ultimate Transverse Load (UTL) = Load when applied at specified point of the pole, the failure occurs.

Minimum Ultimate Transverse Load (MUTL) = Load when applied at specified point of the pole, the first crack appears.

Design Transverse Load (DTL) = Design Working Load

Design Ultimate Transverse Load (DUTL) = Design load at the transverse direction at which the first crack expected to appear (given by the Designer after calculation)

The **Design Ultimate Transverse Load (DUTL)** is less or equal to Ultimate Transverse Load

14.1.5.1 Transverse Strength Test

The pole shall be rigidly supported at the butt end for a distance equal to the specified planting depth. The load shall be applied at a point specified in Table 2 from the top of the pole and shall be steadily and gradually increased to the design transverse load until the occurrence of the first crack. The deflection is then measured. Prior to the application of the design transverse load there shall be no crack.

The load shall then be reduced to zero and increased gradually to a load equal to the first crack load plus 10% of the minimum ultimate transverse load, and held for 2 minutes. This procedure shall be repeated until the load reaches the value of 80% of the minimum ultimate transverse load and thereafter increased by 5% of the minimum ultimate transverse load until failure. Each time the load is applied, it shall be held for 2 minutes. The ultimate transverse load shall not be less than the design ultimate transverse load.

14.1.5.2 Measurement of Cover

The cover shall be measured at 3 points, one within 1.8m from the butt end of the pole, second within 0.6m from the top and the third at the intermediate point. The mean value of the measured cover should not differ by more than +/-1mm from the specified value, and the individual value should not differ by more than+/-3mm from the specified value.

14.1.5.3 The number of poles selected for testing and their conformity criteria shall be as follows:

Lot Size	**Sample Size**	**Permissible No. of Defective Samples**	**No. of Poles for Transverse Strength Test**
Up to 100	10	1	2
101 to 200	15	1	3
201 to 300	20	2	4
301 to 500	25	3	5

14.1.5.4 All the poles selected in 5.3 shall be tested for overall length, cross-section and up-rightness.
The tolerance shall be +/-15mm on overall length, +/-3mm on cross-sectional dimensions, and
0.5% on uprightness.

14.1.5.5 The number of poles which do not satisfy the requirements of overall strength, cross-section and uprightness shall not exceed the number given in 5.3. If the number of such poles exceeds the corresponding number, all poles in the lot shall be tested for requirements, and those not satisfying the requirements shall be rejected.

14.1.5.6 All the poles tested for transverse strength test shall satisfy the requirements of the test. If one or more poles

fail, twice the number of poles originally tested shall be selected from those already selected and subjected to test. If there is no failure among these poles, the lot shall be considered to have satisfied the requirements of the test.

14.1.6 Marking

The poles shall be cleanly and indelibly marked with the following:

a) Month and year of manufacture, at approximately 3m from the butt end;
b) Specified working load in kg, at approximately 3m from the butt end; and
c) The design lifting point.
d) The pole should be marked with the Identification of the Project/Contract at approximately 5m from the butt end.

14.1.7 Bid Documentation

14.1.7.1 The Bidder shall furnish following documents together with Bid;

a. Two (2) clear copies of the standards, governing fabrication and testing of pre-stressed concrete poles and two (2) clear copies of other standards indicated in the specifications.
b. Two (2) clear copies of detailed design and drawings of each type of pole.
c. Two (2) clear certified copies of all tests performed on similar poles of same sizes and similar working loads.
d. A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

14.1.7.2 The Bidder shall provide the following details:

a) Pole dimensions in cross-section and pole taper;
b) Location and size of pre-stressing strands;
c) Hole locations;
d) Design ground line;
e) Marking of the lifting point;
g) Minimum ultimate transverse load;
h) Transverse load at first crack
i) Concrete design mix and cement specification
j) Specifications of the pre-stressing strands, their tensile strength and sizes

15 Porcelain Insulators and Fittings

15.1 Scope

This Specification covers the Type Test, fabrication and supply of pin insulators, disc insulators stay insulators, disc insulator fittings and insulator pins as herein specified for use on overhead power line construction.

15.2

15.2.1 General Requirements of Insulators

Insulators shall be fabricated and tested in accordance with the Standards referenced for each type of insulator or equivalent standards.
The Type Test shall be conducted in the recognized laboratory.
Porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed. The glaze shall be brown in color. The glaze shall cover all exposed parts of the insulators.
The design of insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. The porcelain shall not engage directly with hard metal.
The cement used in construction of insulators shall not give rise to chemical reaction with metal fittings and its thickness shall be as uniform as possible.
The insulators should be manufactured in automatic temperature-controlled kilns to obtain uniform baking and better electrical and mechanical properties.
The preferred make of disc, pin and stay insulators and fittings are Allied Ceramics Pvt. Ltd., BHEL, Aditya Birla Insulators Ltd., Hindustan Chemicals Ltd. or equivalent reputed.

15.2.2 General Requirements of Disc Insulators fittings

The disc insulator fittings shall be designed, manufactured and tested in accordance with IS:
2486 or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable.

The disc insulator fittings shall be supplied with ball and socket couplings and twisted straps. The insulator fittings shall conform to the shape and dimension as per the governing standards

Disc insulator fittings like ball and socket, nuts and bolts shall be made of hot rolled steel and the twisted cross arm strap shall be made

of MS sheet metal. Cotter bolts and U-bolts shall be of galvanized steel. Cotter pins shall be of stainless steel.

All forgings and castings shall be of good finish and free from flaws and other defects. The edges on the outside of fittings, such as the ball socket and holes, shall be rounded. The nominal dimensions of the ball and socket, ball eye and twisted cross arm straps, shall be as per the governing standards.

All ferrous fittings and the parts other than those of stainless steel, shall be hot dip galvanized as per IS: 2629 or equivalent international standards.

15.2.3 General Requirements of Insulator Pins

The insulator pins specified herein shall be fabricated from hot rolled steel. The pin shall be a single piece obtained preferably by the process of forging. It shall not be made by jointing, welding, shrink fitting or any other processes from more than one piece of material. It shall be of good finish free from flaws and other defects. The finish of the collar shall be such that a sharp angle between the collar and the shank is avoided.

All ferrous pins, nuts and washers except those made of stainless steel shall be hot dip galvanized. The threads of nuts shall be cut after galvanizing and shall be well oiled and greased. The galvanizing shall conform to IS 2629-1985 or equivalent national or international standard.

All insulator pins shall be reasonably smooth on all surfaces and free of sharp projections.

15.3 Specific Requirements

15.3.1 Pin Insulator

The pin insulator shall be manufactured and tested in accordance with IS: 731 and IS:3188 or the latest version thereof or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable. The lead thread shall be compatible with the insulator pin specified in these documents.

The pin insulator shall have following ratings and features:

S.N.	Description	Unit	11 kV pin insulator
1	Highest system voltage	kV	12
2	Rated voltage	kV	11
3	Creepage distance (minimum)	mm	265
4	Wet power frequency withstand voltage	kV	35
5	Impulse withstand voltage	kV	75
6	Puncture power frequency voltage (minimum)	kV	105
7	Visible discharge voltage (Effective)	kV	9
8	Cantilever strength	kN	5
9	GI pin head		Small

15.3.2 Disc Insulator

The disc insulator shall be manufactured and tested in accordance with IS: 731 or latest version thereof or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable.

The disc insulator shall be ball and socket fitting type. The disc insulator shall have the following ratings and features:

S.N.	Description	Unit	Value
1	Highest system Voltage	kV	12
2	Rated Voltage	kV	11
3	Porcelain Diameter (minimum)	mm	255
4	Spacing	mm	145
5	Creepage Distance (minimum)	mm	320
6	Power Frequency Puncture withstand Voltage		1.3 x Actual dry flashover voltage
7	Wet Power Frequency Withstand Voltage	kV	35
8	Impulse Withstand Voltage	kV	75
9	Puncture Power Frequency Voltage (minimum)	kV	105
10	Visible Discharge Voltage	kV	9
11	Mechanical Strength	kN	45
12	Ball and Socket Size		16 mm B
13	Applicable Standard for Special Characteristics		IS: 3188

15.3.3 Stay Insulator

The stay insulator shall be manufactured and tested in accordance with IS: 5300 or latest version thereof or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable.
The stay insulator shall have the following ratings and features:

S.N.	Description	Unit	Stay Insulator for 11 kV and 400V Line
1	IS Designation		A
2	Length	mm	90
3	Diameter	Mm	65
4	Cable Hole Diameter	mm	16
5	Creepage Distance (minimum)	mm	41
6	Minimum failing load	kN	44
7	Power Frequency Withstand Voltage		
7.1	Dry	kV	18
7.2	Wet	kV	8

15.3.4 Insulator Pins

The insulator pins to be supplied shall conform to IS: 2486 or equivalent international standards and to the shape and dimensions shown in the drawings contained in this specification. The insulator pin shall be furnished with a spring steel split lock washer and nut assembled on the insulator pin. The ratings and features of the insulator pins shall be as follows:

S.N.	Description	Unit	Required ratings/features for 11 kV
1	Head type		Small S165P
2	Total length	mm	315
3	Stalk length	mm	165
4	Shank length	mm	150
5	Minimum failing load	kN	5
6	Applicable standard		IS: 2486 or equivalent international standard.

The insulator pins shall be compatible with the insulators specified above.

15.3.5 Disc Insulator Fittings

Disc insulator fittings like Ball and socket, nuts, bolts shall be made of hot rolled steel and the twisted cross arm strap shall be made of MS sheet metal. Cotter bolts and U-bolts shall be of galvanized steel. Cotter pins shall be of stainless steel.

All forgings and castings shall be of good finish and free from flaws and other defects. The edges on the outside of fittings, such as the ball socket and holes, shall be rounded. The nominal dimensions of the ball and socket, ball eye and twisted cross arm straps, are given in Drawings. The ultimate strength of the fittings shall not be less than 41 KN.

All ferrous fittings and the parts other than those of stainless steel, shall be hot dip galvanized as per IS: 2629-1985 or equal internationally recognized standards.

15.4 Marking

Each insulator shall be legibly and indelibly marked to show the following:

a) Name or trademark of manufacturer. b) Year of manufacture.
c) Minimum failing load in Newton d) Name of Employer

Markings on porcelain shall be printed and shall be applied before firing.

15.5 Tests

The insulators and fittings shall comply with the type tests and routine tests as per relevant governing standards.

15.6 Bid Documentation

The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of pin insulator and insulator pin and two (2) clear copies of all other relevant standards referenced therein.

The Bidder shall provide certified type test results of pin insulator and insulators pin as required by governing standards.

The Bidder shall provide standard catalogue and certified dimensional drawings of pin insulator and insulator pins.
A clause-by-clause commentary on specification, specifying compliance and deviations, if any.
All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

16 Stay Sets

16.1 Scope

This Specification covers the fabrication and supply of adjustable threaded, galvanized, ferrous, stay sets and nuts for use in overhead line construction.

16.2 Description

- The stay set shall consist of mild steel; galvanized stay rod; stay tightener or adjustable head complete with stay plate a thimble of suitable dimensions
- The stay rod shall be fabricated of mild steel of minimum tensile strength of 4200 kg/sq.cm. The other technical features and dimensions are given in table attached herewith.
- The stay tightener shall be made of mild steel of minimum ultimate tensile strength of 42,000kg/sq.cm. The thimbles shall be made of 1.219mm (18 SWG) GI sheet, and shall be suitable for terminating steel stay wire with a preformed grip.
- The stay plate shall be square type MS plate of dimensions as mentioned in Table herewith. The plate shall have a matching hole at the center to fit the end of the stay rod.

16.3 Fabrication

- The stay rod and nut shall be fabricated to the shape and dimensions shown in table attached herewith.
- The thread form at the threaded end of the rod, and that of the accompanying nut, shall be optional with the supplier. However, it shall be the responsibility of the Supplier to supply the stay rod with a thread form that shall sustain the rated loads specified in table without creep or stripping over the full life of the rod material at specified diameter.
- After fabrication, the stay rod and nut shall be hot-dip zinc galvanized in accordance with IS latest edition, or to an equivalent hot-dip galvanizing standard which produces equal or superior result.
- After galvanizing, the nut and rod threading shall be such that the nut may be run the full length of the thread without the use of tools.

16.4 Tests

- Apart from the tests indicated in the relevant referenced standard of steel, the stay set shall undergo following tests:
- -Visual Inspection.
- -Verification of dimensioned.
- –Tensile strength: The stay set assemblies shall withstand a minimum tensile load specified in Table 1.
- -Bend test: The stay rod shall be bend-tested over a mandrel of 19 mm millimeter through an angle of 90 degrees at any point in the un-threaded section of the rod without fracture of the steel. Temperature of the test shall be 68 degrees Fahrenheit (22.5 deg Celsius).

16.5 Bid Documentation

The Bidder shall furnish with the Bid a complete description of the stay sets proposed to be supplied including, but not limited to, steel classification of base metal, detailed drawings showing shape, dimensions, and threading certified type test results as required by paragraph 4 herein, the identity of the proposed manufacturer, and manufacturers catalogue number, plus catalogue cuts. The technical data furnished shall be bound separately from the Bid Document.

Table 1: Ratings and Features of Stay Sets

S.N.	Description	Unit	Stay Sets for 11 kV and 0.4 kV line
1	Length of stay rod	m	1.8
2	Diameter of stay rod	mm	16
3	Ultimate tensile strength of stay rod and turn-buckle	kg/cm^2	4200
4	Minimum breaking load	kg	6,433
5	Length of threaded portion	mm	300
6	Thimble shape		Suitable for 7/12 mm stay wire

7	Thimble section		18 SWG min.
8	Stay plate section	mmxmmxmm	300x300x6
9	Eyebolt length	mm	300
10	Eyebolt diameter	mm	16

17 Stay Wire

17.1 Scope

This Specification covers the fabrication and supply of zinc-coated steel wire for use in overhead power line as stay wire ropes for line supports (poles).

17.2 Description of Strands

The steel strand shall be fabricated in accordance with IS 2141 or an equivalent international standard. The steel wire strand shall have a left-hand lay. The steel wires shall have no joint throughout the whole length. Strands shall be uniform and shall have no defects such as cracks, dust encapsulation or crevices. Further details are given in Table herein.

17.3 Packing

The steel wire strand shall be furnished in reels holding minimum of 100 kg. Each reel shall have a weather-resistant tag securely attached showing the length, nominal diameter, number of individual wires, grade of the strand, and the class of zinc coating.

17.4 Bid Documentation

The Bidder shall furnish the following technical data with the Bid:

a) If the material to be offered is to be manufactured in accordance with the specified B.S. standard, full technical data for the material and the identification of the manufacturer.

b) If the material offered to be manufactured in accordance with an equivalent standard, two (2) clear copies of that standard shall be furnished in addition to the data required in

(a) above.

All technical data furnished shall be bound separately from the Bids.

17.5 Tests

The testing of individual wires and complete conductor shall be in accordance with the nominated standards.

Table: Ratings and Features of stay wire

S.N.	Description	Unit	Stay Wire for 11 kV and 0.4 kV Line
1	Steel Wire Size	(Nos of wire/SWG)	7/12
2	No. of Wire	Nos	7
3	Diameter of Each wire	mm	2.64
4	Strand Diameter (Overall)	mm	7.8
5	Overall Cross-Sectional Area	mm^2	44.19
6	Steel Quality		Gr.700
7	Minimum Tensile Strength of Steel	N/mm^2	700
8	Min. Breaking load of single wire	kN	3.71
9	Min. Breaking load of strand	kN	26
0	Approximate Weight	kg/km	300
1	Minimum weight of Wire in each reel	kg	100
2	Left hand Lay	Yes/No	Yes
3	Minimum Thickness of Zinc Coating	g/m^2	230

18 11 kV Air Break Switch

18.1 Scope

This specification provides for manufacture, testing at works and delivery for supply of 11 kV AB switches. The 11 kV AB switches shall conform to IS: 9920 (Part-I to IV)

18.2 AB Switches

The 11KV Air Break Switches are required with two poles in each phase. The AB Switches shall be supplied complete with phase coupling shaft, operating rod and operating handle. It shall be manually gang operated and vertically break and horizontal mounting type.

The AB Switch shall be designed for a normal current rating of 400 Amps and for continuous service at the system voltage specified as under: 11 KV AB Switch: 11KV + 10% continuous 50 C/s solidly grounded earthed neutral system. The length of break

in the air shall not be less than
400 mm for 11KV AB Switches.

The 11KV AB Switches are required with post insulators. The AB switches should be suitable for mounting on the structure. The mounting structure will be arranged by the purchaser separately. However, the AB Switches shall be supplied with base channel for mounting on the structure which will be provided by the purchaser. The phase to phase spacing shall be 750mm in case of 11KV AB Switches.

18.3 Post Insulators

The post insulators should conform to the latest applicable Indian standards IS: 2544. Creepage distance should be adequate for highly polluted outdoor atmosphere in open atmosphere. The porcelain used for manufacture of AB Switches should be homogeneous and free from flaws or imperfections that might affect the mechanical dielectric quality. They shall be thoroughly vitrified, tough and impervious to moisture. The glazing of the porcelain shall be of uniform brown in color, free from blisters, burns and other similar defects. Insulators of the same rating and type shall be interchangeable. The porcelain and metal parts shall be assembled in such a manner that any thermal expansion differential between the metal and porcelain parts through the range of temperature variation shall not loose the parts or create undue internal stresses which may affect the electrical or mechanical strength. Cap and base of the insulators shall be interchangeable with each other. The cap and base shall be properly cemented with insulators to give perfect grip. Excess cementing must be avoided.

The bidder shall in variably enclose with the offer, the type test certificate and other relevant technical guaranteed particulars of insulators offered by them. Please note that AB Switches without type test certificates will not be accepted.

Each 11kV Post Insulators should have technical particulars as detailed below:

S.N.	Particular	Value
1	Nominal system voltage KV (rms)	11
2	Highest system voltage KV (rms.)	12
3	Dry Power Frequency one minute withstand voltage (rms) in kV	35
4	Wet Power frequency one minute withstand voltage (rms) in kV	35
5	Power Frequency puncture KV (rms) voltage	1.3 times the actual dry flashover voltage
6	Impulse withstand voltage KV (Peak)	75
7	Visible discharge voltage KV (rms)	9
8	Creepage distance in mm (minimum)	320

The rated insulation level of the AB Switches shall not be lower than the values specified below:

S.N.	Standard declared Voltage	Rated voltage of the AB switch	Standard impulse withstand voltage (positive & negative polarity Isolating distance		One Minute power frequency withstand voltage KV (rms)	
			Across the Isolating distance	To earth & between poles	Across the Isolating distance	To earth & between poles
1	11KV	12kV	85kV	75kV	32kV	28 kV

18.4 Temperature Rise

The maximum temperature attained by any part of the equipment when in service at site under continuous full load conditions and exposed to the direct rays of Sun shall not exceed 45 degrees above ambient.

18.5 Main Contacts

AB Switches shall have heavy duty self-aligning type contacts made of hard drawn electrolytic copper/brass. The various parts should be accordingly finished to ensure inter changeability of similar components. The moving contacts of the switch shall be made from hard drawn electrolytic copper brass. This contact shall have dimensions as per drawing attached so as to withstand safely the highest short-circuit currents and over voltage that may be encountered during service. The surface of the contact shall be rounded smooth and silver-plated. In nut shell the male and female contact assemblies shall ensure.

a. Electro-dynamic withstands ability during short circuits without any risk of repulsion of contacts.

b. Thermal withstands ability during short circuits.

c. Constant contact pressure even when the lower parts of the insulator stacks are subjected to tensile stresses due to linear expansion

of connected bus bar of flexible conductors either because of temperature variations or strong winds. Wiping action during closing and opening.

d. Fault alignment assuring closing of the switch without minute adjustments

18.6 Connectors

The connectors shall be made of hard drawn electrolytic copper or brass suitable for DOG/RABBIT ACSR conductor for both 11KV AB Switches. The connector should be 4 -bolt type.

18.7 Operating Mechanism

All AB Switches shall have separate independent manual operation. They should be provided with ON/OFF indicators and padlocking arrangements for locking in both the end positions to avoid unintentional operation. The isolating distances should also be visible for the AB Switches.

The AB Switch will be supplied with following accessories:

S.N.	Item	Size of 11 kV AB Switch
1	Operating Rod (GI dia)	Length 5.50 meter, dia 25 mm
2	Phase coupling square rod (GI)	Length 1800 mm, Size 25x25 mm
3	Hot dip galvanized Operating handle (GI)	1 No.

The AB Switches shall be capable to resist any chance of opening out when in closed position. The operating mechanism should be of robust constructions, easy to operate by single person and to be located conveniently for local operation in the switchyard. The GI pipe shall conform to ISS: 1239-68 and the vertical down rod should be provided with adequate joint in the mid-section to avoid bending or buckling. Additional leverage should be provided to maintain mechanical force with minimum efforts. All iron parts should be hot dip galvanized. All brass parts should be silver Plated and all nuts and bolts should be hot dip galvanized.

18.8 Arcing Horns

It shall be simple and replaceable type. They should be capable of interrupting line charging current. They shall be of first make and after break type.

18.9 Bush

The design and construction of bush shall embody all the features required to withstand climatic conditions specified so as to ensure dependable and effective operations specified even after long periods of inaction of these Air Break Switches. They shall be made from highly polished bronze metal with adequate provision for periodic lubrication through nipples and vent.

18.10 Design, Materials And Workmanship

The successful tenderers shall assume full responsibility for co-ordination and adequate design. All materials used in the construction of the equipment shall be of the appropriate class, well finished and of approved design and material. All similar parts should be accurately finished and interchangeable.

Special attention shall be paid to tropical treatment to all the equipment, as it will be subjected during service to extremely severe exposure to atmospheric moisture and to long period of high ambient temperature. All current carrying parts shall be of non- ferrous metal or alloys and shall be designed to limit sharp points/edges and similar sharp faces. The firm should submit the following type test certificate along with the certified copy of the drawing. The type test should not be older than 5 years from the date of opening of tender.

1. Test to prove capability of rated peak short circuit current and the rated short time current.

The rated short time current should correspond to minimum of 10kA and the peak short circuit current should correspond to minimum of 25kA.

2. Lightning impulse voltage test with positive & negative polarity.
3. Power Frequency voltage dry test and wet test.
4. Temperature rise test.
5. Mill volt drop tests.

18.11 Dimension of 11 kV AB Switches in (Max.) Tolerance 5%

S.N.	Particular	11KV AB Switch
1	MS Channel	450x75x40
2	Creepage distance of Post Insulator	320mm (Min)

3	Highest of Port shell	254 mm
4	Fixed contact assembly	
	i) Base	165x36x8
	ii) Contact	70x30x6
	iii) GI coupling	110X44
5	Spring	6nos
6	Moving contract assembly	
a	Base Assembly	135x25x8
b	Moving	180x25x9
c	Bush	Bronze Metal
d	Thickness of Grooves	7

18.12 Terminal Connectors

The bidder should provide AB Switches with terminal connectors, set of insulators, mechanical inter works and arcing horns sets. The base channel for the mounting of AB Switches shall also be included in the scope of AB Switches. The operating mechanisms together with down pipe operating handle etc. are also included in the scope of supply.

18.13 Routine Test Certificate

The Routine test certificate should invariably be submitted in duplicate of each lot offered for inspection as per IS: 9920 (part-I to IV). The offers received without Routine test certificate shall not be entertained.

18.14 Acceptance Test

At the time of inspection following test shall be carried out:

a. Physical verification and measurement of dimension.

b. Power frequency high voltage test.

c. Temperature rise test.

d. Mechanical endurance test / operation test.

e. Milli volt drop test.

f. Galvanising test

18.15 Name Plate

The name plate in the following design shall be fixed on each AB Switch.

a. Name of supplier:

b. Name of purchaser:

c. Rating:

d. Serial number of units:

The size of name plate shall be 2" x 1" for 11 KV AB Switch.

19 LT Power Cable (PVC)

19.1 Scope

This Specification covers the design, manufacture, factory test and supply of 1.1 kV grade PVC insulated multicore power cables. The cables will be used for the purpose of 400V use of Nepal Electricity Authority.

19.2 Rated Voltage

The rated voltage of the cables shall be 1100V.

19.3 Service Condition

a)	Ambient temperature	-5 to 55 deg. C
b)	Annual average ambient temperature	30 deg. C
c)	Maximum relative humidity	99%
d)	Environmental condition	Humid Tropical climate
e)	Operational altitude	Up to 1000m above msl
f)	Isokeraunic (Thunder Day) level	90 days

g)	Solar Radiation	1.6kW/m2
h)	Wind Zone	Zone 4

19.4 Applicable Standards

The equipment and components supplied shall be in accordance with the latest editions of the standards specified below and amendments thereof or any international equivalent standards and the NEA Specifications specified hereafter.

a)	IS 1554	Specification for PVC Insulated heavy duty Electric cables for working voltages upto & including 1100 V
b)	IS 8130	Specification for conductors for insulated electric cables and flexible cords

The Bidder may propose alternative standards, provided it is demonstrated that they give a degree of quality and performance equivalent to or better than the referenced standards. The purchaser shall adjudge whether to accept or reject any standards.

The Bidder shall furnish a copy of the alternative standard proposed along with his bid. If the alternative standard is in a language other than English, an English translation shall be submitted with the standard. In case of conflict the order of the precedence shall be (1) IEC standards, (2) ISO standards, (3) European or British Standards, (4) Indian Standards, (5) Other alternative standards.

This list is not to be considered exhaustive and reference to a particular standard or recommendation in this specification does not relieve the Contractor or the necessity of providing the goods complying with other relevant standards or recommendation.

19.5 Technical Parameters

19.5.1 Minimum Technical Requirements

S.N.	Description	Unit	Requirements
1	Rated Voltage	kV	
2	Maximum System Voltage	kV	
3	Rated Voltage between two conductors	kV	
4	Power Frequency withstand voltage	kV	
5	Number of Cores		4
6	Phase Conductor		3
7	Insulation Material		PVC
8	Conductor		de Al.
9	Minimum Number of Strand		
0	Nominal Thickness of Insulation		
1	Minimum Thickness of inner sheath		
2	Type and dimensions of armor		
3	Minimum thickness of outer sheath		

14	Conductor Temperature Rise during Normal Operation	deg. C	70
15	Conductor Temperature Rise during Short Circuit	deg. C	160
16	Direction of Lay		Right Hand
17	Standard Length of Cable Per drum	m	Min. 500

19.5.2 Requirements of size

The required size of PVC insulated, aluminum Conductor, armored cable shall be:
4x400 mm^2, 4x300 and 4x150mm^2

19.6 Basic Features

19.6.1 Design

The power cable shall conform in all respects to highest standards of engineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of offer and the Purchaser shall have the power to reject any work or material, which, in his judgment is not in full accordance therewith.

19.6.2 Conductors

The conductor shall be of multi-strand round aluminum of compacted circular cross-section conforming to IEC or equivalent international standards. The conductor shall be clean and reasonably uniform in size and shape and its surface shall be free from sharp edges.

19.6.3 Insulation

The conductor shall be provided with PVC insulation applied by extrusion. Type of insulation shall be A for general purpose PVC.

19.6.4 Laying up of Cores

In twin, three & multi core cables, the cores shall be laid up together with a suitable lay, the outermost layer shall have right hand lay and the successive layer shall be laid with opposite lay.

19.6.5 Inner Sheath

The laid up cores shall be provided with Inner Sheath applied by extrusion. It shall be ensured that the shape of Cable is as circular as possible. Inner sheath shall be so applied that it fits closely on the laid up cores and it shall be possible to remove it without damaging the insulation.

19.6.6 Armour

The armour wires/strips shall be applied as closely as practicable. A binder tape may be provided on the armour.

19.6.7 Outer Sheath

The outer sheath shall be applied by extrusion over the armouring. The colour of outer sheath is black unless otherwise specified. Thickness of outer sheath should be as per IS: 1554.

19.7 Cable Identification and Marking

The following shall be embossed on the outer sheath of the cable throughout the length of cable at 1.0 meter spacing. The embossing should be very clear and easily visible to naked eye. The height of the printed lettering shall be not less than 20% of the overall diameter of the conductor. Sequential length shall be marked on the outer sheath of the cable throughout the length by Printing in each meter length interval.

- Applicable Standards
- Name/Identification of the manufacturer,
- Name of the Purchaser 'Nepal Electricity Authority'
- Voltage Grade of Cable
- Type of Insulation, material of conductor
- Number of Cores and nominal cross-sectional area of conductor
- Cable Code
- Year and Month of Manufacture

Each phase of the core shall be identified with the color Red, Yellow, Blue and Black on the inner sheath.

19.8 Packaging

All conductors shall be furnished on non-returnable steel drums capable of withstanding all normal transportation and handling. Protective external lagging of sufficient thickness shall be provided and fitted closely on the drums. Binder consisting of steel straps shall be provided over the external laggings. The drums shall be new and sufficiently sturdy in construction to withstand ocean shipping, road transport, several loading and unloading, storage in tropics, hauling and field erection of conductor without distortion or disintegration.

Each reel of the conductors furnished shall contain only one (1) length of conductor. The minimum length of each drum shall be minimum of 500m. All drums shall be legibly marked in paint with the following information:

(i) Manufacturer's Name and Trademark (if any)
(ii) Drum Number or identification number
(iii) Type of conductor
(iv) Size of conductor
(v) Voltage Grade
(vi) Length in meters
(vii) Gross Weight
(viii) Net weight of conductor
(ix) Direction of rolling

19.9 Inspection And Testing

19.9.1 Acceptance Test

The successful Bidder shall make necessary arrangements for pre-shipment inspection and tests by the nominated NEA Inspectors to carry out in his presence the necessary Sample/Acceptance tests conforming to the relevant governing standards on the completed cables offered.

19.9.2 Routine Test

The Routine Tests shall be carried out on the completed cables at the manufacturer's plant in accordance with the governing standards. The test reports shall be made available for the observation of the NEA Inspector at the time of inspection.

19.10 Bid Documentation

The following shall be furnished with the offer:

(a) Complete description, catalogue, drawings showing general construction and size of the cables including dimensional drawing of cable drum for each type of cable.
(b) Completed Schedule of Guaranteed Technical Particulars
(c) A copy of the Manufacturer's ISO 9001 certificate conforming to design and manufacture
(d) Type Test Certificates: The Type Test Certificates shall be from an Accredited Independent Testing Authority acceptable to the Purchaser.
(e) Copy of the Governing Standards
(f) Technical Literature in English Language on installation, operation and maintenance with necessary diagrams and drawings.

19.10.1 Type Test Certificates

The material offered shall be fully type tested by an independent accredited testing laboratory acceptable to the Employer. The bidder shall submit the type test reports along with the offer. The tests shall comply with relevant Standards. The Employer also reserves the right to have tests carried out by an independent agency, whenever there is a dispute regarding the quality of supply.

20 OTHER ELECTRICAL INSTALLATIONS

20.1 Water Level Indicator

20.1.1 Float less Type Level Switch In Water Tanks

The Contractor shall supply and install float less type switch probes in all water tanks as indicated below and shown on the drawings.

- High level alarm (over-flow);
- Low level alarm;
- Low level cut-out for raw water pumps;
- Earthing probe.

Each probe shall be of the correct length for the particular application and tank location. Electrodes shall be of polished stainless steel 20 mm OD. Electrode holders shall be weatherproof in all respect. The earthing probes shall be connected and wired to the building earth systems of the building.

Each set of electrodes shall be installed inside a 230 mm diameter PVC pipe acting as a wave barrier. The level switch set shall operate with a stepped down voltage at 24V maximum. Stepped down transformers shall be provided for each set of control probes and shall be installed inside centralized control cubicles inside pump room. Mechanical steel stuffing boxes shall be used.

20.1.2 Control of Duty / Standby Pumps

Operation of the duty and standby pumps shall be carried out by the following methods:

- Automatically by means of LEVEL sensor (i.e. magnetic switches);
- Manually by means of a local start/stop push buttons on pump local motor control panel and emergency stop switch.

Automatic controls shall be operated by electronic, float less type level switches.

20.1.3 Pump Indicator

Automatic controls shall be operated by electronic, float less type level switches. The following audible and visible indication shall be provided at the pump local control panels as applicable:

- Red "overflow level" indicator with buzzer for the associated water tanks;
- Amber "extra high water level" indicator for the associated water tank;
- Amber "high water level" indicator;
- Amber "low water level" indicator;
- Red "pump trip" indicator for each pump;
- Green "pump on" indicator for each pump;
- "Pump electrical supply healthy" indicator for each pump;
- Amber "remote/local" status indicator.

20.2 LT Voltage Stabilizer

Voltage stabilizer shall correct the voltage automatically as per required specification and variation limit without any distortion in the output voltage waveform.

Voltage stabilizer up to 100 kVA shall be air cooled whereas stabilizer above 100 kVA shall be oil cooled. Stabilizer shall consist of following units:

- Regulator unit
- Buck boost unit

- Automatic control unit
- Enclosure

Automatic regulator unit shall be oil cooled above 100 kVA, naturally cooled on load, stepless rolling contact type. Fittings and accessories for regulator shall be as follows:

- Radiator cooling system (where Oil cooled
- Lifting lugs
- Earthing terminals
- Diagram and rating plate.
- Drain valve and oil filling hole when oil
- Silica gel breather when oil cooled
- Thermometer pockets

20.2.1 Core

The magnetic circuit shall be built of transformer grade cold rolled grain oriented low loss steel stampings having high permeability and conforming to adopted standards. Stamping shall be insulated from each other with material having high inter-lamination insulation resistance and rust inhibiting property and also capable of withstanding pressure, mechanical vibration and action of heat and oil, thus reducing the possibility of sludge formation to a minimum.

The framework clamping arrangement and general structure of the cores shall be of robust construction and shall be capable of with sustained any shock to which they may be subject during transport, installation and service. The assembled core shall be securely clamped on the limbs and the yoke, to build up a rigid structure. The clamping pressure shall be uniform the whole of the core and so adjusted as to minimize noise and vibration in the core when the transformer is in service. The framework and the core bolts shall be efficiently insulated from the core so as to reduce the circulating currents to a minimum.

The core clamping frame shall be provided with lifting eyes for the purpose of tanking and untanking the core with winding mounted thereon and shall have ample strength to take the full weight of the core and winding assembly.

20.2.2 Winding

The coils used for winding shall be circular in shape made of paper insulated continuous and smooth tinned or enameled electrolytic copper conductors of high conductivity.

Liberal ducts shall be provided to prevent any hot spot temperature in the winging that may adversely affect the life of the equipment. Adequate supports wedges and spacers of hard insulating material shall be so fitted that they will neither move nor permit relative movement of any part of winding during transit of normal service or under terminal short- circuit, nor damage the winding insulation in any way. All leads and connections shall be robust, adequately insulated, protected and clamped. The winding assembly shall be dried in vacuum with tested insulating oil of approved standard. The windings shall be subjected to a through shrinking and seasoning process so that no further shrinking of windings occur during service at site. However, adjustable devices shall be provided for taking up any possible shrinkage of coils in service. The assembly shall be held in position under adequate axial compression to withstand the axial thrust likely to occur under terminal short-circuit.

20.2.3 Auto Control Unit

Auto control unit shall be mounted along with the regulator tank and shall consists of

- PCB relay/ electronic relay
- Step syn. Geared motor
- Auto/ manual switch

Set of push buttons

- Lower raise switch/ push buttons
- Indicating lights
- Input & output voltmeters
- Ammeter with selector switch

20.2.4 Technical Parameters

	KVA Rating	As per schedule of quantities
	Rated Voltage	415 VAC
	Input Volts	330 V to 460 V AC
	Output Volts	415 V ± 1%
	Rated Frequency	50 Hz.
	No. of phases for bypass system	3 Phase 4 wires system
	Load	Unbalanced
	Type of cooling	Air cooled upto 100 kVA and ONAN above 100KVA
	Maximum temperature rise	
	of oil by thermometer	44 Deg C
	of winding by resistance	55 Deg C

	of hot spot temperature indicator	65 Deg C
	Limit of hot spot temperature for which the transformer is designed to be	110 Deg C
	Service	Indoor/ Outdoor
	Automatic control gear	Consisting of one electronic relay, reversing geared motor under limit switches in order to avoid over - running highest and lowest positions, chain drive, control devices and all electrical connections. Alternatively, variac consisting of carbon brushes can be provided for Automatic regulation.
	Efficiency	Better than 94%
	Distortion at output	Not exceed 5%
	Rate of correction	Not more than 8 volts per second
	Schedule of Equipment	415 V Automatic voltage stabilizer as per technical requirements shall comprise of:
		• Rolling contact type on load voltage regulator/ variac carbon brush type. • Buck-Boost transformer. • Automatic control gear.
	Tanks and Fittings	The equipment shall be housed in a sheet steel tank fitted with radiators and mounted on bidirectional/ Unidirectional rollers. The following shall be with the equipment
		• Lifting lugs • Earthing terminals. • Rating plate. • Drain valves. • Oil filling hole. • Thermometer pocket. • Oil Level Gauge. • Silica gel breather • Filter Valve.

Note: 0-500 digital voltmeter with selector switch shall be provided for incoming and outgoing side of stabilizer.

21 ALUMINIUM DOORS, WINDOWS AND VENTILATORS

21.1 Material and sections

The aluminum work shall be carried out as per detailed specifications and conditions for the work.

All aluminum work shall be free from defects impairing, strength durability appearance and shall be of the best commercial quality for purposes specified made with structural properties to withstand safely strains / stresses to which they shall be normally subjected. All sections shall be of approved extruded tubular anodized aluminum sections from the approved manufacturers, as per architectural drawings and as per relevant IS Specifications or equivalent. Any equivalent extrusion will be got approved from the Engineer.

The contractor shall provide all items, articles, materials, operations, mentioned or scheduled, on the drawings, including all labour, materials fixing devices, equipment and incidentals necessary as required for their completion.

The contractor shall submit shop drawings and samples of each type of doors, windows, railing and other items of aluminum work to the Project Manager for approval. The shop drawings shall show full size sections of doors and windows etc. thickness of aluminium sections, details of construction hardware as well as connections of doors, windows and other aluminium work to adjacent work. Shop drawings shall be based on actual dimensions available on site. The variation in openings and shop drawings shall not be more than + 1.5 mm.

Aluminium doors and shutters shall be manufactured by an approved manufacturer and shall be of sections, sizes, combination and details shown on the architectural drawings. The frame member shall be of one piece and glazing bars shall be threaded or interlocked as approved by the Engineer.

Glazing for doors and windows shall be of specified thickness and approved quality and shall conform to specification of glazing. Fixing of glazing shall be done with aluminum 'Snap-On' beading as per detailed drawings and instructions. Necessary rubber gaskets of approved make shall be provided.

Upon delivery of doors and windows to site, they shall be handled with care, stored on edge on level bearers and supported evenly.

The manufacturer, immediately prior to the commencement of glazing, shall adjust and set all doors and accept responsibility for the satisfactory working of the opening frames. All doors shall open or slide as indicated in drawings and schedules.

The contractor shall be responsible for the doors & window shutters being set straight, plumb and level and for their satisfactory operation after the fixing its complete.

Fittings shall retain the casements rigidly in both open & closed positions. All fittings shall be got approved from the Project Manager. The fittings and aluminium work shall be complete and shall be wrapped and protected until the complete aluminum work is washed with mild solution of non-alkali soap and water and left in complete finished conditions.

21.2 Fabrication

All fabrications shall be got done with workmen who are skilled in the trade and fully equipped to carry out phases of fabrication in accordance with the best accepted practice and as shown on the drawing. All work shall be shop fabricated and finished and then brought on site for installations. The details of the equipment possessed by the contractor shall be provided, which should conclusively prove that all facilities required to execute the work as per specifications, are available.

All aluminium works shall be deemed to include in various items, complete work including fittings, fixtures, stays, locks, handles, special hinges, floor springs, neoprene/rubber linings, gaskets, bushes, rollers, sealant etc. as directed and approved by the Engineer.

The rates quoted for aluminium works shall be inclusive of all fixtures/fittings also anodized as per main member like handles, stays, sliding gears, tower bolts, cleats, hinges etc., and their weight shall not be considered in the finished product. The payment shall be given only for the members used measured centre to centre of the sections.

All windows, glazing etc shall be made completely water proof to the satisfaction of the Engineer and necessary Silicon / Polysuphide sealants etc. shall be provided. No payment shall be made for providing necessary Silicon / Polysuphide sealant etc. to items under this sub-head.

In the items of aluminum glazing in doors and windows etc. work shall include the provision of mullions, coupling bars as required to join various units of glazing in windows and doors etc. to form larger glazing in doors or door-cum-windows as required and as per drawings.

Taking into consideration varying profiles of aluminum sections being extruded by approved manufacturers and their availability in time as required the contractor shall prepare detailed shop drawings using suitable sections based on architectural design/drawings and adequate to meet the performance and other specifications parameters laid down for the work.

The section profile weight and suitability to meet the requirement/specifications as proposed by the manufacturer and detailed shop drawings shall be subject to approval of the Engineer who should be satisfied that if fully meets the design. In case it is proposed to provide substitute for any aluminium sections, which is specified for any aluminium glazing, this would be subjected to approval of the Engineer who is to be satisfied regarding the suitability of the alternative section and it having no financial variation.

Aluminium sections used for doors and openable windows including sliding windows, fixed glazing, curtain walls, glazing frame work, extruded wall paneling of certain hand rails etc. shall be suitable for use to meet architectural designs of relevant works and shall be subject to approval of Project Manager who would require to be satisfied about their being appropriate on technical, functional and aesthetic considerations.

All joints shall be accurately fabricated and be hairline in appearance. The finished surface shall be free from visible defects.

All aluminium shall be anodized/powder coated as specified. Anodizing powder coating shall be of approved colour and conform to IS 1868-1968 and shall be of AC 15 grade with minimum thickness of 15 microns, when measured as per IS: 6012- 1970, and density shall be at least 32 least 32 mg/sq cm. All sections are to be matt anodized/powder coated in colour as per sample approved by the Architects.

The anodized coating shall be properly sealed by steam or boiling in de-ionised water as per IS 1868-1968 and of IS 6057. Sealing quality shall be tested in accordance with IS: 50949 or similar standards.

Colour anodizing would be done only by GEC approved colour process.

Colour fastners shall be as per 1868-1968 grading-B.

No visual variation in shade shall be permitted. The fabricator shall clearly indicate the shade variation tolerance as measured by standard equipment.

Each glazing shall be tailor made as per opening at site. No cutting and making good of concrete surface shall be permitted.

Doors, windows or fixed glazing frames shall be fixed to concrete or brick work with approved metal fasteners. Method of fixing shall be approved by the Project Manager before mass fabrication.

Samples of typical glazing shall be made and got approved from the Project Manager before fabrication.

All hardware used shall conform to the relevant IS specifications. Design, quality, type number and fixing of the hardware shall be got approved from the Engineer.

A thick layer of the clear transparent lacquer based on Methacrylates or cellulose Butyrate shall be applied on the anodized glazing before they are brought on the site. The lacquer shall be removed on completion of erection.

All screws shall be stainless steel screws threads of machine screws used shall conform to IS: 4218 or otherwise approved by the Project Manager. Gaskets for retaining glass shall be of heavy extruded neoprene.

The corners of the frame being fabricated to a true right angle. Both the fixed and opening frames shall be fabricated out of sections which have been cut to length mitered and mechanically jointed. All members shall be accurately machine milled and fitted to form headline joints. The joining accessories such as cleats, brackets, etc shall be such material as not to cause any bimetallic corrosive action.

All the frame members shall be in plumb and level and jointed in such a way that maximum expansion and contraction will not cause distortion or leakage. The contractor shall be responsible for their satisfactory performance/operation after fixing is complete.

All aluminium work shall be washed with a suitable thinner and left in a finished condition in approved uniform appearance and free from all marks and blemishes. The glass panes shall be thoroughly washed and cleaned before the work is handed over.

The requirements provisions for all anodized aluminium work shall conform to requirements specifications and parameters given in this tender, drawings, instructions and shall at least provide for or conform to IS codes relating to materials workmanship, fabrication, finishing, erection, installation etc. In this connection relevant IS codes including Nos. 1868-1973, 6012-1970, 1285-1975,7400-1974 as deemed applicable by the Project Manager shall be considered.

Suitable sections with lighter/heavier weights as may be required and approved by architect shall be provided by the contractor. No variation in quoted rates shall be made for change in section or weights given as a guide.

21.3 Glass

21.3.1 Clear Glass

The glass shall be float glass of Modi Float or equivalent. Glass used in glazing, openable and fixed doors, windows etc shall provide clear, completely undistorted vision and reflection. It shall be free from any bubbles, waves or blemishes. Glass used shall be of required size as per drawings. No extra payment shall be made for use of glasses of any size having an area up to 32 sq.ft (in one piece) for 5mm thick glass.

21.3.2 Tinted Glass

Tinted glass shall have same quality and specifications as indicated above for clear glass. It shall however be transparent glass to Bronze/Blue/Green/Smoke gray shade as required and would be expected to absorb to absorb a greater proportion of sun's radiant heat and reduce transmission than clear glass.

21.4 Drawings/ Documents

Prior to fabrication, Contractor shall submit 1 copies of shop drawing indicating details of all members, sections and hardware for Engineer's approval. All certificates against tests for anodising and other physical properties of material shall be produced to the Engineer for acceptance.

21.5 Notes

1. All the fittings shall be anodised aluminium (finish compatible with original frame) type unless otherwise specified.
2. Single leaf door shutters and ventilator shutters of more than 0.80 m width shall be provided with one extra hinge.
3. Where height of window shutter and door leaf exceeds 1.2 m and 2.15 m respectively one extra hinge shall be provided for every additional height of 0.5 m or part thereof and length of top bolt shall be increased by the height of the shutter/leaf above 2.15 m from floor level.

4. In double leaf shutters of doors, two tower bolts shall be fixed to the first shutter at top and bottom and one to the closing shutter at the top.
5. All hardware shall conform to the applicable Indian Standards.

21.6 Measurement for Payment

Generally, the items shall be measured in SI. The method of measurement shall be based on the following:

No payment shall be released till the thickness of the anodic coating is found to be minimum 15 microns and sealing quality appropriate everywhere. The testing shall be done by Eddy Current method as per IS: 6012-1970, for thickness and relevant DIN for sealing. Likewise, colour variation measurements shall also be carried out. If any material is found sub-standard this shall be totally rejected. Requisite tests shall be done at the site. 100% checking, as instructed by the Engineer may be resorted to.

Unless stated otherwise in the BOQ, payment for windows and doors shall be made by frame area for each type with same specific section. If items scheduled call for measurement by area, architraves linings, sills etc. shall not be measured separately but shall be considered as being included in the area of the opening closed by the window, door, shuttering or any other specified closure.

Unit area openings shall be considered only if standard weights of specified aluminium section shall be within the permissible limit of variation of the section. The permissible limit of variation for aluminum works shall be + 5% over the standard weight.

All costs for hardware and fittings shall be included in the unit rate of the relevant bill items.

21.7 FRENCH SPIRIT POLISHING

Pure shellac conforming to IS 16 varying from pale orange to lemon yellow colour, free from resin or dirt shall be dissolved in methylated spirit at the rate of 140 gm of shellac to 1 litre of spirit. Suitable pigment shall be added to get the required shade. Readymade polish conforming to IS 348 can also be used.

21.8 Polishing New Surface

21.8.1 Preparation of Surface

The surface shall be cleaned. All unevenness shall be rubbed down smooth with sand paper and well dusted. Knots if visible shall be covered with a preparation of red lead and glue size laid on while hot. Holes and indentations on the surface shall be stopped with glazier's putty. The surface shall then be given a coat of wood filler made by mixing whiting (ground chalk) in methylated spirit at the rate of 1.5 Kg of whiting per litre of spirit. The surface shall again be rubbed down perfectly smooth with glass paper and wiped clean.

21.8.2 Application

The number of coats of polish to be applied shall be as described in the item. A pad of woolen cloth covered by a fine cloth shall be used to apply the polish. The pad shall be moistened with the polish and rubbed hard on the wood, in a series of overlapping circles applying the mixture sparingly but uniformly over the entire area to give an even level surface. A trace of linseed oil on the face of the pad facilitates this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cotton cloth slightly damped with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

21.8.3 Measurements

The length and breadth shall be measured correct to a cm. The area shall be calculated in sqm (correct to two places of decimal), except otherwise stated.

Small articles not exceeding 0.1 sqm of painted surfaces where not in conjunction with similar painted work shall be enumerated.

Area of painting on hand rail shall be calculated by multiplying single running meter to gross height of hand rail (no deduction shall be made to any kind of post.

22 MISCELLANEOUS

Unless specifically otherwise mentioned in case of repair and maintenance work, all the applicable codes & standards published by the Indian standard Institution & all other standard which may be published by them before the date of receipt of Bids, shall govern in all respects of dosing workmanship quality & propitious of materials & methods of testing, method of measurements etc. Wherever any reference to any Indian Standard specifications occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued to or revisions thereof, if any, up to the date of receipt of Bids.

In case there is no Indian Code of Standard specification for the particular work (for repair and Maintenance), such work shall be carried out in accordance with the instructions in all respects, & requirements of the Engineer. Wherever any reference to any Indian standard specification occurs in the documents relating to this contract, the same shall be inclusive of all amendment issued there to or revisions thereof, if any, up to the date of receipt of Bids.

22.1 Surface Discharge Plate

Unless otherwise mentioned in Schedule of Requirements, surface discharge plates are to be made of at least 16 – 25 mm thick M.S. plate having sufficient strength to support entire weight of the pump set and the hydraulic pressure on it. The surface plate consists of a pipe bend of size sufficient to discharge the rated flow of water. The discharge bend has welded or casted flanges in both ends. The size of the surface discharge depends on the outer diameter of the tube-well and the shape may be either rounded or rectangular.

22.2 Turfing

Turfs shall be interpreted as grass that is seasonally dormant during cold or dry seasons and is capable of renewing growth after the dormant period. The turfs shall be brought by the Contractor from areas where the top soil is reasonably fertile and contain a high percentage of loamy topsoil. Turfs shall be cut or stripped from living, thickly matted turf relatively free from weeds or other undesirable foreign plants, large stones, roots or other materials which might be detrimental to the development of the turf or to future maintenance. Turf including the soil containing the roots shall be planted in a neat and systematic way.

The top soil on which Turfing is to be done shall be free of admixture of sub-soil, stone, gravel, clay lumps, plants or their roots, sticks or other extraneous material exceeding 50 mm. diameter. It shall be clay loam. The top soil shall be approved by the Engineer before being placed.

The strips of turf shall be in uniform widths not less than 230mm and length not more than 460 mm. Such lengths should be readily lifted without breaking, tearing or loss of soil. The turfs shall be transplanted within 24 hours from the time it is stripped unless storing is necessary. If stored, turfs shall be stacked, kept moist and protected from exposure to sun.

Turfs shall be cut and moved only when the soil mixture conditions are such that favorable results can be expected. Turfing shall be performed only during the seasons when satisfactory results can be expected. Turfing may be transplanted during drought free periods with the approval of the Engineer provided the turf bed is watered to moisten the soil to a depth of at least 100 mm immediately prior to laying the turf.

The turf shall be carefully placed by hand, edge to edge with staggered joints, in rows at right angle to the slopes, commencing at the base of the area to be turfed and working upward. The turf shall immediately be pressed firmly into contact with bed by tamping to provide a true and even surface. Screened soil of good quality shall be used to fill all cracks between turfs. The quality of fill soil shall not cause smothering of the grass.

The Contractor shall provide general care for the turfed area, protect against traffic and shall continue care until final inspection and acceptance of the work. If the surface become gullied or otherwise damaged during the period the affected area shall be repaved to established grade and condition as directed.

It shall be measured in square meter on the ground surface including 150 mm. thick materials and labour.

22.3 Sand Filling

Sand filling in floor or other place as mentioned or directed by engineer shall be in specified thickness as per drawing or BOQ. The sand layer shall be 75mm layers after sprinkling with water and ramming to full consolidation. Sand filling shall be done with sand confirming Clause 2.3.3.4 in layers not exceeding 75mm. Each layer shall be well watered and rammed to full consolidation with iron rammers. Other procedures shall be for earth filling described in Clause 2.2.

Rates for sand filling shall cover the cost of the provision of suitable material for any lead, placing in layers, watering and compacting as specified will measured as the volume between ground levels before and after the filling and the rate will include forming embankments, terraces, etc.

22.4 Brick bat filling

The brickbats shall be from brick of first class well burnt or slightly over burnt bricks. The bricks bats shall be laid in flat and sand shall be spread over the bricks bats and compacted to the required depth after sprinkling water. Unless and otherwise mentioned in drawing, each layer of the brick bat shall be so laid that the final compacted depth after sand blinding and watering shall not exceed 150mm. The compaction shall be carried out either manually or mechanically to the satisfaction of the Engineer. The sand and water used in brick bat filling works shall confirm Clause 2.3.3.4 and 2.3.3.3.

Rate for Brick bat filling shall cover the cost of the provision of suitable material, placing in layers, watering and compacting as specified will measured as the volume between ground levels before and after the filling and the rate will include forming embankments, terraces, etc.

22.5 Transportation of Surplus Materials

Excavated materials surplus after backfilling shall be disposed off immediately after the completion of backfilling works at a location as directed by the engineer as per Clause 2.2.8.

22.6 Geotextile

Geotextile shall be made of polyethylene or polyster or similar fibres, either woven or nonwoven. Unless otherwise shown on the drawing, the geotextile shall:

- sustain a load of not less than 10kN/m at break and have minimum failure strain of 10 percent when determined in accordance with BS:6906 or shall have a grab tensile strength more than 0.4 kN/m and grab elongation corresponding to this limit in accordance with ASTM D4632.
- have apparent opening size as shown on the Drawing. If no size is shown on the Drawing, then the

apparent size shall be 0.1 mm.

- allow water to flow through it at right angles to its principal plane, in either direction at a rate of not less than 50 litres/sq.m./sec. under a constant head of 100 mm, determined in accordance with BS:6906 (part 3) or ATSM D 4491, unless otherwise shown on the Drawing. The flow rate determined in the test shall be corrected to that applicable to a temperature of 150C using data on variation in viscosity of water with temperature.
- have a minimum puncture resistance of 200N when determined in accordance with ASTM D 4833.
- have a minimum tear resistance of 350 N determined in accordance with ASTM D 4533.

22.7 Gas Vents

When specified, gas vent flaps or vent pipes shall be installed in accordance with the drawings or as instructed by the Engineer to provide adequate venting for the liner system. The venting pipe should be fitted with required fittings and cowling.

22.8 Electro-fusion Welding Machine

Type - Automatic with Bar Code Reader, Automatic Operations & Data Logging:

S. No.	Parameters Description	Specification Range
Input		
1	Operating Temperature	-10 to + 50 deg C (Ref. Manual)
2	Mains Voltage	230V (-15% to + 10%)
3	Supply Current	15 Amp AC (Peak -26 Amp)
4	Frequency	50±10 Hzs.
5	Supply Power	Min. - 5KW
Output		
1	Controlled Welding Voltage	8 - 48 V AC
2	Welding Power	8 to 3120 VA
3	Welding Current	1 to 65 Amp AC (100 Amp short term)
General Features		
1	Manual Operations	Should be Possible
2	Barcode Reader	Pen or Scanner
3	Automatic Temp Compensation	Must be achieved in Automatic mode
4	Environmental Protection Type	IP65
5	Electrical Protection	Class 1 Earthed
6	Overload protection	Thermal 16 A (for 230 V versions)
7	Length of connector cable - Output Cable	3 Meters

8	Length of mains cable- Input Cable	4 Meters
9	Connectors Diameter	4mm F
10	Adapters Diameter	4.7mm F / 4mm M
11	Ambient Thermometer - Precision	± 1° C
12	Standard	ISO 12176 - 2:2008
13	Data Logging - In & Out	USB Port - With 1GB Pen drive to download & Data memory - 2000 Welds
14	Cooling Time display	Activated
15	Maximum Welding time	3600 Seconds
16	Dimension (W/D/H/)	Not to exceed 30 Cm x 30 Cm x 40 Cm
17	Weight with cables	Not to exceed 20 Kg
18	Display	4 Line with Backlight & High contrast. It shall be possible to view on display, any kind of information regarding malfunctions that could occur before or during welding
19	Carrying Case	Metallic Box (Transport Case). Strong Aluminium case with SS fittings
20	Warranty	12 Months from the date of purchase
21	Service Centre & Calibration Services	Shall be available locally
	TPI certification	Should have any third party independent agency certification

22.9 Manual Scraper

1) Blade in hardened steel, with sharp scraping edge.

2) Blade must have interchangeable 4 scraping edges.

3) The blade must have been fixed on a plastic handle inclined at an angle of 450 with the plane of the blade.

4) The minimum width of the blade should be 50 mm.

5) Weight should not exceed 0.50 kg.

22.10 Pillar Type Saddle Clamp (Top Loading) – For Pipe Size 63 to 315 MM.

1) Manufactured from Zinc plated steel. Strong welded construction & Zinc plated steel to avoid bending, damage & rusting.

2) Suitable to work with tapping saddles (Tapping Tees), branch saddles.

3) Designed to hold saddles onto pipe with top load of 1000 to 1500 Newtons, before and during the Electro-fusion process.

4) Designed to hold saddles on 63 to 315mm diameter PE pipe.

5) The Pillar Clamps shall be supplied in two size range: 63-125mm and 63-250 mm.

6) Simple operation, Load cell with Calibrated long life spring shall be used. Encapsulated load cell to avoid malfunctioning of Spring due to mud, grit & muck. Lubrication inside the load cell to ensure smooth clamping & less

7) Load spring and indicator to show correct load has been applied.

8) The loading arm must slide easily up and down the pillar, allowing quick assembly of the joint.

9) The V block / foot of the clamp to allow the tool to swivel and negotiate the pipe orientation in pit / allowing access in a confined space.

10) The Size must be less than 60 cm x 20 cm x 10 cm

11) Weight must be less than 10kg.

12) Tool must be complied with the requirements of the National Grid Transco specification GIS/PL2-5: 2006. Specification for Polyethylene pipes and fittings for natural gas and suitable manufactured gas. Part 5: Electrofusion

22.11 Strap Type Saddle Clamp (Top Loading) -For Pipe Size 63 to 630 MM

1) Manufactured from Zinc plated steel. Strong welded construction & Zinc plated steel to avoid bending, damage & rusting.
2) Suitable to work with tapping saddles (Tapping Tees), branch saddles.
3) Designed to hold saddles on to pipe with flexi-strap with top load of 1000 to 1500 Newtons, before and during the Electro-fusion process.
4) Designed to hold saddles on 63 to 630mm diameter PE pipe with the flexi-strap locked with quick-fix / quick-release buckles.
5) Simple operation, Load cell with Calibrated long life spring shall be used. Encapsulated load cell to avoid malfunctioning of Spring due to mud, grit & muck. Lubrication inside the load cell to ensure smooth clamping & less wear / tear of rotating & rubbing surfaces during heavy load conditions of 1500 Newton.
6) Load spring and indicator to show correct load has been applied.
7) The stirrup at the top of the clamp to allow the tool to swivel and negotiate the pipe orientation in pit / allowing access in a confined space.
8) The Size must be less than 20 cm x 20 cm x 20 cm
9) Weight must be less than 3kg.
10) Tool must be comply with the requirements of the National Grid Transco specification GIS/PL2-5: 2006. Specification for Polyethylene pipes and fittings for natural gas and suitable manufactured gas. Part 5: Electrofusion ancillary tooling

22.12 Pipe Restraining, Alignment and Re-rounding Clamps

1) Shall be suitable for pipes of diameter d 63,60 ,75, 90,110,125,140 160 & 180 in one clamp, with interchangeable plastic insert sleeves for each size.
2) Shall be suitable for Straight, Elbow and Angular joints.
3) In one clamp pipe restraining, alignment and re-rounding features shall be available.
4) Design must be light weight (in aluminium material)
5) Design must be flexible for ease clamping of fittings.

22.13 Pipe Cutter – Wedge Type

1) Suitable for Cutting PE pipes of diameter d20 to 63 mm.
2) Manufactured from steel with Zinc plating or powder-coating. Strong construction to avoid bending, damage & rusting.
3) Sharp cutting edges in hardened steel.
4) Amplified leverage for reducing cutting efforts.
5) Positive locking for accidental release of pipe during cutting.

22.14 Apparatus and Equipment for Water Quality Laboratory

22.14.1 pH Meter

Analytical Method	Electrometric Method; APHA 4500-H+ B
Type	Bench top
Range	-2 to 16 PH : -200 to 1200C
Resolution	0.01 ppm, 0.10C
Accuracy	± 0.1PH ± 0.01 PH , ±0.2 mv, ,± 1mv , ± 0.20C
Calibration	Automatic up to 5 point calibration with 7 standard buffer solutions
Temperature Compensation	Manual or Automatic from -20.0 to 120.00C
Electrode	pH electrode: glass, interchangeable, min. 1 m cable (included); Temperature electrode: min. 1 m cable (included)
Operating environment	minimum 0 – 50 °C; RH 95%
Other features	USB interface Plastic moulded rust proof, water-proof body Data logging up to 200 records Plastic electrode holder Ready indicator GLP features

22.14.2 Lab Nephelometer (Turbid meter)

Principle of operation	Nephelometric
Analytical method	Compliance with ISO 7027 or USEPA Method 180.1 or APHA 2130 B
Range	0.0 to 9.99, 10.0 to 99.9, 100 to 4000 NTU
Range selection	Automatic
Resolution	0.01 on lowest range
Light source / Life	Tungsten filament lamp / greater than 1 00 000 readings
Accuracy	±2 % of reading plus 0.02 NTU
Calibration	Automatic 3-points calibration with memorized buffers; calibration solutions included
Repeatability	±1% of reading
Turbidity standards	< 0.1, 15, 100 and 2000 NTU
Operating environment	0 – 50 °C; RH 95%
Other features	USB PC interface minimum 10ml or 20 ml sample volume minimum 4 empty sample vials Log memory 200 records

22.14.3 Electrical Conductivity Meter

Analytical method	Laboratory Method; APHA 2510 B.
Range	to 29.99 µS /cm ,30.0 to 299.9 µS /cm, 300 to 2999 µS /cm 30 to 200 ms/cm up to 500.0 mS/cm
Resolution	0.01 µS/cm; 0.01 mS/cm
Accuracy	± 1% of reading ± (0.5 µS or 1 digit, which greater)
Electrode	conductivity probe with temperature sensor and min. 1 m cable (included)
Temperature	-5.0 ... +105.0 °C
Salinity	to 400.0% NaCl
Calibration	1 Point offset calibration (0.00 µS/cm in air):1 point slope calibration In EC standard 84 µS/cm
Operating environment	minimum 0 – 50 °C; RH 95%
Temperature Compensation	Automatic temperature compensation
Other features	Simultaneous display of temperature / 200 data memory Rechargeable battery that can last at least 6 hours

22.14.4 Handheld Pocket Residual Chlorine Analyser

Analytical Method	DPD Colorimetric, Method APHA 4500-Cl G
Range	0.01 – 5 ppm
Optics	Dual LED light source optical system with narrow band wavelength filters and photo detectors
Accuracy	Dual wavelength, 530 nm
Wavelength Tolerance	±2 nm
Data point memory	min. 1000
Filter bandwidth	10 nm
Operating environment	minimum 0 – 50 °C; RH 95%
Reagent	Supplied with reagent pack for free and total chlorine – 200 tests
Operating Temperature	0°C – 50°C
Power supply	2×1.5V AA Batteries. Auto switch off setting

Other features	Stability indicator feature that prompts when to take the reading " Hold" feature that freezes the display for easy and accurate recording 25 mm diameter test tube

22.14.5 Thermometer

The lab thermometer shall be equipped with non-mercury red alcohol and white back permanently fused markings. Length of the thermometer shall be minimum 300mm. The range of the capacity is from -10^0C to 150^0C with a division of 1^0C.

22.15 Resilient Bearing Strip

When specified, gas vent flaps or vent pipes shall be installed in accordance with the drawings or as instructed by the Engineer to provide adequate venting for the liner system. The venting pipe should be fitted with required fittings and cowling.

Resilient Bearing Strip is a bearing pad shall be manufactured by all new (unused) materials and composed of multiple layers of prestressed 50/50 cotton-polyester blend duck, 8.1 ounce per net square yard, duck warp count 50 ± 1 threads per inch and filling count 40 ± 2 threads per inch, impregnated and bound with a high quality, oil-impervious nitrile rubber compound, containing rot and mildew inhibitors and anti-oxidants, compounded into resilient pads of uniform thickness.

Pads can withstand compressive loads perpendicular to the plane of laminations of not less than 12,000 psi before breakdown.

Pads meet AASHTO standard specification for fabric-reinforced bearing pads. Low coefficient of friction via PTFE surface

PTFE pad shall be minimum nominal thicknesses of 6.3 mm.

22.16 Stainless Steel Strip

Stainless Steel Strip used in saddle posts, anchor blocks, thrust blocks and other structure shall be as per IS 6911-1992 and dimension shall be as per the drawing. The weight of steel sheet and strips shall be taken from relevant Indian Standards based on 7.85 kg/m2 for every millimeter sheet thickness. For rolled sections, steel rods and steel strips, weight given in relevant Indian Standards shall be used.

नेपाल सरकार
भौतिक पूर्वाधार विकास मन्त्रालय
खानेपानी तथा ढल व्यवस्थापन विभाग
खानेपानी तथा ढल व्यवस्थापन कार्यालय
लमजुङ

Government of Nepal
Ministry of Infrastructure Development
Department of Water Supply and Sewerage Management
Water Supply and Sewerage Management Office
Besishahar, Lamjung

BILL OF QUANTITIES

Name of Project :-Belchautara Co-Financing Water Supply Project, Shuklagandaki Muncipality, Tanahun (Package-II)

Contract Identification No: WSSMOLMG/NCB/Works/083/84-05

S.N	Description	Unit	Quantity	Bidder's Rate (Nrs)		Total Amount	Remarks
				In Figure	In Words		
1	Provision for joint survey for the location of reservoir, pipelengths, junctions and other necessary civil structures for the project with their accessibility.	P.S.	1.00	200,000.00	Two Lakhs Rupees Only	200,000.00	
2	Insurances for the loss of damage and personal injury or death and as stipulated in contract Data	PS	1.00	500,000.00	Five Lakhs Rupees Only	500,000.00	
3	Utility Location, Temporary Diversion, Claim and others items not covered by BOQ, etc	PS	1.00	1,000,000.00	Ten Lakhs Rupees Only	1,000,000.00	
4	Testing and Comensing of entire system for seven days	L.S.	1.00				
5	Earthwork in excavation in all type of soil for pipeline/foundation trench including shoring, bracing, site cleareance by any means as per Drawing, Specification and Instructions of Engineer	Cum	17,897.58				
6	Earth filling work with all type of stacked soil in with water sprinkling, compaction and site clearance for foundation and other trenches all complete as per the specification and as directed by the Engineer	Cum	17,204.39				
7	Providing & Laying dry stone soling in foundation trenches with bond stone blinding in perfect line & level all complete as per Drawing, Specification and Instructions of Engineer	Cum	57.00				
8	Dry flat brick soling in foundation and floors with first class made bricks in true line and level including watering and ramming all complete as per Drawing, Specification and Instructions of Engineer	Sqm	167.62				
9	Providing & laying Plain/reinforced cement Concrete M15 grade complete as per Drawing, Specification and Instructions of Engineer	Cum	52.53				
10	Providing & laying reinforced cement concrete RCC grade M20 complete as per Drawing, Specification and Instructions of Engineer	Cum	19.20				
11	Providing & laying reinforced cement concrete RCC grade M25 complete as per Drawing, Specification and Instructions of Engineer	Cum	69.11				
12	Providing and laying Plum Concrete mixing of 60% M15 concrete and 40% boulder/stones (Boulder mixed concrete) including pipes for weep holes etc all complete as per Drawing, Specification and Instructions of Engineer	Cum	690.00				
13	Supplying & placing of TMT reinforcement bar for column beams, slab, etc. placed in position and binding with 14 gauge binding wire including cutting, binding, carrying, lifting, etc. all complete as per Drawing, Specification and Instructions of Engineer	kg	5,419.06				

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BILL OF QUANTITIES

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Contract Identification No: WSSMOLMG/NCB/Works/083/84-05

S.N	Description	Unit	Quantity	Bidder's Rate (Nrs)		Total Amount	Remarks
				In Figure	In Words		
14	Providing, Preparation and Installing form work including necessary supports and removing after completion as per Drawing, Specification and Instructions of Engineer	Sqm	120.97				
15	Providing and laying 12.5 mm thick cement plaster over concrete surface with 1:4 cement sand mortar in perfect line & level including scaffolding, curing, etc. all complete as per Drawing, Specification and Instructions of Engineer	Sqm	274.19				
16	Providing, mixing, laying cement sand punning with 1:1 cement sand mortar on floors in true line & level including curing as per Drawing, Specification and Instructions of Engineer	Sqm	219.10				
17	Providing and laying granular sub-base on prepared surface, mixing at OMC, and compacting to achieve the desired density, complete as per Drawing, Specification and Instructions of Engineer	Cum	156.80				
18	Providing and laying Crusher Run Macadam on a prepared surface, spreading and mixing, watering and compacting to form a layer of Sub-base/ Base course as per Drawing & Technical Specification.	Cum	117.60				
19	Providing and applying Prime coat with Hot Bitumen (Including cutter) on prepared surface of granular base including cleaning of road surface and spraying as per Drawing, Specification and Instructions of Engineer	Liter	705.60				
20	Providing and applying tack coat with hot Bitumen at specified rate on the prepared non-bituminous surfaces including cleaning as per Drawing, Specification and Instructions of Engineer	Liter	470.40				
21	Providing and laying Close-graded premix surfacing material of 20 mm thickness composed of 11.2 mm to 0.09 mm aggregates using bitumen as wearing course on a previously prepared base including mixing in a suitable plant as per Drawing, Specification and Instructions of Engineer	Cum.	15.68				
22	Procurement & Supply of 15 mm Ferrule all complete as per drawing, specification & instruction of an engineer.	No.	1,793.00				
23	Procurement & Supply of Saddle Clamp all complete as per drawing, specification & instruction of an engineer.	No.	1,793.00				
24	Procurement & Supply of 15 mm dia GI Union all complete as per drawing, specification & instruction of an engineer.	No.	2,593.00				

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S.N	Description	Unit	Quantity	Bidder's Rate (Nrs)		Total Amount	Remarks
				In Figure	In Words		
25	Procurement & Supply of 20 mm dia PE-100 PN-16 all complete as per drawing, specification & instruction of an engineer.	Rm	16,000.00				
26	Procurement & Supply of 15 mm dia GI Elbow all complete as per drawing, specification & instruction of an engineer.	No.	4,800.00				
27	Procurement & Supply of 15 mm dia GI Nipple 50 mm long all complete as per drawing, specification & instruction of an engineer.	No.	4,000.00				
28	Procurement & Supply of 15 mm dia Ball Valve all complete as per drawing, specification & instruction of an engineer.	No.	800.00				
29	Procurement & Supply of 15 mm dia Brass Water Meter Volumetric type including fitting and accessories all complete as per drawing, specification & instruction of an engineer.	No.	800.00				
30	Procurement & Supply of 15 mm dia Socket all complete as per drawing, specification & instruction of an engineer.	No.	800.00				
31	Procurement & Supply of Brass Bib Cock all complete as per drawing, specification & instruction of an engineer.	No.	800.00				
32	Procurement & Supply of 15 mm GI Pipe all complete as per drawing, specification & instruction of an engineer.	Rm	1,600.00				
33	Installation of pipes and fittings and other jobs for House Connections all complete as per drawing, specification & instruction of an engineer.	Job	1,793.00				
34	Procurement, Supply Laying & Butt welding Joining including Transportation of 90 mm PE-100 PN-6 Pipe all complete as per drawing, specification & instruction of an engineer.	Rm	2,067.00				
35	Procurement, Supply Laying & Butt welding Joining including Transportation of 110 mm PE-100 PN-6 Pipe all complete as per drawing, specification & instruction of an engineer.	Rm	89.00				
36	Procurement, Supply Laying & Butt welding Joining including Transportation of 125 mm PE-100 PN-6 Pipe all complete as per drawing, specification & instruction of an engineer.	Rm	1,152.00				
37	Procurement, Supply Laying & Butt welding Joining including Transportation of 140 mm PE-100 PN-6 Pipe all complete as per drawing, specification & instruction of an engineer.	Rm	1,523.00				

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S.N	Description	Unit	Quantity	Bidder's Rate (Nrs)		Total Amount	Remarks
				In Figure	In Words		
38	Procurement, Supply Laying & Butt welding Joining including Transportation of 160 mm PE-100 PN-6 Pipe all complete as per drawing, specification & instruction of an engineer.	Rm	993.15				
39	Procurement, Supply Laying & Butt welding Joining including Transportation of 200 mm PE-100 PN-6 Pipe all complete as per drawing, specification & instruction of an engineer.	Rm	64.00				
40	Procurement, Supply Laying & Butt welding Joining including Transportation of 250 mm PE-100 PN-6 Pipe all complete as per drawing, specification & instruction of an engineer.	Rm	594.00				
41	Procurement, Supply Laying & Butt welding Joining including Transportation of 50 mm PE-100 PN-10 Pipe all complete as per drawing, specification & instruction of an engineer.	Rm	7,685.00				
42	Procurement, Supply Laying & Butt welding Joining including Transportation of 63 mm PE-100 PN-10 Pipe all complete as per drawing, specification & instruction of an engineer.	Rm	11,357.00				
43	Procurement, Supply Laying & Butt welding Joining including Transportation of 75 mm PE-100 PN-10 Pipe all complete as per drawing, specification & instruction of an engineer.	Rm	3,391.00				
44	Procurement, Supply Laying & Butt welding Joining including Transportation of 90 mm PE-100 PN-10 Pipe all complete as per drawing, specification & instruction of an engineer.	Rm	1,545.00				
45	Procurement, Supply Laying & Butt welding Joining including Transportation of 110 mm PE-100 PN-10 Pipe all complete as per drawing, specification & instruction of an engineer.	Rm	827.00				
A	**Sub-total Without PS**						
B	VAT(13% of A)						
C	PS					1,700,000.00	
	Total(A+B+C)						