

SECTION-5

Employer’s Requirement & Specification

1. PROJECT SCOPE, COST, DEFINITION AND CONCEPT:

Scope of Works :-

1. Carrying out all required detailed survey and soil investigations.
2. Design, construction, testing and commissioning of Earthen Dam of capacity 248 millions litres for water Head Works at Tawi Tlang.
3. Design, construction, testing and commissioning of gravity main pipes of approximate length 63 Kms from Tawi Tlang to Melthum Tlang which can carry 15 mld of water.
4. Design, construction, testing and commissioning of 15 mld treatment plant.
5. Design, construction, testing and commissioning of main reservoirs at Melthum Tlang.
6. Design, construction, testing and commissioning of required Feeding Main pipelines from Melthum Tlang reservoir.
7. Design, construction, testing and commissioning of buildings as required.
8. Testing, Commissioning and defect liability for 365 days.
9. Estimated costs :- Rs.114.19 crores.
10. Time of completion:- 31st March, 2020

Based on survey of the sources river discharges and intended construction of dam and considering various engineering options available base on static head, length of the pipe, etc., the design of gravity main is to be optimized for 15 MLD water to be drawn at Melthum Tlang, Aizawl.

The project is essentially Civil Engineering works in nature and involves construction of Earthen Dam including accessories like Spillway, Intake, Outlet and Drain conduit, Control Valves, Parapet Wall, etc., Widening & Improvement of existing Approach Road, laying of Gravity Main Pipeline, etc.

1.1. Land :

The land required for construction of impounding dam is an agricultural field which shall be acquisitioned from the owners at the minimum cost. The land required for widening of the existing approach road of about 8.7 kms from Hualtu Village to proposed dam site will be obtained without compensation since the Village Council of Hualtu Village have pursued and agreed to bear no extra cost. The land required for formations cutting of road along the gravity main line are normally jungle and farm land and will be acquired and settled by means of public consultation meeting.

1.2 : Physical infrastructure components

1.2.1 Earthen Dam:

Low head Earthen Dam shall be constructed across Tuikum stream at a convenient place embanking the almost flat paddy field in the upstream site. A topographic survey using Total Station survey Instrument is carried out and a contour map of 1 meter interval is plotted for determination of capacity of reservoir on the dam sites 'Area – Elevation Curve' and 'Elevation – Storage Capacity Curve'. Hydro-geological survey should be conducted to identify presence of fissures or cracks and engineering properties of soil at the Dam site and comprehensive report shall be reported to the Engineer-in-Charge.

For stability point of view, the design criteria given by IS:12169:1987 for dam height shall be considered wherein the upstream and the downstream slope of dam is taken as 3:1 and 2.5:1 respectively and the minimum width of crest shall be taken at 5.0 m

(i) Cut-off:

The cut off is required to reduce loss of stored water through foundations and abutments and to prevent sub-surface erosion by piping. Cut – off is located just upstream of the centre line of dam within the base of central impervious core with the minimum width of 4m. The positive cut-off shall be keyed at least to a depth of 0.4 metre into continuous impervious sub stratum or inerodable rock formation. If cut off trench is terminated in rock formation which is weathered or have cracks, joints and crevices; and if percolation test exhibit a lugeon value of more than 10(refer IS 6066-1984), then rock foundation below the bed of cut off trench should be grouted.

(ii) Core:

The core provides impermeable barrier within the body of the dam. Impervious soils are generally suitable for the core (IS 1498 -1970). Core maybe provided which shall be extended upto 0.5 m above maximum water level (MWL) to act as the impervious barrier. The soils of nearly impervious soils of not having high compressibility & liquid limit, and organic contents available in the vicinity of dam may be used as the central core of the Dam.

(iii) Casing:

The function of casing is to impart stability and protect the core. The relatively pervious materials, which are not subjected to cracking on direct exposure to atmosphere, and which are suitable for casing is available in the area. Top width of dam is provided as 5.0 m (minimum).

(iv) Internal Drainage System:

To ensure safety of dam, it is very important to handle the seepage water in the dam so as to maintain the original particles of soils in their place. The measures adopted for safe disposal of seepage water through the dam are horizontal filter, rock toe and toe drain. The design and dimensions are as seen in the drawing as per IS 9429-1980.

(v) Slope protection:

The downstream slope protection is ensured by turfing on the entire downstream slope from top to toe. For upstream slope protection from erosion, instead of providing Riprap, it is decided to line with Geotext impermeable membrane sheet which is in line with the selection of the dam by Central Govt.

1.2.2 Spillway:

Spillway is located at the right bank of the dam and is designed as Chute spillway vehicle over the spillway. The capacity of spillway or open rectangular channel to be just sufficient to pass the max flood caused by rainfall of high intensity of 50 years return period vehicle over the spillway. The capacity of spillway is designed to pass maximum flood discharge.

1.2.3 Outlets:

Two numbers each of two types of outlets, viz. clear water outlets and drain pipes shall be provided across the dam section for the purpose of releasing waters of domestic purpose, downstream water rights and emptying or lowering the reservoir in case of emergency, for inspection and maintenance of the dam, reservoir and appurtenances. Intakes shall be constructed at the entrance of clear water outlet and it shall be enclosed by trash racks and screens. There shall be an upstream Control Valves capable of controlling the discharge through all ranges of flow. For clear water conduits, Air vent pipes shall be put just downstream of the Control Valve and Blow-off Valve at or near the downstream toe. The size of outlet conduit shall be as per design approved by the Engineer-in-Charge. Drain pipes shall be positioned such that the full reservoirs capacity except for a small silt storage volume can be discharged by gravity. The entire length of the outlet conduit shall be bedded

on foundation materials of uniform density and consistency, preferably on bed rock. However, the final alignment of the conduit shall be determined in the field after site stripping and after the embankment cutoff trench is excavated.

1.2.4 Diversion Works:

For diversion of water to make water free and clear in the location of dam to enable uninterrupted works of various components of dam project, cofferdam shall be constructed in the upstream of dam and water shall be diverted from there through pipes to the downstream site of dam. Water conduit used for diversion of water may or may not be used as the drain pipe of dam eventually depending upon the suitability.

1.2.5 Approach Road:

There exists approach road from Hualtu Village upto some points beyond the proposed reservoir which is being utilized by farmers of the village. By vehicle, the road can be accessed only by 4-wheeled small vehicle like Pickup, etc. on fair weather. It is necessary to improve the condition of the road to be at least accessible by medium truck for implementation of the project. Hence, it is proposed to widen and lay granular sub base for the whole length of about 8.7 kms.

1.2.6 Inspection Bungalow cum Chowkidar Quarter:

A building will be required during construction period and post-construction maintenance period for the purpose of accommodation and shelter during supervision of works, maintenance inspection by the Officers and Staff in-charge and security duty cum chowkider personnel at the dam site. It is therefore proposed to construct one building for Inspection Bungalow cum Chowkidar Quarter.

1.2.7 Preservation of Catchment Area/Security Fencing.

Preservation of Catchment Area is of utmost important in order to ensure a clean and perennial source of water. Fortunately, almost the whole of the catchment area is a dense mix jungle and is within Tawi Reserved Forest. Therefore, the streams water is totally man made pollution free resulting in the quality of raw water to be clear and acceptable for direct drinking. However, it would be desirable if wild animals do not reach reservoir and even men also cannot enter into the pool without permission and watch of the Security duty personnel to prevent from causing pollution to the reservoir. Hence, it is proposed to construct Fencing around the reservoir with Entry Gate and is included in the DPR.

1.2.8 Conveyance Main/Gravity Mains :

Pipeline for conveying water from the source to the main reservoir at **Melthum Tlang** is required to be laid. The linear distance between the source and the Treatment Plant is 62.84 Kms. It must be designed for flow of 15 MLD. For the sake of economy, ERW/SW API 5L pipes of different grades and different wall thicknesses having different hydrostatic test pressures may be selected, however, better alternative may be adopted if available. Pipe joints will be welded together and dye penetrate test will be conducted at each joint to achieve a leak proof weld. Pipe appurtenance like foot valves, scour valves and air valves are also proposed at suitable points and intervals.

1.2.9 Thrust Blocks / Anchor Blocks and Support Pillars:

The pipeline is to be laid in a mountainous terrain with steep gradient and irregular slopes as may be seen in the pipeline profile. The pipeline in some locations will need to ascend, descend and turn direction rapidly turning those points more prone to burge in the high pressure zones due to water hammer/surge effects, and in also the pipe needs to cross small rivulets and stream where laying of pipeline underneath is practically not possible. As such, suitable measures for anchoring the pipeline, crossings over rivulets and depression, and, for countering sudden deflection are proposed to be adopted in the form of RCC Thrust/ Anchor Block and support pillar.

1.2.10 Earthen Road along Pipe alignment:

As per preliminary survey through Google Earth internet and at ground sites, 30.17 Kms long pipeline in 5 m width will be laid in the jungle and the remaining 31.68 Kms long line will be laid along the existing road shoulder. Since the pipe is heavy and practically not possible to move manually, construction of road is required for transportation of pipes and employing JCBs and Tripod chain pulley system for local handling. Hence, it is proposed to do formation cutting of road along the proposed pipe alignment, which will in other hand be utilized for inspection and maintenance purpose and agricultural link road after the project work period is over.

1.2.11 Main Reservoir at Melthum Tlang:

Elevation of proposed reservoir at Melthum Tlang is approximately 1063m. Rectangular shaped under-ground reservoir with a dimension of 32 m x 22 m in plan and 5 m depth shall be constructed in the flat ground rendered by the community. Excavation of soil to the required dimension shall be done with the side slope of about 1:5:5 ratio. The floor and sides of the tank shall be lined with geo-membrane cell for strengthening the surfaces as well as making it impermeable.

1.3. Environmental compliance/protection measures

The project proposal in its broad spectrum is environmental friendly. Due to damming of the project source an area of approximately 16,033 Sqm upstream of the source will be submerged. However, it will not threaten the existing environment and ecosystem since the area is not known to be a natural habitat for any endangered species of wild animals, trees or plants. No ill effect is expected to befall on the aquatic life either.

During rainy season, a plenty water will overflow the spillway and in the lean period water will be released through blow-off valves provided at or near the toe of dam to meet the downstream water rights. As such, aquatic life and the major course of the river will not be disturbed. Hence, separate environmental impact assessment and management plan is not provided.

1.4. Rehabilitation and Re-settlement

The project proposal basically involves only damming of the source of water with no temporary or permanent settlement in the water submerged area and surrounding nearby areas. Therefore, a rehabilitation and resettlement plan is found not necessary.

1.5 Benefits to accrue after the Project is implemented

Water supply project being social Infrastructure project may not need to assess in terms of financial returns. The availability of adequate and wholesome water in the city due to the project will provide a lot of tangent and intangent benefits to the population of the city. Some of the benefits may be furnished as below.

- i) It is gravity water supply scheme alternative to existing Aizawl water supply scheme which is fully depending on pumping machineries.
- ii) Maintenance of gravity water supply scheme is practically negligible.

iii) The source water lies within Tawi Reserved Forest area and is not polluted. Hence it is naturally pure during the whole year requiring only disinfection for treatment. It is also mentally desirous to drink non chemical treated water.

iv) After the project is implemented, quantity of water required to be pumped from Tlawng river will drop down to one-fourth of current requirement which can give savings of approximately Rs.1200 lakhs per annum.

v) The total cost of the project can be recovered in 9.91 years base on the savings on high pumping cost.

vi) As per norms of CPHEEO, water supply of atleast 135 lpcd is required for a city with existing sewerage scheme or such scheme coming up. Hence, augmentation of water supply for Aizawl city is a must in addition to the existing scheme and Sipmiu Tranch-III project which is coming up.

1.6 Other Information

The Public Health Engineering Department, Mizoram is responsible for the execution of Water Supply Scheme both in the urban and rural areas of the state. It has the necessary technical expertise, manpower, equipments and laboratory facilities to execute and implement the project. Therefore specialized procured service for design, independent supervision and quality assurance is not required. Necessary survey and investigation had already been carried out and hence provision for such is not provided.

1.7 Tourism Scope

The Dam site of the project has an excellent scope as a tourist spot. The famous "TAWI WILDLIFE SANCTUARY" is the catchment area of the Dam. A beautiful water body is going to be constructed using a simple eco- friendly earthen Dam just below the sanctuary. "TAWI WILDLIFE SANCTUARY" is credited amongst the first sanctuaries in Mizoram. The sanctuary hosts a variety of rare and endangered species of flora and fauna. Aside from providing water to the people of Aizawl and the surrounding areas, the Dam is going to attract visitors and combine this attraction with visits of other eco-spots in the reserved forest. The development of tourism industry will automatically imply a spike in employment levels. The allied effects of this include the development of a supportive ecosystem and increased population density. It is going to be important to take adequate measures like leaving water only from designated launch points and protection of the riparian areas.

1.8 ABOUT TAWI TLANG

1.8.1 Location:

Tawi tlang (about 8.7 Km from Hualtu village).

1.8.2 Geology of the area:

According to Geological Survey of India (GSI), the area is underlain by Middle Bhuban formation of Surma Group. This indicates that the study area is a shale (impermeable rock type) dominant area with few siltstone beds.

No prominent lineaments and faults were observed within the study area.

Highly dissected structural hill occupies majority of the study area. Other geomorphic features include less dissected structural hills and significant intermontane valley.

Numerous streams (some of them perennial in nature) were observed.

Thickness of soil cover within the area may range from half a meter to a few meters thick.

1.8.3 Location of selected site:

Location of the selected site is at the intermontane valley across a prominent perennial stream. The Geo-coordinates of the site is 23° 32' 04.02"N & 92° 56' 32.77"E and the elevation is 1107 .00m from mean sea level.

Location for another site is also selected during the field survey in case the original site is found unsatisfactory. Geo-coordinates of the second site is 23° 32' 06.22"N & 92° 56' 30.30"E and the elevation is 1152.00m from mean sea level.

The survey was conducted on 28th April, 2015.

2. TECHNICAL SPECIFICATION FOR CIVIL WORK

PART A SCOPE OF WORKS

PART B GENERAL TECHNICAL SPECIFICATION

PART A

SCOPE OF WORKS:

All Civil works shall be carried out by the Contractors on EPC Contract basis on lumpsum price to be quoted under this Contract.

2.1 General:

All designs-hydraulic and structural shall be done by the successful bidder as per latest prevailing codes. He shall fully assess the intent of the Government in providing designs and construction of structure and supply of material which are functional, technically suitable, economical and easy for maintenance and operation. Approval to the design will be given by the Engineer on behalf of the Government.

2.2 Contract, Drawings, Documents and Manuals:

The Contractor shall prepare and submit structural design calculations Architectural drawings, with all necessary plans, elevations, sections giving design sections adopted, their specifications, details of connections, type adopted, approximate quantities therein in six sets. General arrangement and design drawings with detailed design calculations shall be submitted to for approval within stipulated period from the date of award of the Contract/ Letter of Intent.

Approval of the Contractor’s design drawings and documents means that these are checked for conformity with applicable specifications and general conformity with the engineering requirements covered in the specifications. Approval of the Contractor’s design drawings and documents shall not relieve the Contractor in any way whatsoever of any of his responsibilities under the Contract and the Contractor shall remain wholly responsible for any error in his design drawings, approved or otherwise. Only approved drawings shall be used for construction.

The Contractor shall not make any change in the approved design drawings without the prior approval of the Government. Manufacture or procurement or fabrication prior to approval of design drawings shall be solely at the contractor’s risk.

2.3 Topographical Surveys:

The successful bidder has to design the most economical alignment, grade, pedestals, and anchors and thrust blocks and cross drainage works on the basis of the above survey. Hence he should use his judgment while carrying out this survey to ensure that this design is safe, economical, and easy for construction, maintenance and meet the technology requirement of the Government.

**2.4 After the field work, the contractors shall submit 3 sets of survey drawings.
Soil Explorations for Foundations:**

The soil investigation for foundations is an important item in the scope of this tender, since it influences safety of structures and economy in their construction. The Government expects the bidder to attach utmost importance to these field investigations by deploying competent technical agency and work carried out as per relevant I. S.

PART- B

GENERAL TECHNICAL SPECIFICATION

2.5 General:

The successful bidder shall be entirely responsible for the detailed hydraulic and structural design of all Civil Engineering components of the works including pipes supports and all other appurtenances suitable for the functions. They are required to be performed the detailed designs and drawings and shall be got approved from the Engineer-in-charge before setting out on the site.

- 2.5.1 These specifications establish and define the material, constructional aspects of Architectural Works.
- 2.5.2 Latest revision of specification, Indian Standard Codes and other documents shall be referred to wherever mentioned or otherwise applicable.
- 2.5.3 The provisions of schedule of items, specifications and drawings shall be read in conjunction with each other and in case of contradictions/conflicts amongst them, the clarification shall be obtained from the Engineer whose decision, shall be final and binding. However, prior to that the following procedure may be followed in general.
 - a. Item description shall prevail over specifications when provisions therein are different from those in specifications.
 - b. Wherever, any specific requirements not covered in item descriptions but are given in specifications, the specifications shall be followed in addition to the requirements in item description.
 - c. Whenever drawings call for requirements different from or additional to those in item descriptions and specifications, the decision of the Engineer shall be obtain which shall be binding.
- 2.5.4 All materials shall be of standard quality, manufactured by approved concerns, confirming to IS or equivalent and shall have IS mark unless otherwise approved by the Engineer-in-charge.

In case of any material other than that of approved quality as stated above the contractor shall get all such materials approved by the Engineer prior to procurement and use. The contractor shall furnish manufacturer's certificate for the materials intended to be used. Further to that he shall get the materials tested from approved test house if asked by the Engineer-in-charge at his own cost for which no extra payment shall be made.

The Engineer shall have the right to reject all or any of the materials intended to be used. And such rejected materials shall be immediately removed from the site by the contractor at his own cost and without any claim for compensation etc. due to such rejection.

2.5.5 Payment will be made on lump sum basis as quoted by the Contractor; stage wise payment will be released based on the progress of work, at different stages viz., up to site preparation, foundation, plinth, structure, walls, roof, finishing, painting etc. For pipe laying and formation of roads unit rate quoted by the tender under price schedule will be made based on the actual quantity executed by him.

2.5.6 Providing and operating necessary testing appliances is included in the scope for which no extra payment shall be made.

2.6 Seismic Loading:

Provision shall be made in the design for seismic loading as per zone 5 of IS 1893 for which the seismic acceleration coefficient is 0.08 and with the important factor of 1.5 applied to this, the basic seismic acceleration coefficient adopted would be 0.12 as design standard, in addition to latest I.S. Specification shall follow best modern Engineering practice in the field or as approved by the Engineer. The tender/Contractor shall take care to check the stability of partly completed structures against all loadings.

2.7 Clearing of site:

Before starting the work the site shall be cleared by the Contractor of all shrubs, grass and other vegetations including small and large bushes, all stumps, removal of roots, cutting and disposing of small trees up to 300mm (girth to be measured 1.5 M above ground level) etc., complete as directed. This operation also involves falling, logging and fashioning of timber and stacking the serviceable material separately as directed by the Engineer.

The site to be cleared including site grading shall consists of entire area where works are to be constructed or installed, including space between two adjacent works, approach and such area where temporary facilities for construction and installation are to be placed.

The scope of this item also includes maintenance of the cleared sites until the commissioning and taking over is affected for all the works.

It is the sole responsibility of the contractor to get familiar with the local rules and regulation special requirements of the Forest Department and labour colony etc, whenever applicable and he shall carry out his work in strict accordance with the same, the Contractors shall always follow latest edition of relevant I.S. Codes for various Works irrespective of the year of publication mentioned in technical specifications.

2.8 Technical specification:

Technical specifications for major item of works are specified as herein under. The Contractor shall follow latest Indian Standards and as directed by the Engineer without any extra cost.

INDEX FOR DETAILED SPECIFICATION

SPECI NO	NAME OF THE SPECIFICATION
1.0	MOBILISATION
2.0	EXCAVATION
3.0	DRILLING AND GROUTING
4.0	CONCRETE
5.0	STEEL REINFORCEMENT
6.0	ANCHORING
7.0	RANDOM RUBBLE MASONRY
8.0	BACKFILLING WITH SOIL
9.0	EMBANKMENT
10.0	GRADED FILTER
11.0	ROUGH STONE PITCHING
12.0	WATER PROOFING OF PERIPHERAL WALLS
13.0	RUBBLE AND SAND FILLING
14.0	TURFING
15.0	P.C.C LINING
16.0	GUNITING
17.0	JOINT FILLER BOARDS
18.0	BRICK MASONARY
19.0	STEEL / ALUMINIUM / WOOD DOORS AND WINDOWS
20.0	CEMENT PLASTERING
21.0	POINTING
22.0	STRUCTURAL STEEL WORK
23.0	PAINTING AND PROTECTIVE COATINGS
24.0	FLOORING
25.0	GLAZED CERAMIC TILE WORK
26.0	LIME TERRACING CONCRETE
27.0	G.I. PIPE RAILING
28.0	MILD STEEL LADDER
29.0	M.S CHEQUERED PLATE
30.0	CHAINLINK FENCING AND GATES
31.0	R.R. MASONARY CHAMBERS
32.0	R.C.C PIPE
33.0	FORMATION OF ASPHALT MACADAM ROADS
34.0	PLUMBING AND BUILDING DRAINAGE
35.0	TRASH RACK
36.0	GANTRY
37.0	GATES

2.9

DETAILED TECHNICAL SPECIFICATION- MOBILIZATION

2.9.1 Site Clearance:

The area required for the works and for the permanent and temporary construction sheds shall be cleared of all stumps, bushes, shrubs, debris and other objectionable materials. Materials removed in clearing operations and determined as waste by the Engineer shall be burnt, buried in disposal area or otherwise disposed off as approved by the Engineer. All materials from the demolished structure or materials cleared off from the working area determined as useful shall be stacked at places and in a manner directed by the Engineer. Separate payment will not be made for complying with the requirement of this paragraph and all costs shall be deemed to have been included in the rates for the respective items of civil works.

2.9.2 Diversion/Dewatering:

Any amount of water flowing through the working area will have to be suitably diverted by the Contractor at his own cost and neither extra claim on this account nor any request for extension of time will be entertained. Any amount of water seeping in or collected in the working area will have to be dewatered by the Contractor at his own cost and neither extra claim on this account nor any request for extension of time will be entertained. The Contractor shall not close/block any natural streams or existing canals nor cause any adverse effect for the flow.

2.9.3 Lighting and communication:

In the working area, adequate lighting arrangements shall be provided and maintained by the Contractor at his own cost during the night operations which shall be subject to the approval of the Engineer, communication facilities between the field office and the work site shall be provided by the Contractor at his own cost wherever required.

2.9.4 Mobilisation:

The Contractor shall make, at his cost, all necessary arrangements for the procurement, transport, installation, operation and maintenance of all machinery, Plant and other necessary equipment required for the execution of the work. All temporary structures and storages required for the safety and protection of the machinery and all other accessories shall be done by the Contractor at his cost. The Contractor shall also responsible for repairs and maintenance of the existing road facilities. Additional temporary roads if required by the Contractor shall be made by him at his cost.

This includes the mobilisation of men required for the execution of the work including the transport, labour huts and other amenities to be provided to the labourers. Any work of construction residential/non-residential structures required for the men, materials and machinery are deemed to have been included in the rates indicated for the different items of civil work. No extra payment will be made for mobilizing and demobilizing man and machineries during construction.

2.9.5 Demobilization:

After having served their purpose, all temporary constructions, temporary protective works, structures, machinery, unused materials, etc. shall be removed and site cleared. Care shall be exercise during removal of such temporary works so as to prevent damage to the permanent works. Any damage caused thereby shall be repaired as directed by the Engineer at the expense of the Contractor. The removed materials shall be placed in the specified areas as directed by the Engineer. No extra payment will be made for mobilizing man and machineries during construction.

2.9.6 Cleaning:

During the course of execution of work, the silt and slush accumulated in the working area shall be cleaned periodically and after the completion of the work as directed. The cost of such cleaning shall be deemed to have been included in the rates indicated for different items of civil work and no extra payment on this account shall be made.

2.9.7 Cost of mobilization etc.

The Rates quoted for civil work shall include the cost of all the above items namely, site clearance, mobilisation and demobilisation of materials, men and machinery required for the work and cleaning. No separate payment will be made on this account.

2.9.8 Special care;

As the Works are to be carried out in the close vicinity of a storage dam the contractor shall take all care and precautions not to cause any damage whatsoever to the existing structures.

2.10 SPECIFICATION NO- EXCAVATION

2.10.1 General:

The excavation in all kinds of soil rock stratas required to be done by the contractor under this shall consist of

- i. Excavation in river bed, banks for intake works.
- ii. Excavation for preparing pipe trenches and other excavation required for pipelines.
- iii. Excavation for foundation of all civil works such as pumping stations, building works, cross drainage works, footings, pedestals and other civil works.
- iv. Cutting down and levelling hills etc. required for construction of building structures and formation levels for pipeline and civil works. Ensuring that there is at least 6.0 m clearance on all sides of the structure on firm soil.

The scope of work under this item shall also include cutting the edges of foundation trenches, pipe trenches etc, to give adequate side slopes for stability.

The recommended side slopes shall be as follows:

- a. 1:1 for excavation in earth, soils soft moorum etc
- b. for excavation in hard moorum and soft rock.
- c. For excavation in hard rock.

However, Engineer may ask contractor to carry out excavation with side slopes other than listed above, depending upon the peculiar site conditions.

The contractor shall carry out all such works without claiming extra cost what-so-over.

2.10.2 Classification:

2.10.2.1 Excavation in soft materials:

The soft materials will include all type of earthy or sandy and soils, clay, soft and hard moorum i.e. all kinds of disintegrated rock, shell indurated clay, single made up soil and isolated boulders up to the size of 0.1 cum.

2.10.2.2 Excavation in hard material:

Hard material will include boulders of size higher than 0.10 cum if broken down by whatever means for removal in pieces of not more than 0.10 cum in size, all type of rock, soft and hard, which can be best removed by blasting. If the blasting is not permissible the work will have to be done by chiseling. By the term 'Soft Rock' is meant rock masses but of a soft variety, crystalline in structure which is otherwise like hard rock. It only indicates the degree of softness but will not include disintegrated masses of rock which is hard murrum in formation, earthy in colour which generally has fractures of cleaves soft rock can be removed by crow bar or a pick in chips but for mass removal only blasting has to be done. On Hard Rock a crow bar or pick will only rebound removing but an insignificant quantity. The classification of the hard strata will be done by the Engineer. For the blasting operation, it will be the responsibility of the contractor to obtain permission from District Magistrate or any competent authority for use of explosives and take such other measures and precautions are necessary as per explosives rules. The contractor shall remain liable to pay compensation in case of accidents for which no claims department shall be entertained.

2.10.2.3 Blasting:

Wherever possible the rock excavation may be carried out by any blasting method. Depending upon site conditions the Engineer may direct contractor to do the excavation by chiseling only. Whenever blasting operation is to be restored with the prior approval of the Engineer, permission from competent authorities shall be obtained and the materials if available with the department will be supplied to the contractor on recovery basis. The necessary precaution and protection measures shall be taken to life and property before starting the blasting works. The work of blasting shall be carried out by the competent and experienced licensed blaster. During blasting, red danger flags shall be prominently displayed and all the people, except those who have actually to light the fuses, must be removed to a safe distance, not less than 200 meters as a rule. For special cases, suitable extra precautions must be taken. All fuses must be cut to the lengths required before being inserted into the holes. The number of charges to be fired and the actual numbers as shots heard must be compared and the person responsible must satisfy himself by examination that all the charges have exploded before working people are permitted to approach the site. The with-drawl of a charge which has not exploded or, under no circumstances, permitted and the charge shall be flooded with water; and the hole marked in a distinguished manner. Another hole shall be jumped at a distance of about 45 cm. from the old hole and fired in the usual way. The results shall be carefully examined by the person in-charge of the blasting and operation continued, until the original charge is exploded. For storage of explosives, the Contractors shall obtain the previous permission of the competent police authority for locating the storage godown at site, the manner and method of storing explosives near the site of works and they shall be stored in accordance with the rules of the Explosives Department in respect of explosives, petrol, oils, fuels and other inflammable materials. All handling of explosives, including storage, transport etc. shall be carried out under the rules approved by the Explosives Department of the Government. The contractor shall at his own expense, construct and maintain at site of works, proper magazine for the storage of explosives and proper storage facilities for oil, fuel, etc, for use in connection with the work. The Contractor shall at his own expense obtain such licenses as may be necessary for storing and using explosives, oils, fuels etc. The Government shall not be responsible for the above storage or use of explosive on the site or any accident or occurrence whatsoever in connection therewith. The responsibility and risk thereof shall be solely on the Contractor. In order to ensure the safety of surrounding property and person, no charge shall be used which is larger than necessary, Rock excavation adjacent to any structure shall be buried on in such manner so as not to cause damage to it.

2.10.2.4 Protection:

The excavation of all kinds in wet or dry condition will be carried out by the contractor to the required foundation level as per design drawings or as directed to exact dimensions to be verified from the sight rails to be fixed by the Contractor at the required intervals. The excavated materials shall be stacked clear away from the edge of excavation as directed without any extra cost. The Contractor shall provide shoring and strutting of approved type as directed when excavation in deep cutting or in a deceptive strata or where it is desirable for the safety of surroundings structures and of labour, guarding and lightning of the portion of excavation shall also be provided. Any extra excavation necessary to provide space for such support or other working space shall be at contractor’s expense. The Contractor shall submit a detailed plan for review showing the design of shoring, bracing, slopping or other provisions to be made for worker protection from the hazard of cabling during excavation. In ordered by the Engineer, the Contractor shall have to provide additional support or sheets or modify the arrangement as directed. Nothing extra to be paid for removal of masonry or concrete structure or for cutting and removing stumps of trees met within the excavation.

Excavated materials meeting the requirements of Bill of materials may be conserved for subsequent use but their suitability for specific purpose shall be determined by the Engineer. The Contractor shall not waste or otherwise dispose off suitable excavated materials.

2.10.2.5 Fencing, watching and lightning:

The Contractor shall make all proper provisions for protecting the work by fences and by watching and lightning at night or otherwise as may be directed and approved by the Engineer at his own cost. In the event of the Contractor not complying with provisions of this clause; the Engineer may with or without notice to the Contractors at the risk and cost of the contractors put up a fence or improve a fence already put up or adopt other measures as he may deem necessary. The cost of all such measures adopted by the Engineer shall be borne by the contractors. Whenever any works is carried out across the road, the contractors shall arrange for special men for directing the traffic on the road. They shall also provide warning posts near such works and shall provide red lamps as danger signals during night times.

Whenever any work is to be carried out at night time, the site of such work shall be illuminated adequately by flood lights or incandescent lights to the satisfaction of the Engineer. If proper arrangements are not made by the contractors they shall be warned for the first offense after which a penalty as decided by the engineer shall be imposed.

2.10.3 Dewatering:**2.10.3.1 General:**

The foundation will be kept dry be resort to pumping alone or pumping in combination with diversion channels coffer dam, bunds, diversion weir, or other method suitable for local conditions at the choice of contractor. The responsibility of adequacy of dewatering arrangements and quality and safety of work rests solely with the contractor at his cost. No setting out shall be done, no masonry laid, no concrete deposited, no pointing made, no measurements taken in water. A schedule programme as directed by the Engineer for the method adopted to be adhered to.

2.10.3.2 Pumping measures:

Adequate pumping arrangement shall be made by the contractor for dewatering the foundation, pipe trenches and another construction area as to keep them dry during the progress of work of excavation, masonry or concrete and pipe laying. The concrete or masonry work shall be kept dry for a period sufficient for enough setting of the work. The dewatering arrangement shall be enough such as to preclude the possibility of movement of water to fresh concrete or masonry thereby impairing the strength. Contractor shall make his own arrangement for labour, materials and equipment for coffer dam, pumps, engines and other machinery and services required for execution of the item.

If any pits are filled due to flood or flows or rains or any other causes, the pumping required for dewatering pits and for desalting be done without making extra claims. Shoring, strutting, sumps and other protective works required for facility of dewatering shall be designed and provided by the contractor to ensure full safety of work, workmen, machinery damage and injury caused by execution of this item.

2.10.3.3 Coffor Dams:

The coffer dams where required shall be constructed by the Contractor to required depths and heights and safety, designed and constructed with suitable dimensions and protection and shall be made enough water-tight for facility of construction inside it. The coffer dam shall leave sufficient clearance for construction and inspection facility and permit installation of pumping machinery as required. The works constructed such as coffer dam, sumps for facility of diversion and dewatering shall be removed after they have served their purpose in the manner and to the extent directed by the Engineer. The river shall be brought to the original cross section by filling any excavation done and/or by removing deposited material in the bed after construction works is over.

2.10.3.4 Disposal of water

The water being dewatered shall be disposed off by the contractor at his cost in Manner Infirmary with the rules in force and as approved by the Engineer.

2.10.4 SPECIFICATION NO - DRILLING AND GROUTING

2.10.4.1 Scope:

This specification covers the item of.

- i) Drilling holes of 45 mm to 50 mm diameter vertical or inclined upto 10 deg to vertical in all formations of rock/ concrete/ soil by percussion method for consolidation/curtain grouting including flushing and cleaning the hole with air and water at required pressure.
- ii) Grouting holes with cement grout at specified pressure for consolidation/curtain grouting.

2.10.4.2 Application publications:

All methods and procedures for drilling, water loss tests and grouting shall conform to the latest revisions of the following Indian standard Specifications.

IS-1489	Specification for Portland pozzolana cement.
IS-5229	Code of practice for in situ permeability tests in rock bed.
IS-8112	Specification for High strength ordinary port land cement.
IS-6066	Recommendations for pressure grouting of Rock Foundations in river valley projects.

2.10.4.3 Pattern of Drilling for grouting:

The pattern of drilling and grouting shall be as decided by the Engineer. The grouting operation shall always be started from the side towards which the seams dip, so that the trapped air may be more easily forced out. This can be decided on the basis of field conditions assessed by the Engineer whose decision shall be final. Adequate lightning shall be provided and maintained by the Contractor during the night operations which shall be subject to the approval of the Engineer, Communication facilities between grout plant and location of holes grouted shall be provided by the Contractor where required by the Engineer.

2.10.4.4 Selection of holes:

The actual location, spacing, direction and depth of grout holes will depend on the nature of the rock and its dip and strike direction, jointing pattern etc and shall be as directed by the Engineer. The order in which the holes are to be drilled and the manner in which each hole is to be drilled and grouted, the proportions of cement and water to be used in grout, the type and quantity of admixture to be used, the time of grouting, the pressure to be used in grouting, the depth at which the packers are to be fixed and all other details of the grouting operations shall be as directed by the Engineer. The grout holes shall be water tested and grouted in sections or stages located between depths in the hole best suited to treat the geological defects of the foundation as determined by the Engineer or his authorised representative. All pressure grouting operations shall be performed in the presence of the Engineer. The stage depths for grouting holes shall be generally 3m. However, the same shall be increased or decreased, if necessary, in accordance with the site and geological conditions encountered or as directed by the Engineer. Generally consolidation grouting shall be taken up after laying concrete for few lifts. Pipes shall be embedded in concrete at the locations of the holes to be drilled for grouting. The pipes required for this purpose will have to be arranged by the Contractor. All certain locations, the drilling and grouting shall be carried out and completed before placing any reinforcement and concrete, if directed by the Engineer.

The cost of all labour and materials required for drilling, flushing the grout holes and pressure grouting shall be deemed to be included in the unit rates quoted.

2.10.4.5 Drilling grout holes:

Drilling and grouting shall be accomplished through pipes embedded in concrete or set in rock. The holes shall be further drilled by approved percussion drilling equipment. The holes shall be further drilled vertical or inclined as directed. Percussion drilling shall be by pneumatic type of equipment having both linear impact as well as rotary motion and shall be capable of producing well rounded holes. Percussion drills are to be equipped with constant water flushing arrangement at the bottom of the holes being drilled. Adequate supply of water shall be ensured from time to time to wash the holes being drilled. Adequate supply of water shall be ensured from time to time to wash the holes being drilled. Adequate supply of water shall be ensured from time to time to wash the holes being drilled. The rates for drilling shall be deemed to be inclusive of cost of each washing. Drilling equipment and techniques shall be such as to minimize chances of holes cave in or become oversize. In the case any part of hole caves in after charges. Water used for drilling shall be clear water. If drilling bit or rod is jammed in any hole at any stage, the same shall be abandoned. No payment shall be made for drilling, washing and grouting carried out for such holes. The contractor shall have to drill fresh hole and complete it in all respects as directed by the Engineer.

2.10.4.6 The diameter of grout hole shall be not less than 40mm for consolidation/curtain grouting. Unless otherwise directed, grout holes shall be spaced widely and shall be drilled and grouted. Using this procedure, the drilling and grouting of all holes shall be completed with such final spacing of holes as the grouting results shown to be necessary. After holes in a region have been drilled and grouted and as the construction work progresses, the condition of the surrounding foundations or the development of leakage shall be observed and additional holes be drilled and grouted. Where parts of foundations are already covered with concrete, holes shall be drilled through concrete into the underlying or surrounding rock at such locations and to such depths as directed. No allowance above the unit rates will be made for drilling such holes or for the expense of moving equipment to other operations and returning them to a previously drilled area.

2.10.4.7 Each grout hole shall be drilled to its full depth or stage depth and grouted in stages up or down. Where necessary, because of the rock jointing and/or type of material encountered during the drilling the grout hole shall be drilled and grouted in successive operations by stages down from the collar of the hole. The method of grouting, stage up or stage down, shall be as directed by the Engineer. In case of stage up grouting, minimum interval of 6 hours be kept between grouting of successive stages in the same hole. Similarly, 24 hours minimum time shall be allowed between grouting of successive stages in the same hole when stage down method is adopted. Where stage down grouting is directed, redrilling required because of the contractor's failure to clean out a hole before the grout has set shall be by and at the expense of the contractor. No allowance above the unit rates tendered for drilling grout holes in stages will be made because of the need for interrupting the drilling of holes to permit grouting, for cleaning out holes before further drilling or for any amount of moving of equipment that may be necessary due to such successive stage grouting.

2.10.4.8 When the drilling of each hole or stage of hole has been completed, clean water shall be circulated through the hole until it is flushed free of drill cuttings. The hole shall then be temporarily capped or otherwise suitably protected to prevent the hole from becoming clogged or obstructed until it is grouted. Any hole that becomes obstructed before it is grouted shall be opened by and at the expense of the contractor.

2.10.4.9 Washing of drilling holes:

Upon completion of drilling the holes as per pattern and before water testing or grouting is commenced, each hole shall be thoroughly washed with water and air under required pressure or as directed by the Engineer to remove any accumulated sludge of drilling or cuttings. The time of washing shall be about 20 minutes for each stage and may be varied by the Engineer. After completing the drilling of holes to the required depths, water shall be allowed to run in the holes until returning water at the top of holes reasonably clear of sludge and clay. If reasonably clear water does not emerge even after 10 to 15 minutes, the drill rod is to be removed and the holes washed with a blow pipe of about 12mm diameter with flattened lower end having two way connection at the upper end so that alternate jets of water and compressed air, the seams and cracks in the rock surrounding the holes shall be thoroughly cleaned. The washing shall be continued till the loose material is removed from the seams and cracks in the rock surrounding the holes shall be thoroughly cleaned. The washing shall be continued till the loose material is removed from the seams and crevices and till all the possible interconnections established between adjacent holes and cleaned. It shall also be continued till the colour of the effluent disappears. The pressure of air and water applied for washing shall be limited to grouting pressure. However, the actual pressure of application for washing of any individual hole shall

be determined on the site as revealed from the experience gained on previously completed holes.

2.10.4.10 Holes taking water freely shall be washed for reasonable length of time, where out flow occurs from adjacent holes. After cleaning the hole it shall be capped. The connected holes shall be blown clear off any muck which may have been washed and settled below the seams. For any hole, the washing shall usually be done just before grouting. Final washing shall not be completed too far in advance of grouting and shall be done as the last operation preparatory to grouting. Before the grouting of a hole is taken up, the adjoining holes shall be kept clean so that they will be ready for grouting in case they are found connected with a grouted hole.

2.10.5.1 Water loss test:

Selected grout holes shall be water tested to determine initial grout mix as well as grout pressure to be applied and to ascertain the effectiveness of grouting treatment. If the ground water level in the vicinity of the hole is below the collar level of the hole, after washing and before conducting the water loss test, the hole shall be saturated by allowing continuous flow of water for not less than 72 hours. After the hole is saturated the water loss tests shall be carried out by keeping packers at top of the respective stages being tested. If it is not possible to keep the packer at the top of the respective stage effectively, the test shall be carried out by keeping the packer at the top of the hole. Alternatively, the inflatable type packer may be used in such cases if directed by the Engineer. The water tests shall be cyclic. The tests shall consist of a series of simple tests performed in succession in accordance with Indian Standard IS -6066. Water loss for specified duration shall be measured in the same stage at varying pressures, usually in the ratio $p/3$, $2p/3$, P , $2P/3$ where 'P' represents the maximum safe pressure for that stage or 3Kg/Sq.cm , whichever is lower. In simple tests water at the prescribed pressure shall be continuously pumped into the hole until measurements taken at an interval of 10 minutes indicate that the rate of absorption has become constant for a minimum period of 10 minutes. The results of water loss shall be expressed in lugeons, that is, litres per metre, per minute, at a pressure of 10 kg/sq.cm in accordance with I.S-6066. For homogeneous strata the lugeon coefficient of 1 is approximately equivalent to permeability of 10 cm/second . When the test pressure is less than 10 kg/Sq.cm test results at different pressures may be converted to standard pressure on a linear scale but a specific mention of such conversation shall be made in the records.

2.10.5.2 Water loss tests shall be carried out in holes before grouting to assess pre-grouting permeability of the rock and to decide proportion of initial grout mix. Tests carried out in secondary and tertiary holes will indicate post grouting permeability and effectiveness of grouting in primary/ secondary holes. Tests carried out in an individual test hole at any time will indicate the effectiveness of the grouting carried out in the holes located around it. Test holes drilled for this purpose shall be located midway between the grouted holes or as directed by the Engineer. Water loss tests shall be carried out in each stage before grouting to find out whether grouting of that stage can be omitted. It shall provide information about the effectiveness of grouting and the necessary or otherwise of further grouting.

2.10.6.0 Pressure grouting

2.10.6.1 General:

The grout mix for pressure grouting shall be composed of mainly cement and water in proportion as specified by the Engineer.

2.10.6.2 Materials:

- i) Cement: Cement shall conform to Indian Standard IS-8112.
- ii) Water: Water shall meet the requirements as indicated under concrete specification.
- iii) Additives: The decision to use any commercially available additives shall be governed by field conditions and approved by the Engineer.

2.11.0 Plants and equipment:

All plants and equipment required to mix and pump the grout into the various stages of the grout into the various stages of the grout holes shall be provided by the Contractor. The apparatus for mixing and pumping grout including circulating line and fittings shall be of type and size approved by the Engineer and shall be capable of effectively mixing and stirring the grout and forcing it into the grout connections in a continuous flow at any specified pressure upon a maximum of 3 kg/Sq.cm measured at the collar of the hole. Water supply to the mixer shall be adequate at all times to provide the required pumping rate.

2.11.1 The mixer shall be suitable for properly mixing the cement with the water to remove any air attached to the particles of cement and to ensure thorough wetting. Different impeller shapes be used when sand, rock dust or other additives have to be incorporated in the cement slurry. In addition to the grout mixer, a holdover mechanical agitator tank similar in volume to the mixer shall be provided. The drain valve from mixer to agitator shall be adequate in size so as to regulate the injection rate. A suitable measuring device shall be equipped with screens to remove from the grout entering either from the mixer or from the return line any hardened grout and 1.18 mm IS sieve in case of sand mixed grout is pumped. All grout shall be pumped with a helical screw rotor type pump or a double acting reciprocating pump. The helical screw rotor type pump shall have a minimum capacity of 100 litres per minute at a pressure of 7 kg/Sq.cm. The double acting reciprocating pump shall have a minimum capacity of 30 liters per minute at a pressure of 10 kg/Sq.cm. A standby grouting equipment shall be maintained in a satisfactory manner and shall be capable of continuous and efficient performance during grouting operation. Grout holes abandoned due to faulty equipment shall be at the Contractor's expense. The arrangement of the grouting equipment shall be such as to provide a supply line and return line from the grout pump to grout hole. A manifold consisting of a system of valves and a pressure gauge shall be located in the line at the collar of the hole to permit continuous circulation, accurate control of grouting pressure and regulation of flow into the grout hole. The minimum size of the supply line, return line and manifold, including valves and fittings shall be 25mm inside diameter. When sand, rock dust or other additives are required to be incorporated in cement grout, the diameter of the supply line, return line and manifold including valve and fitting shall be suitably increased so that such grout can be conveniently pumped for grouting of foundation. A pressure gauge shall also be placed in the discharge (supply) line at the grout pump. Pressure gauges shall be equipped with gauge savers when pumping grout and the gauge shall be checked frequently to ensure accuracy.

2.11.2 The grout pump shall be so located above the collar of the hole, where practicable, to prevent pressure head in the line from exceeding the allowable grouting pressure at the collar of the hole.

2.11.3 The contractor shall keep in stock at all times, sufficient number and variety of packers to accomplish in the grouting. The packers shall consist of pneumatic tubes or expansible rings of rubber, leather or other suitable material attached to the end of the grout supply pipe. The packer shall be so designed that they can be

expanded to seal the drill holes, capable of withstanding water pressure equal to maximum grout pressures to be used.

2.12.0 Grouting procedure:

2.12.1 Each grout hole shall be drilled to its full depth/stage depth and shall be grouted in stages of depth not more than 3 m up/down. Where necessary because of substantial drill water loss due to rock jointing and /or type of material encountered during the drilling, the grout hole shall be drilled and grouted in successive operations by stages down from the collar of the hole. The method of grouting stage up or stage down shall be as directed by the Engineer.

2.12.2 Where stage up grouting of a hole is directed by the Engineer, the grouting shall be performed by attaching a packer to the end of the grout supply pipe, lowering the grout supply pipe into the hole to the top of the bottom section that is required to be grouted at a given pressure, grouting at the required pressure, allowing the packer to remain in place until there is no back pressure, withdrawing the grout supply pipe and packer to the top of the next higher section that is required to be grouted and thus successively grouting the entire hole in stages at the specified grouting pressures.

In case of stage up grouting, minimum interval of 6 hour be kept between grouting of successive stages in the same hole.

2.12.3 Wherever stage down in grouting in necessary, as determined by the Engineer, the drilling and grouting shall be performed in successive operations, consisting in each case, drilling the hole to the required depth, flushing and grouting that section, cleaning out the grout hole by washing or other suitable means after the grout in the hole attains its initial set but before it attains its final set, drilling the hole to an additional depth, flushing and grouting by fixing packer near the bottom of the previously grouted stage and thus successively drilling and grouting the hole in stages at various depths until the required depth of hole is completely drilled and grouted. Sufficient time lag shall be kept between the completion of grouting for the previous stage and the commencement of grouting for the next stage as directed by the engineer. Pressure as high as practicable and as determined by trails, but safe against rock or concrete displacement shall be used in grouting. Different grouting pressure may be required for grouting different sections of the great holes. 24 hours minimum time shall be allowed between grouting of successive stages the same hole when stage own method is adopted.

2.12.4 If, during grouting of any hole, grout is found to flow from adjacent grout hole in sufficient quantity to interfere seriously with the grouting operations or to cause appreciable loss of grout, such connections shall be capped with valves to allow intermittent bleeding. When grouting is being done with packers, the pressure of the grout returning from any adjacent hole immediately above the point where the grout is entering and such pressure shall be kept below the allowable pressure for the stage of that hole. Where seating a packer or capping is not essential, adjacent holes shall be left to facilitate the escape of air and water as the grout is forced into other holes. Before the ground has set, the grout pump shall be connected to holes from which grout flow was observed and grouting of all holes shall be completed at the pressure specified for grouting. If during the grouting of any hole grout is found to flow or leak shall be plugged or caulked by the Contractor as directed by the Engineer. The grouting of any hole shall be carried out to refusal or grout intake less than one litre per minute under permissible grouting pressure. The maximum permissible grouting pressure shall not exceed 5kg/ sqcm under any circumstances. So far as practicable, the full grouting pressure shall be maintained

during grout injection. As safeguard against rock or concrete displacement or while grout leaks are being caulked, the Engineer may require that grouting be done intermittently, waiting for a period of 8 hours or more between pumping periods to allow grout in the formation to set. After the grouting of holes or connection is completed the pressures shall be maintained by means of stop cocks or other suitable valve devices until the grout has set sufficiently so that it will be retained in the holes or connections being grouted. The consistency of the grout mix shall be varied as directed by the Engineer depending on the conditions encountered. The thickening of the mix during grouting operations shall be done in scientific manner on studying the behavior of the hole and as directed by the Engineer. All the completed grout holes shall be filled upto the top of the hole with thick mix of cement mortar in proportion of 1:3 by weight.

2.12.5 Grouting and clear water test records:

Records of drilling, grouting and testing etc shall be maintained by the contractor neatly, systematically in the manner approved by the Engineer. The exact locations of all holes in relation to proper reference lines and accurate logs of all operations shall be decided in the records. Records, maps and sections shall indicate all stages, connections of holes grouted. All information regarding the grouting operations, amount of grout intake, effects observed in the surrounding holes or rock etc, observations about the behaviour of the holes under air and water pressure, appearance of wash water, quantity and proportion of grout used, time and pressure of grouting applications shall be noted for each hole. A copy of such records shall be submitted to the Engineer daily during drilling and grouting operation. The cost of this shall be deemed to have been included in the unit rate tendered.

2.13.0 Measurement and payment:

2.13.1 Drilling Grout Holes:

Payment of drilling holes for consolidation and curtain grouting will be made for the actual depth of holes drilled into the foundation or concrete as per the direction of the Engineer including the holes drilled in rock or concrete for setting pipe for foundation grouting. Stage depths of drilling grout holes will be measured from the collar of the holes at the exposed surface of the rock or concrete. However, when pipe for grouting is embedded in concrete, the measurement for drilling grout holes will be made from bottom of the embedded pipe.

2.13.2 Payment for drilling grout holes will be made at the unit rate tendered in the ‘Schedule-B’ which shall include cost of furnishing all labour, materials, tools and equipment required for drilling the holes, maintaining the holes free from obstructions until grouted and all incidental works connected therewith, in accordance with specifications. The unit rate shall also include cleaning of all the holes before the grout has set and the drilling for the next stage is taken up for stage grouting. No payment shall be made for re-drilling if required because of Contractor’s failure to clean out a hole before the grout has set. The unit rate shall also include the cost interruptions in drilling operations due to cleaning out holes before further drilling to any amount of moving equipments that may be necessary due to successive stage grouting. The unit rate shall also include mobilisation and de-mobilisation of all men and machinery, cost of dewatering, drainage, de silting, protective works etc., with all leads and lifts. The unit rate for drilling holes shall also include the cost of flushing and cleaning of holes before grouting.

2.13.3 Grouting:

2.13.4 Payment of grouting will be made on the basis of weight of cement in dry state actually forced into the holes.

2.13.5 The unit rate shall include all expenditure on labour, materials, mobilising and demobilising equipments required for carrying out satisfactory grouting work. The unit rate shall also be inclusive of cost of clearing of the site before and after the grouting work, plugging of grout holes with cement mortar, treatment of surface leakage and preparation, maintenance and submission of records and all other incidental operations connected therewith in accordance with the specifications. The unit rate shall also include the cost of repeated movement and installation of equipment required for grouting from time to time due to successive stage grouting. The unit rate shall also include the cost of repeated movement and installation of equipment required for grouting from time to time due to successive stage grouting. The unit rate shall include necessary dewatering, de silting, protective works, drainage with all leads and lifts. The unit rate quoted per tonne of cement for grouting shall include cost of transportation, storing, handling, and mixing, adding additives if any. Grout mix with or without additives rejected because of any reasons such as clogging, spilling, improper mixing, improper operation procedure or failure of equipments or negligence of the contractor will not be measured and paid.

The contractor has to make arrangements for transportation, loading and unloading, stacking, storing handling of cement /additives at work site at his own cost.

2.13.6 Conducting Water Loss Tests:

2.13.7 Payment of water loss test will be made on the basis of number of tests carried out irrespective of depth of holes or the part depth of holes suggested for the test. For example, water loss test carried out in three different stages in a single hole shall be taken as three tests.

2.13.8 Payment will be made once only for each water loss test of a stage of a hole for which water loss testing is directed by the Engineer regardless of the number of times that water under pressure is applied to the hole or re-applied following caulking, surface leaks or because of any other reason which prevents a satisfactory test being completed at the first attempt. Payment for water loss tests for grout holes will be made at the unit rate tendered. The unit rate shall include the cost of all labour, materials and equipments required to perform the work and all other incidental works including saturation of holes before water loss test connected therewith in accordance with the specifications, including dewatering, de silting, protective works etc, complete with all leads and lifts.

2.14.0 SPECIFICATION NO – CONCRETE**2.14.1 Scope:**

This specification covers the item of providing and placing of concrete of various grades in the various components of the project. The scope of work consist of furnishing all materials including shuttering, scaffolding and centring, labour, furnishing, maintaining the operation of all equipment for manufacturing, transporting, placing, compacting, finishing and curing of concrete in the structures included in the Contract and performing all functions ancillary thereto.

2.14.2 Applicable publication:

All concrete and its constituents, methods and procedures of manufacture shall conform to latest revisions of the following Indian Standard Specifications unless other specified.

I.S. 269	Ordinary Portland cement of 33 grade
I.S. 383	Specifications for the coarse and fine aggregates from natural
I.S. 456	Code of practice for plain and reinforced concrete
I.S. 457	General construction of plain and reinforced concrete for dams and other massive structures.
I.S 516	Methods of sampling and analysis of concrete.
I.S 650	Standard sand for testing cement.
I.S 8112	High strength Portland Cement
I.S.1199	Methods of sampling and analysis of concrete.
I.S.1489	Specification for Portland Pozzolona cement
I.S.1791	Batch type concrete mixers
I.S. 2386	Methods of test for aggregates for concrete (Part 1 to 8)
I.S. 2505	Concrete vibrators-immersion type, general requirements.
I.S 2511	Laying in-situ cement concrete flooring
I.S 2750	Steel scaffolding
I.S 3025	Methods of sampling and test (Physical and Chemical) for water in industry (Part 1 to 44)
I.S.3370	Concrete structures for the storage of liquids
I.S.3414	Design and installation of joints in buildings
I.S.3558	Use of immersion vibrators for consolidating concrete.

2.14.3 Quality Assurance:**2.14.4 General practices:**

- i. In order to achieve the required strength and associated properties of concrete, proper control of the water cement ratio by weight need be enforced. The strength shall be prime consideration and W.C ratio as prescribed by Engineer in charge shall have to be observed.

ii. Operators:

The Engineer strictly requires that at no time whatsoever will the mixer operator or those supervising or inspecting the works be permitted to alter, adjust or in particular assess the quantity of water specified by the Engineer for mixing the concrete Batching shall be accurate and as specified by the Engineer.

iii. Water cement ratio:

The water cement ratio will be determined after mix trials arranged by the Contractors in the presence of the Engineer or his representative. If batching is by volume, the Contractor shall be required to fabricate such volumetric batchers and water containers as the Engineer may determine and require so as stimulating the ideas of the trial mix without recourse to assessments by site staff and workmen.

iv. Weighing:

The contractor shall make available always a weighting machine if so required by these Documents, guaranteed by the Contractor for its accuracy, for weighing cement and batches of aggregate as and when the Engineer or his

Representative of his assistant may require. The machine shall be capable of weighing cement and batches of aggregate as and when the Engineer or his representative or his assistant may require. The machine shall be capable of weighing up to 75 kilograms and shall be accurate of half (0.5) Kilograms.

v. **Compaction:** All concrete shall be compacted by vibration just sufficiently so that the appearance of laitance is kept to a minimum and in such manner as directed by the Engineer's representative. Under no circumstances shall concrete be completed by trowels or the like.

vi. **Transport and placing:**

Fresh concrete from the mixer shall be dumped on a clean hard non-absorbant and well drained surface and shall be transported to where required by the quickest and most efficient means so as to prevent pre-set or segregation. Any laitance from previous mixers shall not be remixed.

2.14.5 Testing:

Materials shall be tested as here-in-after specified and unless specified otherwise all sampling and testing shall be performed in the approved testing laboratory, at the Contractor's expense.

Materials

2.14.7 Cement:

Cement shall be procured by the contractor and shall comply with the requirements of IS: 269 or 8112. The testing in the laboratory at the direction of the Engineer, shall perform such tests as are deemed necessary at the cost of contractor. Cement bags or bulk silo shall be tagged for identification at location of sampling. Test will include tensile test and weighing the cement supply to check for net weight received at site, cement shall be stored by the contractor in weather proof silo designed

for the purpose or in dry weather tight and properly ventilated structures floors raised 15 to 20cm above ground non absorption of moisture or flooding. All storage facilities shall be subjected approval by the Engineer and shall be such as to permit easy access for inspection and identification.

Each consignment of cement shall be kept separately and the Contractor shall use the consignment in the order in which they are received. Any cement in drums or bags which have been opened shall be used immediately. Different types of cement shall be kept in clearly marked separate storage facilities. Not more than 15 bags shall be stacked vertically in one pile. Cement shall be stored in double locking arrangement, so that cement transactions can be with the knowledge of supervisors staff. Daily account of cement shall be maintained by contractor in the prescribed register and shall be made available to inspecting authorities for store verification.

The Contractor shall provide from each consignment of cement delivered to the site such samples as the Engineer may require for testing. Any cement, which is, in the opinion of the Engineer, lumpy or partially set be rejected and the Contractor shall promptly remove such cement from the site, as directed by the Engineer. Cement which has been stored on the Site, for more than ninety (90) days and cement which in the opinion of the Engineer is of doubtful quality shall

not be used in the work until it has be retested and tests results show that it complies in all respects with the relevant standards.

2.14.8 Water for concrete mixing and curing:

Water shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of salt, traces of oil, acids, alkalies organic matter and other deleterious materials. The sources of water shall be approved by the Engineer in charge and the containers for conveyance, storage and handling shall be clean. If necessary standard cement tests shall be conducted using the water intended to be used, in comparison with those add distilled water to check quality of water. The water for curing shall be within PH range 4.5 to 8.5. Generally potable water is fit for mixing and curing.

2.14.9 Aggregates for concrete:

- i. **Fine Aggregates:** Sand for concrete work shall be clean, well graded, strong, durable grits particles free from injurious amounts of clay, dust, kankar nodules, soft or flaky particles, shale, salts and other deleterious substances and shall be approved by the Engineer in charge. Maximum size of particle shall be restricted to 5mm minimum being 0.15mm.

(Sand in the area may not be fit for concrete works and will have to be brought from Silchar)

- ii. **Coarse Aggregates:** The coarse aggregate shall generally be cubical in shape broken generally from best trap/granite/quartzite/gneiss stones and as available in the region. It shall be hard, strong, dense, durable clean and of proper gradation free from skin and coating.

The maximum size of coarse aggregate shall be large as possible but no greater than $\frac{1}{4}$ of the minimum thickness of concrete member provided that in case of R.C.C. the size presents no difficulty to surround the reinforcement thoroughly and fill up the corners properly.

In the PCC the maximum size may be of 40m subject to above imitations in absence of any special provision.

For heavily reinforced beams the maximum size shall be restricted to 6mm less than minimum lateral distance between the bars. In case clear spacing between reinforcing bars is 15 cm or less the maximum size of aggregate shall be restricted to 20mm only. Generally for R.C.C works, 20mm maximum size of aggregate shall be satisfactory.

Aggregates will be tested before and after concrete mix is established and whenever character or source of material is changed. Tests will include a sieve analysis to determine conformity with limits of gradation.

- iii. **Samples:** Samples of aggregates 50 kg in weight will be taken by the Contractor as source of supply and submitted to the Engineer before placing orders. These samples if approved shall remain preserved in the Engineer’s care for reference and the type of aggregate used in the works may not be altered without the Engineer’s prior approval.

Aggregates shall be obtained from an approved source and shall conform to the requirements of I.S: 383 and shall be washed clean. For fine aggregate Grading table of I.S: 383 shall be applicable.

Aggregates shall not be flaky or elongated particles, defined as particles having a maximum dimension greater than five times the minimum dimension. Aggregates shall have a water absorption not exceeding two percent when tested in accordance with the standard laboratory tests.

The Contractor shall sample and carry out a mechanical analysis in the presence of the Engineers representative, of the fine aggregate and each nominal size of coarse aggregate in use employing the methods described in I.S: 383 and 2386 at least once in each week when concreting is in progress and as such more frequent intervals as the Engineer may require. The grading of all aggregates shall be within the respective limits specified in the codes and should the fraction of aggregate retained on any sieve differ from the corresponding fraction of aggregate in the approved mix by more than two percent of the total quantity of fine and coarse aggregate. The Engineer may instruct the Contractor to alter the relative proportions of the aggregates in the mix to allow for such difference or may require further trial mixes.

- iv. **STORAGE:** Storage of aggregates shall be provided at each point where concrete is made such that each nominal size of course aggregate shall be kept separated at all times. Contamination of the aggregates by the ground or other foreign matter shall be effectively prevented at all times and each heap of aggregate shall be capable of draining freely. The Contractor shall ensure that graded coarse aggregates are dumped, stored and removed from store in a manner that does not cause segregation. Wet fine aggregate shall not be used until the opinion of the Engineer, it has drained to a constant and uniform moisture content., unless the Contractor with the knowledge of the Engineer measures the moisture of the fine aggregate and added water in each batch of concrete mixed to allow for the water contained in the fine aggregate.

2.14.10 Concrete mixers (For controlled concrete):

The control concrete shall be provided in any RCC works of important structure like Intake works and water retaining structures. The controlled concrete shall conform to I.S. 10262.

2.14.11 Mix design:

Mix is normally a prerequisite to any concreting job and will be required on all major works, if required by the Engineer and approved testing laboratory shall and the contractor’s expense, design a mix for each class of concrete and shall submit full details of mix designs to the Engineer for approval. The Engineer’s representative and the contractor shall clearly code each approved mix with a number and date file all details for identifying and reproducing exactly the same mix.

Each mix design shall be such that the aggregate shall comprise fine aggregate and coarse aggregate of the minimum size specified and the combined aggregate grading shall be continuous. Aggregate shall be calculated by weight and batching produce shall be established. The cement content by weight shall not be outside the minimum limits calculated from the minimum and maximum dry aggregate to cement ratios specified. The water/cement ratio shall be in the region of 0.45 to 0.55 and shall never exceed 0.60.

2.14.12 Preliminary mix:

The proportions of cement, aggregate and water determine by the Contractor in his mix design shall be used in preliminary mix of concrete made and tested for strength and work ability under laboratory conditions observing the appropriate requirements. These preliminary mixes shall be repeated with adjusted proportions as necessary until concrete mixed meeting the requirements of the preliminary and trial mix test specified and with the workability defined herein have been produced. If any time during construction of works the source of cement or aggregates is changed or the grading of the aggregate altered then further preliminary mixes shall be undertaken.

2.14.13 Trial mix:

After the Engineers approval, the preliminary concrete mix design for each class of concrete and during execution based on the preliminary tests, the Contractor shall prepare a trail mix of each class in the presence of the Engineer. The trial mixes shall be mixed for the same time and handled by means of the same plant that the Contractor propose to use in the works. The proportions of cement, aggregates and water shall be carefully determined by weight in accordance with the approved methods, of the fine aggregate and each nominal size of coarse aggregate used.

2.14.14 Water:

Water for mixing concrete, mortar or grout shall satisfy the recommendations of I.S: 456. If required to do so by the Engineer, the Contractor shall take samples of the water and test them for quality.

2.14.15 Admixtures:

Admixtures shall mean material added to the concrete materials during mixing for the purpose of altering the properties of normal concrete mixes. If the Contractor wishes to use admixtures, otherwise than as expressly ordered by the Engineer, he shall first obtain the Engineers written permission. The methods of use and the quantities of admixture used otherwise shall in no way limit the Contractor's obligations under the contract to produce concrete with the specified strength and workability. Concrete of any class containing an admixture shall be separately designed and have separate preliminary test and trial mixes made and tested or approved by the Engineer as if it were a separate class or concrete.

2.14.16 Waiver of mix design and weight batching:

On certain works the Engineer may waive the requirement of designed mixes and may allow the use of established nominal mix proportions, provided always those preliminary trials are made to establish the volumetric batching procedure and mix strengths. The contractor will ensure that any established procedure approved by the Engineer is strictly adhered so as to achieve consistent strength consistent strength, durability and economy of the

concrete while ensuring approved workability of the mix. Any waiver of mix design or weight batching will not relieve the contractor of his obligations to consistently produce concrete of the specified and approved a stress and durability as determined by works tests defined hereinafter. The nominal mix concrete shall be provided generally for the items excluding those mentioned in para 4.5 above. However, in any particular work/ part of work the authority accepting the tender may do, to adopt mix designed (controlled) concrete whose decision in this behalf shall be final and binding.

2.14.17 Workability:

The workability of such class of concrete shall ensure that satisfactory compaction can be obtained when the concrete is placed and vibrated in the works. There shall be no tendency to separate when it is handled, transported and compacted by the methods which the contractor purposes to use when handling, transporting compacting that class of concrete in the works.

2.14.18 Classes of concrete:

All structural concrete shall conform to the following strength and limitations using ordinary portland cement concrete class.

The nominal mix preparations are given herein above only as a guide and are not binding. Mixes shall be designed and controlled within the specified limits of crushing strength and aggregate/cement ratio together with all the stipulation/and specifications with regard to aggregates and water/cement ratio.

Grade of concrete	Maximum Aggregate size	Crushing Strength at 28 days (kg/cm ²)		Total quantity of dry aggregate by mass per 50 kg of cement to be taken as the sum of the individual masses of Fine and Coarse aggregate. max
		Preliminary trial mix test	Minimum works Test	
M 20 (1:1.5:3)	20/40	260	200	160
M 15 (1:2:4)	20/40	200	150	220
M 10 (1:3:6)	40	135	100	300

Trial mix testing:

2.14.19 Cubes:

The Contractor shall make six 150mm compression test cubes in the presence of the Engineer from each trial mix. The cubes shall be made, cured, stored and tested at twenty eight days after manufacture in accordance with the method described in I.S: 516. If the average value of the ultimate compression strength of the mix cubes taken from any trial mix is less than the Trial Mix Crushing strength specified or if any

one cube strength fall below the prescribed the preliminary trial mix, trial mix and set of test cubes.

2.14.20 Workability:

The workability of each trial mix of each class of concrete shall be tested by the contractor in the presence of the Engineer by means of a slump or any other test. If the workability test shows that the workability required is not attained for any trial mix for any class of concrete, the trial mix shall be redesigned by the Contractor and further workability test shall be undertaken for the trial mix of concrete.

2.14.21 Approval:

Only the approved mix of each class of concrete shall be used in the works and if at any time during the construction of the works the source of quality of cement or aggregate is changed or the grading of the aggregate alters, the Engineer may require that further preliminary tests be carried out and further trial mixers of concrete to be made, tested and approved for use.

Formwork:

2.14.22 Quality assurance:

2.14.23 Requirements:

All form works shall be constructed of timber, sheet metal or other approved materials. It shall be firmly supported, adequately strutted braced and tied to withstand the placing and vibrating of concrete and the effects of weather. Designs of structures shown on the Engineer’s drawings do not include any allowance or consideration for imposed construction loads. Three copies of the Contractor’s shoring and formwork drawings shall be submitted to the Engineer for record purposes only and not for review or approval. Forms, shoring and false work shall be adequate for imposed live and dead loads including equipment and men, height or concrete drop, concrete and foundations pressures and stresses, wind pressure, lateral stability and other safety factor during construction. The contractor shall hold solely responsible for any failure and for the safety of work and workmen. He shall pay necessary compensation, if need be, for damage to work, property and injures to persons. The scaffolding hoisting arrangements and ladders shall have easy approach to work spot and afford easy inspection.

2.14.24 Standard and tolerances:

All formwork shall be fabricated by the Contractor at his cost in compliance with the best modern practice, so that the finished surface is even, unblemished, free of fins and true to line, level and shape as shown by the drawings. The forms shall comply with the requirement of I.S: 456. Faces of formwork in contact with concrete shall be free from adhering foreign matter, projecting nails and the like, splits or other defects and all from work shall be clean and free from standing water, dirt, shavings, chippings or other foreign matter. Joints shall be watertight to prevent the escape of mortar causing of formation of fins or other blemishes on the face to concrete. Openings for inspection of inside of the formwork and for the removal of water used for washing down shall be provided and so formed as to be easily closed before placing concrete.

Before placing concrete, all bolts, pipes or any other fixtures which are to be built in shall be fixed in their correct positions and pipe sleeves and other devices for forming holes shall be held fast by fixing to the formwork or otherwise. Holes shall not be cut out in any concrete without approval of the Engineer.

2.14.25 Shop drawings:

Concrete construction joints and expansion joints shall be of the types and at location indicated and shop drawings for approval shall be submitted showing proposed location and type of construction sequence of forming and concrete placing operations. Shop drawings shall be submitted at least 15 working days in advance of from fabrications. The joint shall conform to I.S. 3414.

Materials:**2.14.26 Formwork coating:**

The coating on all formwork shall be of non-staining mould oil that will not leave residual matter on surface of concrete or adversely effect bonding to concrete of any subsequent paint, plaster, mortar or other applied materials. Coatings containing mineral oils, paraffins, waxes or other non-drying ingredients are not permitted. For concrete surface contacting potable stored water, the coatings and from release agents shall be prevented from coming into contact with reinforcement or with concrete at construction joints.

2.14.27 Timbers:

Timber shuttering shall be fabricated from partially seasoned timber, which shall not warp under the effects of the ambient temperature and humidity. Boards shall be strong enough to support the stresses imposed on the shuttering without flexing. The planks shall be shown straight and all edges and planes shall be straight and free from warp.

2.14.28 Joints:

All joints shall be bonded to prevent loss of grout during concreting.

2.14.29 Plywood:

Plywood shall conform to IS: 4990 and shall be braced as necessary. Wooden forms shall be lined with plywood.

2.14.30 Metal forms:

Metal forms shall be true to detail, in good conditions, clean, free from dents, bends, rust and mineral oils. They shall be of adequate gauge with appropriate angle frames.

2.14.31 Moulds:

For grooves, drips, rebates, profiles, chamfers and similar items, smooth finished timber coated with specified from coating shall be used.

Execution:**2.14.32 Shoring on trenches and false work for concrete:**

The loads shall be properly distributed over base area on which shoring is erected, either concrete slabs or ground, if on ground, it shall be protected against undermining or settlement, particularly against wetting of soils and near excavations. The form shall be constructed to produce in finished structure lines, grades and chamfer as required. Jacks, wedges or similar means shall be used and firmly anchored to take any settlement in formwork, which may occur before placing concrete. Chamfers for beams and slabs shall be as indicated.

2.14.33 Form construction:

Form shall be built to exact shapes, sizes, lines and dimensions as required features. Forms shall be made for easy removal without hammering or prying against concrete. Metal spreaders may be used to provide accurate spreading of forms. Construction of forms shall be such that there will be no sagging, leakage or displacement occurring during and after pouring of concrete. Forms shall be coated with specified coating material only prior to placement of reinforcement steel and coating material shall not come into contact with reinforcing bars. Formwork shall be provided to maintain necessary slopes, chamfers etc. as specified.

Field Quality Control:**2.14.34 Control during Concrete replacement:**

Required slab and beam chamfers shall be checked and correctly maintained on concrete placement and to promptly seal mortar leaks.

2.14.35 Defects in formed surfaces:

Workmanship in formwork and concreting shall be such/ that concrete shall normally require no making good surfaces being perfectly compacted and smooth. If any blemishes are revealed after removal of formwork, the Engineer's decisions concerning remedial measures shall be obtained immediately. These measures may include but shall not be limited to the following.

Fins, pinhole bubbles, surface discolouration and minor defects may be rubbed down with sacking immediately after the form work is removed.

Abrupt and gradual irregularities may be rubbed down with Carborundum and water, after the concrete has been full: cured. These and any other defects shall be remedied by methods approved by the Engineer which may include using a suitable epoxy resin or where necessary cutting out to a regular dove-tailed shape at least 75 cm deep and refilling with concrete over steel mesh reinforcement sprung into the dove tail.

2.14.36 Removal of forms and shorings:

Formwork shall be so designed as to permit easy removal without resorting to hammering or levering against the surface of the concrete. The period of time elapsing between the, placing of the concrete and the striking of the form work shall be as approved by the Engineer after consideration of the loads likely to be imposed on the concrete and shall in case be not less than the period shown below, depending on the ambient temperature.

LOCATION OF FORM	Time for striking using ordinary Portland Cement (days)
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i. Beam sides, walls and columns	3
ii. Slab soffits up to 4.5 M Span and beam	7
iii. Slab soffits beyond 4.5 M span and beam soffits up to 6 M span	14
iv. Beam soffits and arch ribs more than 6-M span	21

Sequence of striking formwork shall be approved by the engineer in important structures. The Contractor shall be held responsible for any damage arising from removal of form work before the structure is capable of carrying its own weight and any incidental loading. The contractor shall be wholly responsible for repairing or reconstructing as directed by the Engineer the section of works so affected.

In retaining wall construction shoring and false work shall not be removed until 21 days after concrete has attained at least 90 percent of 28 days compressive Strength as demonstrated by control test cube whichever is earlier. Construction equipment or permanent loads shall not be imposed on columns, supported slabs, supported beams until concrete has attained the 28 days design compressive strength as demonstrated by control test cubes.

2.14.37 concrete curing during removal:

Concrete shall be thoroughly wetted as soon as forms are first loosened and shall be kept wet during removal operations and until curing media or sacking is applied. Potable water supply with hoses or buckets shall be kept ready at each removal location before removal operations are commenced.

2.15.0 Batching:

2.15.1 Cement:

All cement used in making concrete shall be measured by weight either with an approved weighing machine Or by making the size of each batch of concrete such as to require an integral number of complete bags of cement of weight consistent with the requirements Clause 9 of IS: 269. In case of ordinary mixes the cement bag shall be taken to be 50 Kg (35 litre).

2.15.2 Aggregate:

The fine and coarse aggregates shall be measured separately either by volume in gauge boxes made as hereinafter specified or b: weight using machine with weigh batching attachments. For high grade concrete, the fine aggregate and the several nominal sizes of coarse aggregate shall be measured single or cumulatively by weight. The Engineer will rule on this requirement.

2.15.3 Gauge boxes:

Gauge boxes shall be soundly constructed by the Contractor, with the approval of the Engineer and shall be of timber or of steel 10 contain exactly the volume of the various aggregates required for one batch of each mix. They shall have closed bottom, which shall be sand tight. Each gauge shall be clearly marked with the mix code and the aggregate for which it is intended. When calculating the size of the gauge box of fine aggregate due allowance shall be given to the average amount of moisture contained in the stockpiles on the site. Before the contractor shall put any gauge box into use on the site he shall obtain the approval of the Engineer of the size and construction of such gauge box.

2.15.4 Water container

Containers for measuring water shall be soundly constructed of metal to contain the exact quantity of water required for a batch of mix. due allowances having been made for the moisture content of the aggregates, as hereinafter specified, or such fractions of the quantity as are approved by the Engineer. Containers shall have spouts, the spill levels of which determine the quantity. Fixed containers shall be elevated and have overflow pipes, which determine the quantity held in the container and shall have an outlet valve and hose fixed to the bottom of the container. Before any container is put into use the approval of the Engineer shall be obtained.

2.15.5 Weigh-batching:

Weigh batching machines shall provide facilities for the accurate control and measurement of the materials either singly or cumulatively and shall be capable of immediate adjustment of operators in order to permit variations as ordered by the Engineer. All weight dials shall be easily visible from the place at which filling and emptying of the hoppers is controlled

2.15.6 Addition of water and mixing:

i) **WATER** -The addition of water to a mixer shall be controlled such that between five and ten percent of the water enters the mixer before cement or aggregates are batched and a further five to ten percent of water enters the mixer after the said materials have been batched. The remainder of the water shall be added at a uniform rate with the said materials. The water-measuring device shall also be readily adjustable so that the quantity of water added to the mixer can. If necessary in the opinion of the witnessing Engineer's representative be varied. The natural moisture contents of the aggregates shall be determined before the commencement of concreting or at such intervals as may be as necessary or as required by the Engineer.

In consultation with the Engineer's representative, the Contractor shall make due allowance for the water contained in the aggregate when determining the quantity of water to be added to each mix, and shall adjust the amount of water added to each mix to maintain the approved water cement ratio of the mixed concrete. All important concrete shall be machine mixed to give complete coating of cement mortar on each coarse aggregate particle and to produce uniform coloured concrete with uniform distribution of materials. The mixer shall be run minimum 1.50 minutes. In case for a minor job hand mixing is permitted by the Engineer, it shall be done on smooth watertight platform not allowing the added water to flow out. The fine aggregate shall be done on smooth watertight platform not allowing the added water to flow out. The fine aggregate shall be spread in uniform thickness layer over which cement as required shall be placed and they shall be mixed thoroughly to give dry mortar. Water is then added gradually in required proportion, turning the mass, to give designed consistency mortar. The required quantity of coarse aggregate is then placed on mixing platform, wetted and mortar added. The entire mass is turned and retamped to give uniform concrete of required consistency. 5% additional cement shall be used for hand mix concrete (without any extra payment for the additional cement used).

ii. **ADMIXTURES** - Any admixtures approved by the Engineer, which may be used shall be measured separately in calibrated dispenser and shall be added to the mixture together with the water.

iii. **UNIFORMITY OF MIX** -Concrete shall be mixed in batches in Plant capable of mixing the aggregates, cement and water (including admixtures, if any) into a mixture uniform in colour and consistency and of discharging the mixture without segregation.

2.16.0 Contractor's return:

2.16.1 The Contractor shall render to the Engineer, not more than twenty four hours in arrears a daily return for each class of concrete of the number of batches mixed, and total volume of concrete placed, the number of batches wasted or rejected and the weight of cement used. In case of ordinary mixes, where permitted the cement bags consumed for

quantities of various classes of concrete shall be furnished. In addition daily details of time of starting concrete, closure, number of batches through mixer, W.C. ratio, slump date of striking form work etc. shall be maintained. These day to day records shall be authenticated by responsible supervisory staff.

2.17 Plant and equipment:

All mixing and batching plants, boxes, containers and other equipment shall be provided and maintained by the contractor. Concrete Mixer shall be cleaned before commencing mixing and at such intervals as may be directed by the Engineer, the Contractor shall provide weights, containers and equipment necessary for testing the accuracy of the weighing plant and admixture dispenser.

2.18.0 Concreting:

2.18.1 Preparation:

The Contractor shall clear from the surface of the foundation or previously placed concrete all oil, loose fragments or rock, earth, mud, timber and any other foreign matter and shall clear standing water and wash the surface of a previous lift of concrete to the satisfaction of the engineer. Where laitance on a lift of concrete is evident or if a substantial binding between this lift or bay of concrete and the next is required, in the opinion of the Engineer's representative, the contractor shall have the surface wire brushed after initial (one day) set of the concrete or have it bush hammered at no extra cost of the Government. Any reinforcing starter or other bars covered with laitance shall be wire brushed to clean the surface of the metal. As ordered by the Engineer, or as shown on the drawings the formation surfaces on which concrete is to be placed shall be covered with either binding concrete not less than 75mm thick, or water proof building paper or polythene sheeting 0.1 mm in thickness immediately after completion of the final trimming of the excavation.

2.18.2 Inspection:

Concrete shall not be placed until the Engineer has inspected the formwork and the reinforcing steel, and has approved the surface upon which the concrete is to be placed.

2.18.3 Transporting:

Fresh concrete shall be transported from the mixer to its place in the works as quickly and as efficiently as possible by methods which will prevent preset or segregation. If segregation has nevertheless occurred in any instance the materials shall be remixed or discarded at the option of the Engineer.

2.18.4 Placing:

Fresh concrete shall be placed and compacted before initial set has occurred and in an event, not later than thirty minutes from the time of mixing. Concrete shall be carefully placed in horizontal layers which shall be kept at an even height throughout the work, and shall not be allowed to slide or flow down sloping surface but shall be placed in its final position from skips, or similar devices. If this is impracticable it shall be shovelled into position, care being taken to avoid segregation. No concrete shall be dropped more than 1.5m. If greater drops are necessary approved chutes may be used. If the concrete abuts against earth or any other material liable to become loose or to slip, care shall be taken to avoid falls of materials on the surface of the wet concrete.

As far as possible concrete for any particular portion shall be done in one continuous operational living construction joints, if specified in the drawing.

Before commencing subsequent concrete on the one, left incomplete, all the loose particles, laitance etc. shall be removed and surface shall be covered with thick cement slurry. The concrete compacted manually shall be laid in layers not more than 15 to 20 cm. The successive layer shall follow within 30 minutes or earlier.

2.18.5 Compaction:

All concrete placed in situ shall be compacted with power driven or pneumatic internal type vibrators to be provided by the contractor unless otherwise approved by the Engineer in writing and shall be supplemented by hands padding and tamping where required. Vibrating screed type vibrators may be used for thin slabs. There shall be sufficient and spare vibrators of adequate capacity for compact the work in hand. Vibrators shall be inserted into the un- compacted concrete vertically and at regular intervals. Where the un compacted concrete is in a layer above freshly compacted concrete the vibrator shall be allowed to penetrate vertically for about 75mm into the previous freshly compacted layer. The vibrators shall not be allowed to come into contact with the reinforcement or formwork nor shall they be withdrawn quickly from the mass of concrete but shall be drawn back slowly so as to leave no voids. Internal type vibrators shall not be placed in the concrete in any arbitrary manner nor shall concrete be moved from one pan of the work to another by means of the vibrators. The vibrators shall have minimum 3600 (and preferably 5000) impulses per minute. The duration of vibration shall be limited to that required to produce satisfactory compaction of the concrete without causing segregation, vibration shall on no account be continued after the appearance of water or grout on the surface. This shall be permitted exceptionally for small jobs by the Engineer. In such case, compaction shall be attained by means of rodding, tamping, ramming and slicing with suitable tools. The thickness of concrete layers will also be suitable reduced when hand compaction is resorted to.

2.18.6 Under water concreting:

No concrete shall be, placed in, water without me Engineer's written permission, which may only be granted if in his opinion it is not practicable to place the concrete in the dry. Concrete shall not be placed in running water nor shall concrete be allowed to fall through water. Any water entering the area where concrete is being placed shall at the Contractor's expenses is kept clear of the concreting works. If permission is granted the mix shall suitably to strengthen by increasing the cement content and reducing the water cement ratio to no more than 0.45, and the placing shall be only through a bottom opening water tight box approved by the Engineer and shall not be opened until they are resting on the work.

2.18.7 Curing:

All concrete shall be protected from the effects of sunshine, rain, running water or mechanical, and damage and cured by covering with jute, hessian or similar absorbent material kept constantly wet or a layer of sand kept covered in water is also permissible for a continuous period of fourteen days at least from date of placement. Should the contractor fail to water concrete continuously, the Engineer may provide labour, materials required for watering and recover the cost from the contractor.

2.18.8 Finishing:

Immediately after removal of forms any undulations, depressions, cavities, honey combing, broken edges or comers high spots and defects shall be made good and finished with cement mortar 1:2: but the necessity of such finishing shall not exceed 1%. Where concrete surface is to receive plaster the surface shall be roughened immediately after removal of

forms and within a day thereof to secure a hold for the plaster. The rate of concrete is inclusive of this roughening and finishing. Concrete after finishing shall be cured for the full period.

2.19.0 Joints:

2.19.1 Construction joints

Construction joints are defined as joints in the concrete introduced for convenience in construction at which special measures are taken to achieve subsequent continuity without provision for further relative movement. No concreting shall be started until the Engineer has approved the method of placing the positions and form of the construction joints and the size of lifts. The face of a construction joint shall have all laitance removed and the aggregate exposed prior to the placing of fresh concrete. The lenience shall wherever practicable be removed by supplying the concrete surface with water under pressure and brushing whilst the concrete is green the whole of the concrete surface forming part of the joint shall be checked to expose the aggregate. Where aggregate is damaged during hacking, it shall be removed from the concrete face by further hacking. All loose matter shall be removed and the exposed surface thoroughly cleaned by wire brushing and washing down, and the surface to which fresh concrete is applied shall be clean and damp.

2.19.2 Expansion joints:

Expansion joint are defined as joints intended to accommodate relative movement between adjoining parts of a structure' pipes special provision being made where necessary for maintaining the water tightness of the joint.

The joint location and type shall be as indicated in the drawing. The contractor shall comply with the instructions of manufacturers of proprietary jointing materials and shall if required by the Engineer, demonstrate that the jointing materials can be applied satisfactorily and will last the life of the structure.

Flexible water stops shall be fully supported in the formwork, free of nails and clear of reinforcement and other fixtures. Damaged water stops shall be replaced and during concreting care shall be taken to place the concrete so that water stops do not bend or distort.

The surface of set concrete shall not be disturbed and concrete shall be placed against the dry finished surface. If ingress of water or corrosive agents in the joints is possible the space where such steel is continued shall be cleaned and coated with two coats of an approved bituminous paint to a distance not exceeding 10mm.

Where specified the surface of the concrete shall be painted with two coats of an approved bituminous paint, which shall be allowed to dry before placing new concrete against it. Care shall be taken to prevent paint getting on the water stop if any. Expansion joints shall be formed by separating strip of perforated compressible imperishable joint filter to be approved by the Engineer.

2.20.00 Embedments:**2.20.01 General:**

The contractor shall embed/place in position prior to concreting pipes sleeve, fittings and other items including any plant supplied by the Government or by other contractors under the Projects or supplied by himself.

The contractor shall also embed/build in any plant supplied and erected by others. The contractor shall also erect all formwork truss ties and other temporary works to enable the pipes, fittings or plant to be built in. and such formwork shall be designed to allow placing of the concrete or grout so as to fill the void completely, and to enable air to escape from any cavity of the machinery shall be filled with concrete, cement / sand mortar or cement grout as directed by the Engineer.

2.20.02 Concrete:

Concrete shall be of the same class mix as the concrete of member into which the plant is being built, except that the maximum aggregate size shall be as agreed with the Engineer for each particular situation, where required by the Engineer, the mix shall also incorporate the approved expanding grout additive used in accordance with the manufacturer's instructions. In specific situations, the Engineer will require the filling in to be done with cement / sand mortar or with cement grout.

2.21.00 Measurement of concrete:**2.21.01 Classes:****A. CAST-IN SITU**

For concrete cast-in-situ separate measurements shall be made of plain concrete, reinforce concrete for each of the specified classes of concrete.

1. All work in connection with concrete and concreting as specified including formwork and joints shall be taken as included for valuation by the measurement of only such items as are set forth in the Bill of Quantities.

2. Cast-in-situ concrete shall be measured to the limits shown on the drawings and any concrete placed outside such limits by reason of the Contractor's method of working or due to his carelessness or error and whether it has been permitted by the Engineer or shall not be measured for payment except as may be expressly provided otherwise in the Bill of Quantities no deduction from the measurement shall be made in respect of -

- a) the space occupied by any reinforcement, rails, joints or the like embedded in the concrete.
- b) any purpose made hole or opening which has an average cross sectional area less than 0.25 sqm or which has volume less than 0.1 cum.
- c) any portion of chases, rebates, channels, pipes, ducts or the like whose cross-sectional area is less than 75mm dia-meter or side of square or rectangle.
- d) any chamfer less than 150mm wide on the splay.

3. Protection of foundation surfaces or building paper where ordered by the Engineer, shall be measured as the net area so protected and no measurement shall be made of laps of joints.

4. Building in pipes, fittings and plant shall be measured by number or by volume or concrete placed if such volume exceeds 0.1 cum. Building anchor bolts shall be measured by number.

2.22.00 Testing:

Cube tests will be carried out from time to time to ensure quality control of concrete.

From each batch at least 3 tests specimens will be prepared. The average of the crushing strength of the three test specimen shall be taken as the strength of the batch, provided the individual strength of each specimen does not vary beyond 15% of the average.

At least 80% of the batch strengths shall satisfy the design strength (Works Test). In case above is not satisfied, the concrete represented by the tests shall be dismantled.

SPECIFICATION NO: STEEL REINFORCEMENT

2.23.0 Quality:

2.23.1 Steel for reinforcement shall be specified in the drawings. The quality of M.S. bars shall conform to IS 432/1966. High yield deformed bars conforming to IS 1139/1966 and cold worked steel bars conforming to IS 1786/1966.

2.23.2 They shall be of tested quality of not less than Grade-I. It shall also comply with the relevant specifications of IS: 456/1964 and 3370/Part I to IV for water retaining structure. The Contractor shall produce a test certificate of the manufacturer. If independent tests are necessary these shall be carried out according to IS 1521 and 1608 at contractor's cost. The bars shall be cleaned, scraped for removing scales of rust etc. before use, the cutting, hooking, bending, placing in position, binding with fine wire 1.65 mm dia of approved quality will also be included in the item.

2.23.3 Unless or otherwise indicated specified bars shall bent and fixed in accordance with the provisions of IS 2502. The bending shall be done cold with approved bending machine.

2.23.4 During concrete placing, a fitter shall be in attendance to inspect fixed reinforcing bars and maintain bars in correct position at each location. Splices shall be wired, contact lap splices unless or otherwise indicated conforming to IS 456. Welding of the reinforcing bars is not permitted unless indicated or approved by Engineer in writing.

2.23.5 Payment:

The calculated weight of reinforcement detailed on the drawing or otherwise specified and for this purpose the weight of reinforcement shall be taken as 7.85 gms/m for each mm of nominal cross sectional area. Weight given in appendix A of IS: 432. 1966 shall be taken as standard unit weights for various dia. The length shall be measured upto two places to replaces of decimal in metres and weight correct upto 0.1 Kg shall be computed.

SPECIFICATION NO: ANCHORING**2.24.0 Scope:**

This specification covers the item of Providing, fabricating and fixing in the drilled holes 25 mm dia, cold twisted deformed steel anchor rods including the cost of all materials, machinery, labour, cleaning and flushing of holes, grouting with cement slurry, with all leads and lifts etc., complete.

2.24.1 Anchor rods/bolts:

Contractor shall carefully check the location and layout of anchor rods/ bolts to be fixed in foundations constructed, to ensure that the structures can be properly erected as shown on the drawings. Any discrepancy in the anchor bolts/foundations shall be reported to Engineer.

A certain amount of cleaning of foundations and preparing the area is considered normal and shall be carried out by Contractor at no extra cost.

The work of drilling holes for anchoring, cleaning, flushing and grouting shall conform to Standard Practice. The diameter of the hole shall not be less than 45 mm and depth as indicated in the drawing. The material, fabrication and placing in position of anchor rods etc shall conform to fabrication of reinforcement.

2.24.2 Measurement and payment:

The payment for anchoring shall be made on the basis of length of anchor rod fixed which includes cleaning, flushing of holes, providing, fabricating, fixing in position, grouting with cement slurry etc.

SPECIFICATION NO: RANDOM RUBBLE MASONARY**2.25.0 Scope:**

This specification covers the item of Providing and constructing random rubble masonry structure in cement mortar 1:4 by weight with approved stones including cost of all materials, machinery, labour, scaffolding, ramps, cleaning, packing mortar, wedging stone chips, curing, all leads and lifts etc., complete.

2.25.1 Materials:**2.25.2 Stone/rubble:**

All stones shall be quarried from approved quarries only. Stones shall be clean, hard, durable, dense, tough, medium or fine grained and uniform in colour. The stones shall be free from decay, weathered portion or glossy surfaces, soft skin, Weines, flows, cracks, cavities, vesticles and other defects and shall conform to IS:1597 (part I). The stones shall break with a clean fracture and shall make a ringing sound when struck with hammer. The crushing strength in unconfined compression test on 15 cm cubes shall not be less than 750 Kg/Sq. cm, when tested on any plane and the specific gravity shall not be less than 2.6. Stones shall be got approved by Engineer.

Stones absorbing water more than 1% by dry weight after 24 hours immersion in water shall not be used. Stones shall be roughly cubical in shape and each stone shall not weigh less than 35 Kg.

For all works below ground level and buried faces, the masonry shall be done with ordinary quarry dressed stones for hearting and faced with selected quarry dressed stones.

For all work above ground level and exposed faces, the masonry shall be well bonded, faced with hammer dressed stones with squared quoins at joints and corners. The face stones shall have rectangular face. The bed and top shall be dressed to a width of 80 mm and sides to 40 mm. The face stones shall be of 300 mm minimum height. 400 to 450 mm in width and shall be between 500 to 750 mm long and suitable for being built as headers and stretchers. The sectional area of the stone at tail shall not be less than the half the area at its face.

Bond stones shall conform to the specification of hammer dressed face stones except that the length shall not be less than 750 mm. The stones shall be laid at interval not more than 3 m and staggered in alternate courses of masonry.

2.25.3 Cement

The cement to be used for the preparation of mortar shall conform to the specification under concrete.

2.25.4 Sand:

The sand to be used for the preparation of mortar shall conform to the specifications for sand specified under concrete. The sand shall be free from clay, shale, loam alkali and organic matter shall be of sound, hard, clean and durable particles. Sand shall be got approved by Engineer before use. If so directed by the Engineer, sand shall be thoroughly washed till it is free of any contamination.

2.25.5 Water:

The water to be used for the preparation of mortar and for curing/cleaning shall conform to the specifications for water furnished under concrete.

2.25.6 Mortar:

Mortar for masonry shall be prepared as per IS: 250, consisting of an intimate mixture of cement, sand and water mixed thoroughly in an approved type of mixer for a period of at least 1.5 to 2 minutes or as directed by the Engineer. Mix proportion for cement mortar shall be as by weight or as specified by the Engineer. Gauge boxes for sand shall be of such dimension that one full bag of cement containing 50 Kg of cement forms one unit.

For preparing cement mortar, the ingredients shall first be mixed thoroughly before adding water, after making necessary allowance for moisture content in sand. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall preferably be machine mixed, though hand mixing in a thorough manner may be allowed when the quantity involved is very small. The mortar so mixed shall be used within 30 minutes of mixing. Mortar left unused within the specified period shall be rejected.

Retempering of mortar shall not be permitted.

All tests on mortar shall be conducted as and when directed by the Engineer and under supervision of the Engineer, at the cost of the Contractor.

2.25.7 Laying of masonry:

The stones shall be laid in mortar of proportion specified for by the Engineer the particular item of work under. Clean the masonry/concrete/rock surface prior to starting of masonry by wet sand blasting/air water jets as directed by the Engineer. The final preparation of the surface on which the masonry is to be laid shall not be done earlier than a week before the actual laying of masonry.

Immediately before laying masonry the prepared surface shall be moistened and coated with cement slurry of water cement ratio equal to 0.6 by weight, not earlier than 15 minutes prior to actual laying of masonry. Then a layer of mortar 5 to 6 cm thick, of same consistency as that to be used for masonry shall be immediately spread over the slurry and worked into all the depressions and irregularities in the surface, corners and joints.

The stones, before laying shall be dressed using a mason's hammer to knock out weak corners, weathered edge, scales etc. and shall be placed on their flat bed.

The stones shall be kept wet for sufficient time before use to prevent absorption of water from the mortar. The stones shall be laid carefully so as to break joints.

No stones shall tail into the wall either with a point or to length less than 1.5 times its height. The thickness of the joints in face work shall not exceed 25 mm and shall not be less than 12 mm.

Spawls and pins shall not be allowed to show on the face of the wall. At least two bondstones for every 1.0 S-m of wall face shall be provided. These shall be through stones in walls 600mm thick and under

In walls thicker than 600 mm. the length of bond stones shall not be less than 750 cm. The stones for hearting of the wall shall not be less than 150 mm in any direction. Chips and spawls shall be wedged to avoid thick mortar beds and joints. The wall faces, corners and joints of openings shall be truly vertical and or to the slopes indicated in the drawings or as directed by the Engineer. The quoins shall be of selected stones dressed with hammer to form the required angle and laid header and stretcher alternately.

The exposed face of the work shall be carefully and neatly pointed with cement mortar of 1:3 proportions in all joints. On the other side, the joints shall be neatly struck with trowel while the mortar is fresh.

No water shall be added to the mortar at the time of construction of masonry.

The intermediate masonry surfaces shall be as rough as possible to secure good bond between successive layers. The masonry shall not be disturbed until its final setting time and it attains sufficient strength. Hammering or breaking of stones on fresh masonry shall not be permitted.

The masonry shall be raised in courses not more than 60 cm height and unless otherwise directed, the next course shall not be laid earlier than 24 hours after laying of previous course.

Wire brush the masonry surface, if necessary after the mortar has set finally (i.e after 8 to 12 hours), to remove all laitance, excess mortar etc. Work shall be planned in such a way that fresh layers of masonry are started every alternate day. Keep the surface continuously wet/moist until the next layer is placed and the exposed surface shall be kept moist (i.e cured) for a period not less than 21 days, by gently spraying water so as to avoid damage.

The masonry for hearting shall be constructed simultaneously with the masonry/concrete on the face of the structure and both shall be thoroughly bonded.

2.25.8 Measurement and payment:

The unit of measurement shall be one cum or part thereof. Payment shall be made for the quantity of masonry calculated from dimensions shown in the drawings less openings of size 0.1 Sq.m or above. If the cross sectional area of the wall/structure actually constructed is less than the designed section, and accepted by the Engineer, the quantity calculated on the basis of cross sectional area as constructed shall be measured and paid.

SPECIFICATION NO: BACKFILLING WITH SOIL

2.26.0 Scope:

This specification covers the item of Back filling with excavated and/or borrow area soil or soil mixed with rubble and compacting as directed, behind retaining walls, around foundations, cable trenches etc.

2.26.1 Applicable publications:

Back filling work shall conform to the latest revisions of the Indian standard specifications or other internationally recognized standard specifications.

2.26.2 Collection, spreading and compaction:

The material for backfilling shall be soil or soil of boulders, as specified by the Engineer, obtained from borrows area or excavated soil as approved by the Engineer. The materials for backfill shall be free from roots or other perishable and objectionable materials. The materials used shall be those approved by the Engineer. The Contractor shall place the back fill in layers at all such locations indicated in the drawings or as directed by the Engineer. The layers shall be of uniform thickness. Rolling shall be done using sheep foot/flat foot roller in case of cohesive soil and vibratory rollers shall be used for non-cohesive soils. Wherever the working space is not adequate for deploying rollers for compaction of the backfill material, the Contractor shall use mechanical/ pneumatic tampers. When smooth drum roller is permitted by the Engineer, each layer after satisfactory compaction shall be roughened by picking or disc burrowing before placing next layer to provide good bond and homogeneity between successive layers. The clods in fill material shall be broken before watering and rolling to permit satisfactory placement and compaction. The mechanical/pneumatic tampers and in 30 cm layers for rollers prior to compaction and compacted material in each layer shall not be less than 95% of the laboratory maximum dry density. The moisture content of the compacted backfill at the time of compaction shall be as directed by the Engineer.

2.26.3 Measurement and payment:

The payment shall be on the basis of volume content of backfill work done as per specification and drawings. The unit rate quoted in 'Schedule-B' shall be for the finished item of work between the lines and grades as indicated in the drawings or as directed by the Engineer. The rate shall include cost of excavation of soil and sorting out of roots, large rock fragments etc., from the stock pile of excavated material in dump yard or from approved borrow area, transportation, machinery, handling, spreading, placing to lines and grades, watering, tamping by mechanical tampers, compacting by rollers and all other requirements warranted by the specifications. No payment shall be made for backfilling made beyond the required lines as indicated in the drawings or as directed by the Engineer. The Contractor will be permitted to use excavated which shall be paid by the Contractor.

SPECIFICATION NO: EMBANKMENT**2.27.0 Scope:**

This specification covers the item of Forming embankment with soil from approved borrow areas and/or from available excavated materials including excavation, sorting, transportation, spreading to required thickness, watering and compaction of the required density etc.

2.27.1 Applicable publications:

The earthen embankment work shall conform to the last revision of Indian Standard or the other Internationally recognised standard specifications.

IS-2720 (part-ii)	Determination of water content.
IS-2720 (part-vii)	Determination of water content Dry density relation using light compaction.
IS-2720 (part viii)	Determination of water content Dry density relation using heavy compaction.
IS-2720 (part-xxix)	Determination of dry density by core cutter Method.
IS-3764	Safety code for excavation works.
IS-11532	Guidelines for construction of river embankments.

2.28.2 Preparation of foundation:

The foundation, except rock surfaces for embankment shall be prepared by ploughing, levelling and rolling after adding water, if necessary so that the surface in the foundation will be as compact and well bonded with first layer of the embankment.

The rock surface on which the embankment is to be laid, shall be soaked and coated with slurry of Bentonite or clay plus Bentonite. Then the embankment layer is laid with a moisture content of 3% to 5% more than the optimum moisture content.

2.27.3 Collection, spreading and compaction:

The embankment is to be provided with locally available impervious materials either from the approved borrow area and/or from available excavated in the drawings or as directed by the Engineer.

The compacted earth shall consist of impervious soil for homogenous section and for hearing in case of zoned section. For casing zone in case of a zoned section the material shall be semi-impervious or previous soil. All material for embankment shall be from approved borrow area or from excavated material tested and approved by the Engineer. The materials for earth fill shall be free from roots or other perishable and objectionable materials. The materials used shall be approved by the Engineer and the Contractor shall place the earth fill at all such locations indicated in the drawings or as directed by the Engineer.

The borrow area from where the material for embankment is to be obtained shall be stripped upto a minimum of 1.00 m and all stumps, roots, top soil, humus and organic materials shall be removed and dumped as directed. No separate payment would be made for this.

2.27.4 Placing and compaction:

The layers shall be of uniform thickness. Rolling shall be done using sheep foot/flat foot roller for clayey soils and vibratory rollers for gravelly soils. In case of coarse grained soil for casing, smooth drum roller may be permitted by the engineer. Each layer after satisfactory compaction shall be roughened by picking or disc burrowing before placing next layer to provide good bond and homogeneity between successive layers. The clods in fill material shall be broken before watering and rolling to achieve satisfactory placement and compaction. The material for embankment shall be placed in approximately 15 cms thick layers for mechanical tampers and in 30 cms layers for rollers prior to compaction and compacted by the approved mechanical tampers or rollers. The dry density of the compacted material in each layer shall not be less than 97% of the laboratory maximum dry density. The moisture content of the embankment material spread in layer, at the time of compaction, shall be as directed by the Engineer. The embankment shall be laid for 60cm more than the width indicated in the drawings on either side to ensure proper compaction of entire designed width. However these 60 cm strips, which remain un compacted, shall be trimmed off before taking up slope protection works.

2.27.5 Field control:

Contractor shall keep close check on the materials and moisture content and compaction based on the test results.

As and when directed by the Engineer, samples shall be collected from the embankment and got tested for density from an approved laboratory, by the Contractor at his own cost subject to minimum of one test per 100 cum of embankment work. Standard penetration tests shall be conducted as and when directed by the Engineer to ascertain the in situ density of the embankment. Occasional tests shall be carried out to determine the in situ permeability by taking holes for depth not more than 1.5 m in the compacted embankment. The description of taking samples i.e., method and selection of locations for core samples, conducting tests etc., shall always rest with the Engineer.

2.27.6 Raising of embankment:

When the work is stopped at the end of a working season and is to be started in the beginning of next season or after other stoppages, the top surface shall be stripped of all loose and cracked material to the satisfaction of the Engineer, before resumption of work. When the work on the embankment is resumed, the stripped surface shall be rolled adequately and necessary bond shall be provided between the old and the new surface by adequate water, scarifying etc. No extra payment shall be made for such stripping, rolling, scarifying and/or watering involved. The minimum levels of the embankment over the entire length, at the end of a season, shall be at least one metre above the expected maximum water level or as directed by the engineer.

2.27.7 Finishing of embankment:

The top of the embankment shall be raised by 2.5% of the designed height at all sections, to account for the post construction settlement, above the designed top elevation of embankment and the top of berms.

The embankment work shall be given a neat finish as regards line and grades and top of embankment. The entire work and the working area and borrow areas shall be

left neat and clean. All humps and hollows from the neat lines of the embankment shall be graded. Materials used to fill the depressions shall be thoroughly compact and bonded to the original surface. Slopes shall be maintained until final completion and acceptance by the engineer. Any material that is lost by weather action or other causes shall be replaced by the Contractor at his own cost.

2.27.8 Measurement and payment:

The rate quoted in Schedule B for the finished item of work between the lines and grades as indicated in the drawings or as directed by the Engineer and no extra payment for the embankment carried out beyond the lines indicated will be made on any account. The rate shall include cost of excavation, sorting out of boulders and other deleterious materials from the stock pile of excavated material, transportation, machinery, handling, spreading, placing to lines and grades, watering, tamping, compacting etc and all requirements warranted by the specifications. No payment will be made for embankment work done beyond the required lines indicated in the drawings or as directed by the Engineer. Where embankment comprises different type materials, separate measurements shall be taken for different zones but combined together under embankment work for the purpose of payment.

SPECIFICATION NO: GRADED FILTER

2.28.0 Scope of work: This specification covers the item of,

Providing and constructing graded filters, comprising of layers of sand and metal of size 20mm and down and compacting with all lead and lifts. The number of thickness of sand and metal layers shall be specified gradation and from approved source and at locations as indicated in the drawings or as directed by the Engineer.

2.28.1 Applicable Publications:

All materials and workmanship for providing graded filters shall conform to the latest revision of the following IS specifications or other Internationally recognised standard specifications.

IS-383	Coarse and fine aggregate from natural source for concrete.
IS-9429	Drainage system for earth and rock fill dams.
IS-11532	Construction of river embankments.

2.28.2 Materials:

The gradation of the filter materials shall be as indicated below and as specified for sand and metal under concrete.

Description of the layer	Filter material
Sand layer placed over foundation grade or adjacent to embankment soil at either both or one side.	Graded Sand
Metal layer adjoining the sand layers.	Graded metal 20 mm and down.

The Engineer at his discretion may modify the gradation to match the foundation/embankment/backfill materials to satisfy the filter criteria. The contractor shall do the necessary processing of sand at his own cost. The thickness of filter layers shall be as specified by the Engineer.

The particles of decomposed, weathered rock, soft rock, wood, vegetation or any other deleterious materials shall not be used in the filter. The metal shall be crushed rock obtained from approved quarries and shall be free from dust. The filter criteria shall be as per IS-9429 and shall satisfy the following criteria with respect to the adjoining soil material.

The gradation curves of the filter materials shall be nearly parallel to the gradation curve of the base material.

2.28.3 Placing and compaction of filter:

The filter media shall be laid as shown in the drawing or as directed by the Engineer. The number of layers in the filter media and the thickness of each layer shall be as per the drawings or as directed by the engineer.

Before placing the filter layer, the sub grade shall be cleaned and brought to level and line by filling the depressions, if any, with compacted impervious materials as specified under Specification No. 010. The bottom layer of the filter shall be placed, watered and compacted. Subsequent layers shall be laid and compacted in a similar way. The variation in thickness of each layer shall not be more than 25mm or less than the thickness specified in the drawings or as directed. The compaction of the filter media shall be done after watering, by vibratory rollers or by other means approved by the Engineer to obtain a minimum relative density of 70%.

2.28.4 Measurement and Payment:

All materials going into the filter media shall be stacked and premeasured before placing in position. The quantity so measured should be corroborated with the quantity that has gone into embankment or the backfilling.

Measurement shall be for the entire filter media comprising of the specified thickness of each individual layer of graded materials and payment will be made for the quantity of filter on the basis of unit rate quoted.

SPECIFICATION NO: ROUGH STONE PITCHING

2.29.0 Scope of work:

The specification given here refers to the work of Rough Stone pitching. The work to be done under these specifications includes the construction of 30cm thick rough stone pitching over 15cm thick 40mm down size aggregate backing with cost of collection, transportation of stones and metal and laying to the required line and grade including all materials, machinery, labour etc., with all leads and lifts.

2.29.1 Classification:

The items covered under these items are as under.

Constructing 30cm thick rough stone pitching over 15 cm thick 40 mm down size aggregate backing including the cost of all materials, machinery, labour etc., complete with all lead and lifts. The work includes quarrying, collection and stacking of materials, preparing the sub grade to line and grade, laying the backing material and stone pitching to the specified thickness, line and grade, packing, wedging with spalls etc complete.

2.29.2 Applicable Publications:

All materials and workmanship for the construction of stone pitching shall conform to the following Indian Standard Specifications or other internationally recognized Standard Specifications.

IS: 383-1970.	Coarse and fine aggregates from natural sources for concrete.
IS: 1597-1992.	Construction of stone masonry Part-1 Rubble stone machinery.
IS: 7779-1975.	Properties and availability of stones for construction purposes.
IS: 8237-1985.	Protection of slope for reservoir embankments.
IS: 8381-1977	Quarrying stones for construction purposes.

2.29.3 Materials:

All stones shall be obtained from approved quarries only. Stones shall be clean, sound, hard, durable, dense, tough and free from decay, weathered portion, soft skin, veins, flows, cracks, cavities, vesticles and other defects and shall conform to IS 1597 (Part-1). The stones shall break with a clean fracture and shall make a ringing sound when struck with hammer and the specific gravity shall not be less than 2.6. The stones shall not weigh less than 40 kg except the chips/spalls used for packing or wedging. The stones shall be got be approved by the Engineer before use.

The 40 mm down size aggregates for backing shall conform to the specifications of coarse aggregates given under concrete.

2.29.4 Laying of pitching:

The earth surface of the excavation and/or the slope of the embankment to receive the pitching shall first be prepared by scraping/ making up the existing surface to the required line and grade as shown in the drawings or as directed by the Engineer and the pitching shall be laid over 15 cm thick 40mm down size aggregate backing. The thickness of the pitching shall comprise of 0.30 m thick layer of stones and 0.15 m thick aggregate backing. The stone layer shall be formed in a single layer and the stones on the face shall not be less than 25cmsX20cms and 30cms deep at right angles to the slopes. The layers of the pitching shall be done as mentioned in IS: 8237-1985 or its latest revision.

The stones shall have fairly large flat surfaces, as far as possible so as to ensure minimum voids and to obtain a fairly even surface. The stones shall be placed on edge normal to the slopes. Beginning at the bottom of the slope, the stones, shall be laid, hand packed with broken joints and so matched and inter locked that they are keyed together with a minimum of joint space. Rock fragments and spalls shall be tightly driven into the interstices to wedge the pitching stones so as to close direct opening to the under lying slopes. Such fillings shall be carried on simultaneously with placing in position of large stones and shall in no case be permitted to lag behind. The wedging shall be done with large chips, each chip being well driven with a hammer so that no chip can be removed or picked by hand. The distribution of large size stone shall be uniform. High irregular projections shall be knocked off and finished so that the pitching shall present a neat smooth and uniform surface.

A filter backing consisting of 15 cm thick layer of aggregate of size 40mm downsize shall be provided. The aggregate shall be laid over the prepared surface which shall be well watered and compacted and hand packed as shown in the drawing and as directed by the Engineer. The aggregates shall be well graded and shall be free from weathered rock, debris, wood,

vegetation and other deleterious material and compacted with suitable methods approved by the Engineer.

2.29.5 Measurement and Payment:

The measurement and payment shall be based on the area of pitching work done and the unit shall be square meter. The rate quoted for this item shall include the cost of all materials, machinery, labour with all lead and lifts etc. complete including formation of the surface, aggregate backing etc.

SPECIFICATION NO: WATER PROOFING OF PERIPHERAL WALLS

2.30.0 Scope:

This specification covers the item of Water Proofing to outer face of peripheral walls with plastering of specified thickness, with cement mortar of specified proportion as indicated by the Engineer, including preparing the surface, cleaning, application of suitable bonding agent, preparation of mortar with admixture, finishing curing etc, complete with all materials, equipment, tools, labour, all leads and lifts etc.

2.31.0 Applicable Publication:

The work shall conform to the following latest IS Specifications or internationally recognised standards.

IS-269	43 grade Ordinary Portland Cement.
IS-1542	Sand for plaster.
IS-1661	Application of cement and cement-lime plaster finishes.
IS-2250	Preparation and use of masonry mortars.

2.31.1 General:

Sand, cement and water used shall conform to specification No 005 to the extent they irrelevant to this work. Sand shall be clean and preferably natural and passing through 1.5 mm mesh sieve for finishing coat. The grading of sand shall satisfy the IS. Stipulations. Mortar mixing shall be done as per specification No 007.

- i. The faces of concrete/masonry and other surfaces for which water proof rendering is to be done shall be thoroughly cleaned of all organic growth and efflorescence by scrubbing with a tough wire brush and/or by chiselling to provide good bond. The joints in case of masonry work shall be raked to a depth of at least 5 mm and surface cleaned and thoroughly washed with water and wetted for at least 24 hours prior to application of bonding agent and commencement of plastering.
- ii. A suitable polymeric compound shall be applied to the prepared surface to provide good bond between the face of walls and the plastering to be done. The method of mixing/preparation, application of bonding agent shall be as suggested by the supplier/manufacturer.
- iii. The proportion of mortar shall be as specified in ‘Schedule-B’, by weight. The thickness of plastering shall be 20mm or as specified in ‘Schedule-B’ and shall be done in two layers, the first layer being 6 mm thick. The interval between the first be left rough to receive the finishing coat.

2.31.2 Mixing of mortar and plastering:

Cement mortar shall consist of an intimate mixture of sand, cement, water and a suitable water proofing compound mixed thoroughly in an approved type of mixer for a period at least 1.5 to 2 minutes or as directed by the Engineer. Wherever hand mixing of mortar is permitted by the Engineer, sand and cement shall be mixed thoroughly in dry condition before adding water and mixing manually to the required consistency.

The admixture shall be added to the cement in dry state or through water as suggested by the supplier. The dosage, method of mixing, application etc shall be as per the supplier of the water proofing compound. The mortar shall be used within 30 minutes of its mixing. Set mortar shall be rejected.

Plastering shall be done from one end to the other in a continuous manner without construction joints. If a construction joint becomes inevitable, the subsequent work shall be continued after roughening, cleaning of the edge of previous work and applying a coat of bonding agent over edge of the previous work. The mortar shall be used within 30 minutes after mixing plastering shall be done from top to bottom. The plastering surface shall be cured for a minimum period of 14 days.

2.31.3 Measurement and Payment:

The payment for this item shall be for the area of water proof rendering done for the required thickness. The rate quoted in schedule B shall be for the finished item of work and shall include cost of all materials, labour, necessary scaffolding, all leads and lifts, curing etc., complete and no extra payment will be made on any account.

SPECIFICATION NO: RUBBLE AND SAND FILLING**2.32.0 Scope:**

This specification covers the item of Providing and filling with rubble and sand of approved quality below floors and for foundation filling including watering and ramming, all leads and lifts etc., complete.

2.32.1 Applicable codes and specification:

The work covered under these specifications shall conform to latest revisions of the relevant Indian Standards or any internationally recognised standards.

2.32.2 Materials:

Rubble to be used for packing/filling under floors, foundations etc., shall be hard and durable rock, free from veins, flaws and other defects. The quality and size of the rubble shall be subjected to the approval of the Engineer.

- i. Sand to be used shall be natural, hard and durable, free from silt other deleterious substances.
- ii. Rubble shall be hand packed as directed by Engineer. This shall be laid closely in position on the sub-grade. All interstices between the stones shall be wedged in with smaller stones of suitable size well driven to ensure tight packing and complete filling of interstices. Such filling shall be carried out simultaneously with the placing in position or rubble stones and shall not lag behind.
- iii. Small interstices shall be filled with hard clean sand and well watered and rammed.

2.32.3 Measurement and payment:

Payment shall be made for rubble and sand filling work done measured in cum.

SPECIFICATION NO: TURFING**2.33.0 Scope:**

This specification covers the item of Providing turfing for the canal embankment as indicated in the drawings or at location as directed by the Engineer, over 10 cm thick fertile fine soil backing with

cost of collection, transportation of soil and other materials and providing turfing to the required line and grade including all materials, machinery, labour etc., with all lead and lifts.

2.33.1 Turfing:

Turfing shall be done through seeding or planting grass seedlings or through turf cakes. The type of grass to be provided shall be as directed by the Engineer.

The 10cm thick fertile soil layer for backing shall be fine clayee soil obtained from the top layers from suitable borrow area. Roots, clods, pebbles and stones shall not be used for the backing layer.

The embankment slope to receive the turfing shall first be prepared by scraping/making up the existing surface to the required line and grade as shown in the drawings or as directed by the Engineer and the turfing shall be laid over 10 cm thick fertile, fine soil backing.

The turfed/seeded surface shall be watered twice daily for a period of not less than 15 days. Subsequently for a period of another 15 days or as directed by the Engineer watering shall be done once daily. Water shall be gently sprayed using house pipe and a spray tail piece so as not to damage the turfed surface.

2.33.2 Measurement and payment:

The Payment shall be based on the area of turfing work done and the unit shall be square metre. The rate quoted for this item in 'Schedule-B' shall include the cost of all materials, machinery, labour with all lead and lifts etc., complete including formation of the surface, fertile soil backing, watering etc.

PECIFICATION NO: P.C.C. LINING**2.34.0 Scope of works:**

The work to be done under these specifications includes the construction of 55mm thick Pre-cast Cement Concrete (PCC) lining, 25mm thick sand layer backing with cost of collection, transportation of stones and sand and laying to the required line and grade including all materials, machinery, labour etc., with all lead and lifts.

2.34.1 Classification:

The items covered under these items are as under.

Constructing 55mm thick PCC lining over 2.5mm thick sand layer including the cost of all materials, machinery, labour etc., complete with all lead and lifts. The work includes quarrying, collection and stacking of materials, manufacture of PCC slabs, preparing the sub grade to line and grade, laying the backing material and PCC slabs to the specified thickness, line and grade, pointing the joints with CM 1:3, curing etc complete.

2.34.2 Applicable publications:

All materials and workmanship for the construction of stone pitching shall conform to relevant Indian Standard Specifications or other internationally recognised Standard Specifications.

2.34.3 Materials:

All materials like cement, coarse and fine aggregates for the manufacture of PCC slabs and laying and pointing shall conform to the specifications given under concrete to the extent they are relevant to this work.

2.34.4 Laying of PCC slabs:

The canal slope or bed surface to receive the PCC lining shall first be prepared by scraping /making up the existing surface to the required line and grade as shown in the drawings or as directed by the Engineer and the lining shall be laid over 2.5 mm thick sand backing. The size of the PCC slabs shall be 550mm x 550mm x 55mm grove edged as per design. The slabs shall be made out of cement concrete M-15 with 20 mm down approved clean, hard, graded aggregates and properly cured. The manufacturing of PCC slabs shall conform to specifications given under concrete. The total thickness of the liming shall comprise of 55mm thick layer of PCC slabs and 2.5 mm thick sand backing. The PCC slabs shall be laid over the sand layer and gently tamped, jointed matching the groove edges and pointed with cement mortar 1:3. The pointing shall be done as per specifications covered under section 35.

The PCC slabs shall have flat surfaces, square and straight edges, finished smooth. Beginning at the bottom of the slope, slaps shall be laid, joints broken and gently tamped. Joints shall be so matched and inter locked that they are keyed together with a minimum of joint space. The liming shall be done in such a way as to present a neat smooth and uniform surface.

A backing consisting of 2.5 mm thick layer of sand shall be provided. Sand shall be laid over the prepared surface which shall be well watered and compacted as shown in the drawing and as directed by the Engineer.

2.34.5 Measurement and payment:

The measurement and payment shall be based on the area of lining work done and the unit shall be square metre and the rate quoted. The rate quoted for this item in 'Schedule-B' shall

include the cost of all materials, machinery, labour with all lead and lifts etc., complete including formation of the surface, sand backing etc.

SPECIFICATION NO: GUNITING

2.35.0 Scope:

This specification covers the item of Providing guniting in cement mortar including the cost of all materials, machinery, labour, scaffolding, mixing, applying, finishing and curing etc., complete using CM (1:3) proportion, 50 mm thick in two layers with 10 BWG weld mesh of 75 x 25 mm size.

2.35.1 Applicable publications:

All materials and workmanship for providing guniting work shall conform to the latest revisions of the following Indian Standard Specifications or other Internationally recognised Standard Specifications.

IS: 6433	Guniting equipment
IS: 8112	43 grade Ordinary Portland cement
IS: 383	Coarse and fine aggregates from Natural sources for concrete.
IS: 2116	Sand for masonry mortars.
IS:4948	Welded steel wire fabric for general use.

2.35.2 Materials:

The cement, sand and water to be used for the preparation of mortar for guniting shall conform to the specification of mortar.

2.35.3 Guniting:

The surface to be gunited shall be thoroughly cleaned and got approved from the Engineer. The surface so cleaned shall be kept wet till it is covered by first coat of guniting.

The sand and cement to be used for guniting shall be in 1:3 proportions by weight. The quantity of cement and sand required for each batch of mix shall be added dry into the guniting machine and properly mixed for sufficient time so as to get a homogeneous mixture as directed by the Engineer. The dry mix is then fed into the gun through a flexible hose. The water shall be added near the gun nozzle. There shall be suitable regulating devices to vary the water content and air pressure in the nozzle so as to produce the desired consistency of the mortar.

The gun shall be held at an angle and at a distance, optimum from the point of producing maximum coverage and least rebound.

The weld mesh to be used for guniting shall conform to IS 4948-1974 and shall be made out of 10 BWG M.S rods welded together to form a grid of 75 x 25 mm. The weld mesh shall be firmly fixed to the surface to be gunited by means of hooks or by dowel bars drilled into the surface or as directed by the Engineer.

The first coat of guniting shall be 25mm thick on average and shall be applied over the cleaned and wetted surface in a sequential way starting from the top of a reach and proceeding down words. The second coat of gunite shall then be applied in a similar way after a lapse of 12 hours but not later than 72 hours. The top coat shall be neatly done so as to produce an uniform appearance.

The gunited surface shall be cured for 15 days.

2.35.4 Measurement and payment:

Payment shall be on the basis of area of guniting work done shall include for the finished item of work and shall include cost of all materials, labour, machinery, necessary scaffolding, all leads and lifts, curing etc., complete.

SPECIFICATION NO: JOINT FILLER BOARDS

2.36.0 Scope:

This Specification covers the item of Providing and placing in position 20 mm thick Pre-moulded bituminous joint filler boards of approved quality at expansion joints between beams/columns/walls etc., as shown in drawings or as directed by the Engineer including cost of all materials, labour, with all leads and lifts etc., complete.

2.36.1 Materials

Pre moulded joint fillers shall be of non-deteriorating and resilient type conforming to I.S. 1838. Sealing compound shall be grade "A" as per I.S. 1834, Bitumen shall conform to I.S. 702.

2.36.2 Fixing of Joint Filler:

The concrete surface shall be made clean, smooth and free from dirt or loose particles. When the surface is completely dry a coat of hot blown bitumen conforming to IS.702 of grade 85/25 shall be given with brush or spray. When the bitumen is still hot, the pre moulded joint filler fibre board shall be pressed against the surface and held in position, till the time if automatically remains fixed in position. Where the joint filler has been specified in two layers, the second board will be fixed on to the board fixed as above with a few jacking patches of bitumen between the two. After placing the filler in position, the surface of the filler against which further concreting is to be done is given a coat of bitumen.

2.36.3 Filling of Joint Sealing Compound:

Before application of the sealing compound, the sides of the joints are sprayed or brushed with bitumen primer. The primer is then allowed to dry out thoroughly for at least 24 hours and then filled with a mix of 30% fine sand and 70% sealing compound by weight.

2.36.4 Measurement:

Joint filler shall be measured in square metre and sealing compound in linear meters as per dimensions shown in drawings both correct to two decimal places.

SPECIFICATION NO: BRICK MASONRY**2.37.0 Bricks:****2.37.1 Manufacture:**

Common burnt clay building bricks shall conform to the requirements of IS: 1077 and shall be of quality not less than class 200 sub-class A with moisture absorption rate not exceeding 15 percent as defined in IS: 1077. The bricks shall be chamber burnt and shall have sharp corners and smooth faces and shall not be damaged in any manner and sizes shall conform to the works sizes specified within 3 percent.

Burnt clay building bricks for unexposed work shall conform to IS: 1077 and shall be of quality not less than class 200 sub-class B with a moisture absorption rate not exceeding 15 percent.

2.37.2 Samples:

The contractor shall deliver samples of each type of brick to the Engineer and no order shall be placed without the written approval of the Engineer.

All the bricks used in the works shall be of the same standard as the approved samples. The same shall be preserved on site and subsequent deliveries shall be checked for uniformity of shape, colour and texture against the samples. The deliveries varying from the samples will be rejected and removed from the site.

2.37.3 Uniformity:

The bricks selected for exposed pointed brickwork walls shall be of uniform colour, deep cherry red or copper colour and uniform texture.

18.04.00 Samples of the bricks shall be tested in accordance with IS 3495 by the contractor for the compliance of aforesaid before any order is placed and soon after receipt of a consignment tests shall be carried by the engineer’s representative.

2.37.4 Brickwork:

Laying of bricks:

All exposed brick work shall be constructed in accordance with the provisions of IS 2212.

Brickwork shall be uniformly budded, bricks being laid frog upwards. Each brick shall be floated and rubbed in upon such sufficient quantity of mortar that the mortar is squeezed up into the joints, but if such joints are not filled with mortar by this process they shall be flushed up with the mortar from the next succeeding bed.

The coarse shall be laid truly and strictly to line and horizontal level.

2.37.5 Bond:

Brickwork courses shall be alternatively laid in stretcher bond and header bond. Damaged bricks shall not be used for exposed brickwork. All edges and sides shall be kept strictly plumb and square, in line and flush with required finished face. As the work proceeds it shall be continuously checked with a 2m long straight edge and spirit level.

2.37.6 Construction:

Walls shall be carried up in a uniform manner and no one portion raised more than 1 m above another at any one time, the upon and being racked out. Overhang Work shall in no case be permitted. Brickwork shall be cleaned down after each days work and newly laid brick work shall be protected by suitable measures.

In dry weather the suction rate of clay bricks shall be adjusted by wetting as necessary before use. Bricks shall be stored in a free draining area and protected from rain.

Where brickwork rests upon lintels or supporting ribs of concrete, the brick shall be cut as necessary and carefully bedded so that the proper to the outer level of brick work is obtained.

2.37.7 Pointing :

At that time of laying, all joints of exposed brick work shall normally be racked out neatly and pointed to 19th mm depth.

2.37.8 Approval:

All workmanship shall be strictly in accordance with the foregoing. The Engineer of his representative reserves the right to reject any of the work on ground of shabby workmanship. Such rejected work shall be removed and rebuilt to the Engineer's satisfaction.

2.37.9 Mortar:

Quantity of mortar to be used in one cum, of masonry shall a from 0.3 cum for thin masonry to conventional bricks. Ordinary portland cement conforming to IS: 269 shall be used and conform to specifications therefore under section for concrete. Cement and sand shall be mixed in specified proportions and being measured in measuring boxes. The proportion will be by volume on the basis of 50 kgs bags of cement being equal to 35 lit. The mortar may be hand

mixed or machine mixed, but hand mixing will be permitted for small quantities and in exceptional cases.

The water cement ratio may be as under or as directed by the Engineer.

Nominal Mix Cement	Sand	W/C Ratio
1	1	0.25
1	1 ½	0.28
1	2	0.30
1	3	0.40
1	4	0.53
1	5	0.60
1	6	0.70
1	8	0.90

The mortar prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes. The mortar remaining unused after that period or is otherwise damaged shall not be re tempered or remixed.

2.37.10 Curing:

Brick masonry shall be initially protected from sun, rain etc. by wet hessian or straw, till set and thereafter kept continuously wet for fourteen days from the date of laying, unless other length of period is ordered in the special provisions. Watering shall be done carefully in the beginning through a hose so as not to wash the mortar out of the joints. On holidays at the close of day’s work and other periods of cessation of work, the bisti is to be kept continuously for this purpose. Should the contractor fail to water the work to the satisfaction of the Engineer the latter may supply requisite materials and equipment to water the work properly and charge the cost to the Contractor.

SPECIFICATION NO: STEEL/ ALUMINIMUM/ WOOD DOORS AND WINDOWS

2.38.0 Material

All steel Doors, Windows, Fixing and Glazing of Metal Ventilators shall conform to IS: 1038, IS: 1361, IS: 1081 or equivalent as method in specification and on drawings and as approved by the Engineer.

The minimum thickness of glass, if required to be provided shall be 4mm and 5.5mm. If wired glass/toughened glass/ laminated glass is required. It shall be free from flaws, specks, bubbles etc. All panes shall have perfectly squared corners and straight edges. Wood screws M.S. bolts, nuts, screws, washers Peg stays and other fittings shall be treated for corrosion as recommended by relevant Indian standards including Aluminium/Teak wood beating.

2.38.1 Workmanship

Doors, Windows, Ventilators etc. shall be truly square and flat, free from twist and warp. They shall be constructed of sections which have been cut to the required lengths, tenoned and riveted or welded at the corners. The general fabrication shall conform to IS: 1038 and 1361.

If the Contractor is required to supply Doors, Windows, Ventilators etc., he shall obtain them from an approved manufacturer. The Contractor shall first submit for the approval of the Engineer, the name and address of the manufacturer whose metal casement he intends to use, together with typical drawings and specifications describing the details of construction for each type of Door/ Window/Ventilators.

The doors . Windows and Ventilators shall be painted 2 coats of synthetic enamel paint and with one coat of approved zinc oxide chromate red oxide chromate red oxide as indicated in drawing or schedule. All steel surfaces shall first be thoroughly cleaned free of rust, scale or dirt and mill scale by pickling or similar process and then shall be painted with one coat of approved zinc chromate red oxide primer before despatch.

2.38.2 Glazing

All glazing shall be as per IS: 1081. Windows and Ventilators shall be designed for solid drawn steel bedding, glazing fixed from outside. The Doors are to be glazed, they shall be designed for glazing from inside. All windows casements shall have holes drilled in the frames and shutters respectively at suitable places for inserting spring type glazing clips which shall be supplied by the Contractor. Glass panes shall not be placed directly against the metal. A thin layer of putty shall be evenly spread over the glazing rebate and the glass pressed firmly against it.

2.38.3 Fixing:

Doors, Windows and Ventilators shall not be built in, at the time the walls are constructed but shall be subsequently fixed into prepared openings, as laid down in IS:1081. Holes to accommodate the fixing lugs are to be left or cut and the doors and Windows fixed after all the rough masonry and plaster work have been finalised. The M.S lugs of the doors and Windows shall be jammed in cement concrete (M-15 grade) with stone chips (10mm, Down) after erecting and propping in proper position, line and level.

2.38.4 Fittings:

Hardware shall be fixed as late as possible, preferably just before the final coat of paint is applied. It shall be fixed in a workman like manner, so that it may not work loose and in such a way that screws and pins are not marked and mutilated by hammers and screw drivers. It shall be tested for correct operation.

Where specified, doors shall be fitted with a three way bolting device which can be operated by a suitable sufficiently long handle from outside as well as inside and a locking system. Solid steel sliding bolt aldop shall be provided on the outside. In case of doors provided with a service door, the lock shall be fitted on the service door. All materials shall be best procurable and shall conform to the relevant IS specifications, safety bars of 12 mm x 12 mm shall be provided 75 cms c/c horizontally in windows and ventilators at no extra cost.

2.38.5 Ventilators

'S' type steel louvers of pressed steel sheet of 10 SWG (1.2 mm) thickness connected to steel frame of I.S: 1038 and IS: 1381 shall be provided in windows and ventilators as per drawings and direction of the Engineer.

2.38.6 Steel Plate Doors

Steel doors may be of hinged type, or sliding or sliding and folding type, single shutter or double shutter and of double walled construction as specified on the drawings or by the

Engineer. All doors shall be provided with sturdy frame and hold fasts for fixing into the wall. Unless otherwise specified the frame shall be box type prepared from pressed steel sheet of thickness not less than 16 gauge welded at the corners. The shutters shall be made from pressed steel sheet or 18 gauge thickness of hollow space between the double walls and welded/ riveted flush vertically and horizontally to both walls of the shutter using necessary steel plate cleats at joints. The width of stiffeners shall be minimum 150mm at a maximum spacing of 300mm vertically. Horizontal bracings shall be provided in addition along the lock position as lock rail and also if the shutter height is more than 2000mm. The whole shutter shall be of welded construction and shall be hung at the sides by three or four hinges. In the double walled doors hollow space in between should be left to give an overall thickness of 38mm, a threshold plate of mild steel flat 50mm x 10mm shall be provided for the full width of opening shall be provided if required.

In case of steel casement doors with pressed steel sheeting, the shutter shall be double walled type with flat steel sheet of 16 gauge thickness welded to either side of the shutter frame with hollow space in between. The sheet shall be provided with stiffeners both horizontally and vertically welded to inner side of one sheet and suitably fixed by counter sunk screws from outside the other sheet and finally fixed on the steel framing of the shutter by welding. The stiffeners 200mm overall width formed by folding 16 gauge sheet should be fixed vertically along centre and horizontally adjacent to locking handle. In case of a shutter wider than 1000mm, two vertical stiffeners equally spaced centrally shall be fixed for each shutter. Three nos. M.S. lug of angle 25 x 25 x 6 and 300mm long shall be bolted on each side of doors and windows frame in contact with wall for embedding.

All frames and steel plate surfaces shall be painted with two coats of approved synthetic enamel paint over a coat of red oxide zinc chromate primer.

2.38.7 Steel Plate Doors (Flat Sheet Steel Type)

Steel doors may be of the hinged type or sliding folding type, single shutter or double shutter and of single walled or double walled construction, as specified by the Engineer. All doors shall be provided with a sturdy and hold fasts for fixing into the wall. Unless otherwise specified the frame shall be prepared from mild steel angles of size not less than 65 x 65 x 6mm welded at the corners. The shutter shall be made from flat steel sheet of 2mm thickness for normal size single shutter doors, 2 to 3mm for large size double shutter doors with or without service doors, with a frame of mild steel angles not less than 50mm x 50mm x 6mm, all round, suitably braced by means of mild steel flats. The whole shutter shall be of welded construction and shall be hung at the sides by means of three or four hinges as specified in drawings. In the case of double walled doors, the shutter shall consist of two plates each 2.5mm, thick, with the hollow space of 33mm in between to give an overall thickness of 38mm. Where specified, a threshold plate of mild steel flat 50mm x 10mm shall be provided for the full width of the opening. Suitably spaced mild steel lugs shall be welded on the threshold plate for fixing into the floor.

2.38.8 Paints:

All windows, frames, door shutters etc. shall be painted with 2 coats of synthetic enamel paint of approved quality and shear paint over a coat of red oxide zinc chromate primer.

2.38.9 Payment

Payment shall be made on square metre basis of area of opening in the wall. Rate shall include breaking and making good to the walls, sill etc, glazing or louvers, painting, providing and fitting all fixtures and fastening, all labour, materials etc. complete.

2.38.10 M.S.Rolling shutters:

It shall be of approved make, made out of 18 gauge 75mm black lath either mechanically operated from both inside and outside by reduction gear type mechanism or manually operated as per the schedule of rates. It shall be fitted with two self-aligning ball bearing with locking arrangement (both inside and outside) including G.I. housing, hook, M.S. pressed

etc. complete. The hold and cowl portion shall be fixed to obtain full head room up to lintel soffit, They shall be provided with locking arrangements for pad locks, pulling hooks, handles, top cover etc. It shall be painted with two coats of approved paint over a coat of red oxide primer.

2.38.11 Payment

The payment shall be made on square metre basis of area of clear opening in the wall. The rate shall include supplying, fixing and painting the rolling shutters, hood cowl etc. all complete as per specifications and approval of the Engineer-in-Charge.

2.38.12 Bird screen mesh

Bird screen mesh shall consist of 25mm x 25mm x 20 gauge weld mesh placed between a frame work of M.S. angle iron and stiffeners of flats 25mm x 6mm bolted or screwed with washers, nuts at a spacing not greater than 600mm. The entire mesh frame work shall be placed as per direction by the Engineer in Charge. The whole works shall be given one coat of red oxide zinc chromate primer and two coats of synthetic enamel paint of approved colour.

2.38.13 Payment

Payment shall be made on the basis of area covered by bird screen, inclusive of the cost of weld mesh, frame work consisting of angles, flats and necessary fixtures painting with all labour and material etc. complete excluding the building structural work on which mesh is supported.

2.38.14 Aluminium doors

Anodized tubular aluminium doors shall be of approved make shall be of size and design as per relevant drawings.

All moving and fixed frames shall be manufactured from aluminium alloy conforming to IE: HE 9 WP. The door frames and shutter shall be single action or double action as indicated in drawing with spring closer in floor. The glazing shall be 5.5 mm thick toughened glass fixed with necessary gaskets and aluminium beading strip. The door shall be provided with anodized aluminium door handles for full width of the door inside and outside. The average thickness of anodic coating shall not be less than 15 microns. The door frames shall be provided with approved anchors 90 cms c/c maximum for fixing.

2.38.15 Payment

Payment shall be made on square metre basis of finished work. The rate shall include providing all necessary materials, Fittings, Fixtures with labour and fixing in position, breaking concrete or brick masonry to receive frames hinges etc and making good the same. The rate shall also include providing for double action hydraulic floor hinges.

WOODWORK IN DOORS

2.39.0 Scope:

This specification covers the item of Wood works in doors.

Wood used for all work shall be the best of the respective class specified and properly seasoned by at least 6 months air drying, suitable for joiner's work, should be of natural growth, uniform in texture, straight grained, free from sapwood, dead knots, open shakes, boreholes, rot, decay and any and all other defects and blemished.

The thickness specified for joiner's wrought timber are, unless otherwise specified, prior to planning and 3 mm will be allowed from the thickness stated for each wrought faces.

All joining shall be wrought on all faces and finished off by hand with sand paper, with slightly rounded arises.

The joints shall be pinned with hard wood pins and put together with white lead, Jointing shall be by means of mortise and tennon or dovetailed joints as approved.

Any joiner's work which shall split, fracture, shrink or show flaws or other defects due to unsoundness, inadequate seasoning or bad workmanship, shall be removed and replaced with sound material at the Contractor's expense.

Door frames, transoms and mullions shall be rebated. All dimensions shall be as per drawings. The top framing member of doors with sill shall project about 150mm in brickwork. The verticals of door frames shall project about 50mm below finished floor. Surface coming in contact with brick work shall be painted with bitumen as directed by the Engineer. Each of the door frame shall be provided with 2 Nos. M.S. 400 x 40 x 5 mm hold-fasts on each side. These hold fasts shall be embedded in 15 cm thick cement concrete 1:3:6 using 20mm and down size aggregates. The work shall conform to IS: 4021.

The doors shall be panelled as described in the item of work. All panelled doors shall be supplied with approved fittings such as hinges, keyless mortice lock of approved make with handles on both sides, aluminium tower bolts and aldrops, door stops etc., as shown in drawings, Door closers, where separately specified shall be of heavy duty hydraulic type to be approved by the Engineer. Each door leaf shall have two 250mm tower bolts, two aluminium handles and one door stopper mounted near bottom of the door.

The workmanship of all door shutters shall conform to the requirements of IS: 1003 and IS: 2202.

2.39.1 Measurement and payment:

All doors will be measured in s-m. The measurement will be taken to the outside of frame work exclusive of horns, projections etc. The rate quoted shall be all inclusive such as nails, screws, glazing fixtures, fittings, providing peep holes, locking device, handles, door stops etc. The rate shall also be inclusive of 2 coats of synthetic paint of approved quality and shade over a coat of wood prime.

SPECIFICATION NO: CEMENT PLASTERING

2.40.0 Scope:

Specifications hereunder shall cover plastering concrete, stone or brick masonry surfaces in cement mortar of specified prop and specified thickness including scaffolding, curing etc, complete as directed.

2.40.1 Materials:

Cement mortar shall have the proportion of cement to sand as mentioned in the wording of the item or in special provisions and shall comply the following for:

- i) **CEMENT:** Cement shall conform to IS: 269-1967. Ordinary Portland cement shall be used. The weight of ordinary Portland cement shall be taken as 50 Kg per bag. The contractor shall ensure that cement is of sound and required quality before using it. Any cement which has deteriorated caked or which has been damaged shall not be used. The specifications covered under the section concrete shall be applicable in addition.

- ii) **WATER:** Water for mixing cement mortar or concrete shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of silt and traces of oil, acid and injurious alkali, salt, organic matter and other deleterious materials which will either weaken the mortar or concrete or cause of florescence. Water fit for drinking shall generally be found suitable for mixing cement mortar. Water for curing mortar or concrete shall not be too acidic or alkaline. It shall have PH ranging between 4.5 to 8.5.

2.40.2 Fine aggregate:

All fine aggregate shall conform to IS 383-1963 and relevant portion of IS 515-1959.

Sand shall be clean, well graded, hard, strong, durable and gritty particles free from injurious amounts of dust, clay kankar, nodules, soft or flaky particles, shale, alkali., salts, organic matter loom mica or other deleterious substances and shall be approved by the Engineer. The maximum size of particles shall be limited to 3mm. If the fine aggregate contains more than 4 percent of clay, dust or silt be washed.

Sea sand shall not be used. The fine aggregate for cement mortar for masonry and first coat of the plaster should generally satisfy the following gradings.

I.S. SIEVE	PERCENTAGE BY WT PASSING SIEVE
480	100
240	80-95
120	70-90
60	40-85
30	5-50
15	0-10

The fineness modules shall not exceed 3.00. The fine aggregate for cement mortar for joints, pointing and second coat of plaster may have the following grading.

I.S. SEIVE	PERCENT AGE BY WT PASSING SIEVE
480	100
240	100
120	75-100
60	40-85
30	5-50
15	0-10

The fineness modules shall not exceed 1.6. IS-1542/196 shall generally apply for sand for plaster. The fine aggregate should be stacked carefully on a clean, hard surface so that it will not get mixed up.

2.40.3 Proportion:

Cement and sand shall be mixed in specified proportions, sand being measured in measuring boxes. The proportion will be by volume.

The mortar may be hand mixed or machine mixed.

2.40.4 Preparation:

In hand mixed mortar, cement and sand in the specified proportions shall be thoroughly mixed on a clean impervious platform. Fresh and clean water as

specified above shall be added gradually and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be covered completely with a film of wet cement. Wherever specified waterproof compound of approved quality will also be added in a proportion specified by the manufacturer. The water cement ratio may be as directed by the Engineer.

Cement	Sand	Water cement ratio	Quantity of water per 50 Kg of cement (Its)
1	1	0.25	12.50
1	1.5	0.28	19.00
1	2	0.30	15.00
1	2.5	0.35	17.50
1	3	0.40	20.00
1	4	0.53	26.50
1	5	0.60	30.00
1	6	0.70	35.00
1	8	0.90	45.00

Machine mixed mortar shall be prepared in an approved mixer. Water cement ration shall be as per hand mixed mortar. The mortar so prepared shall be used within 30 minutes of adding water, the mortar remaining unused after that period or mortar which had partially hardened or is otherwise damaged shall not be retempered or remixed. It shall be destroyed or thrown away.

2.40.5 Scaffolding:

Scaffolding required for facility of construction shall be provided by the Contractor at his expense. Scaffolding shall be erected with steel sections or pipes, ballies or bamboos of adequate strength so as to be safe for all construction operations. The contractor shall take all measure to ensure the safety of the work and working people. The contractor shall be entirely responsible for any damage to property or injury to persons resulting from ill erected scaffolding, defective ladders and materials or otherwise arising out of his default in this respect. Put log holes shall be made good by stones or bricks to match the formwork when scaffolding is being removed after ensuring that all holes behind are solidly filled in with 1: 4: 8 cement.

2.40.6 Preparatory works:

All joints in the facework that is to be plastered shall be raked out to a depth equal to not less than the width of the joints. In case of new works the raking shall be done when the joint mortar is still green. Smooth surfaces of concrete, old plaster. In case of stone masonry, brushing on the walls to receive the plaster. In case of stone masonry, brushing, brushing on the walls to receive the plaster shall not be more than 12mm. The surface to be plastered shall be cleaned and scrubbed with fresh water and kept for 6 hours prior to plastering.

Patches of plaster 15cm x 15cm shall be put about 3M apart as gauges to ensure even plastering in one plane.

2.40.7 Plastering:

In all plaster work the mortar shall be firmly applied with somewhat more than the required thickness and well pressed into the joints and on the surface and on the surface and leveled with a flat wooden rule to give required thickness. All corners must be finished to their true angles or rounded as directed by the engineer to give neat appearance.

The mortar shall adhere to the masonry surface intimately when set and there should be no hollow sound is any hollow sound when stuck. The plastering shall be preceded from top downwards.

2.40.8 Watering and curing:

All plaster work shall be kept damp continuously for a period of 14 days. To prevent excessive evaporation on the sunny or windward side of the building in hot dry weather, matting or gunny bags may be hang over on the outside of the plaster in the beginning and kept moist. Should the Contractor fail to water the work to the satisfaction of the Engineer, the latter may engage requisite labour, materials and equipment to water the work properly at the cost of the Contractor.

2.40.9 Cement plastering in two coats:

The first coat for R.R. Masonry shall be of 10mm and that for C.R., Masonry would be 20mm. In case more thickness is specified the work shall be carried out in two coats necessarily. The first coat shall be applied as above, but the surface is not floated or polished but roughened to give a key to the second coat of plaster, for this, before the first coat hardness, it shall be combed in wavy lines, 12mm apart and 3mm deep. This coat shall be kept damp for 2 days thereafter and then allowed to dry.

Before starting to apply the second coat, the surface of the first coat shall be damped evenly and second coat applied. The final surface shall be rubbed smooth after floating it with a thick coat of pure cement slurry while the base coat is still fresh. The finished surface shall be true and even, present an uniform texture throughout and all jointing mark shall be eliminated.

2.40.10 Plastering in single coat:

After first coat of plaster is done, the surface shall be rubbed smooth after floating it with thick cement slurry or the neeru finish as the case may be a detailed in pars 7.9. The finished surface shall be true and even and present a uniform texture throughout and all jointing mark shall be eliminated.

SPECIFICATION NO: POINTING

2.41.0 Scope

This specification covers the Item of Providing pointing to stone/ brick masonry in CM (1:3) including raking the joints 2 cm deep, finishing, curing, necessary scaffolding with all leads and lifts etc., complete.

2.41.1 Materials and preparations:

Sand, cement and water used shall conform to Specifications No 005. relevant specifications under concrete/ plastering. Sand shall be clean and preferably natural and passing through 1.5 mm mesh sieve. The grading of sand satisfy the IS stipulations.

The joints of R.R./brick masonry and other surfaces for which pointing is to be done shall be thoroughly raked to a depth of about 20 mm, cleaned of all organic growth and efflorescence by scrubbing with a tough wire brush and/or by chiseling to provide good key. The surface shall be thoroughly wash with water and wetted for at least 24 hours prior to commencement of pointing.

The proportion of mortar shall be 1:3 by weight. The type of pointing shall be flush/struck/stuck pointing as shown in the drawing or as directed by the Engineer.

2.41.2 Mixing of mortar and pointing:

Cement mortar shall consist of an intimate mixture of sand, cement and water mixed thoroughly in an approved type of mixer for a period at least 1.5 to 2 minutes or as directed by the Engineer. Wherever hand mixing of mortar is permitted by the Engineer, sand and cement shall be mixed thoroughly in dry condition before adding water and mixing manually to the required consistency. The mortar shall be used within 30 minutes of its mixing. Set mortar shall be rejected.

Pointing shall be done in squares or steps of nearly 10 square meters. Pointing shall be done from top to bottom. The pointed surface shall be cured for a minimum period of 14 days.

2.41.3 Measurement and payment:

The payment shall be based on the area of pointing work done and the unit shall be sqm. The rate quoted shall be for the finished item of work and shall include cost of all materials; labour, necessary, scaffolding, all leads and lifts, curing etc., complete and no extra payment will be made on any account.

SPECIFICATION NO: STRUCTURAL STEEL WORK**2.42.0 Scope:**

This specification covers the item of.

Design, fabrication, supply, erection, embedment, painting, testing and commissioning of the following:

- i) Embedded parts/ inserts
- ii) Steel supports, brackets, ladders, cable trays etc.

2.42.1 General description:

It is proposed to embed inserts in concrete to provide base for supports, brackets, cable trays etc. This item of work includes providing, detailing, fabrication, embedding in concrete, erection, painting etc. of inserts and the structural portion of the work as directed by the Engineer.

2.42.2 Applicable publication and section:

All the materials, designs, fabrication, transportation, painting and erection of structural steel work, embedded parts, shall conform to the relevant Indian Standards Specifications or other Internationally recognized standards specifications.

Detailed specifications pertaining to structural steel, fabrication, erection, painting, commissioning etc shall be as per relevant I.S.

2.42.3 Designs and drawing:

All components of the structural steel work shall be designed by the Contractor. The general drawings showing the major components will be supplied to the Contractor by the Engineer.

2.42.4 Materials:

All structural steel sections like angles, channels, flats, I-section and other sections used for fabrication shall conform to relevant Indian Standards.

The section shall be well a clearly rolled to the full sections and shall be of the correct size as shown in the drawings. All the members shall be free from sales, blisters, laminations, cracked edges and defects of any other sort.

2.42.5 Fabrication:

The structural steel components and embedded parts shall be fabricated to the dimensions and shape as shown in the drawings or as directed by the Engineer made out of appropriate materials. .

2.42.6 Sleep assembly:

The portion of to shop assembly shall as per Standards.

2.42.7 Shop painting:

The specifications for shop painting as furnished under pertaining shall also apply to this tem of work to the extent they are relevant.

2.42.9 Shop inspection and testing:

The specifications for shop inspection and testing as shall be as per relevant IS or as directed by the Engineer.

2.42.10 Transportation and storage:

The specifications for transportation and storage shall be as per relevant I>S or as directed by the Engineer.

2.42.11 Transportation and storage:

The specifications for field painting as shall be as furnished under painting shall also to this item of work to the extent they are relavant.

Erection:**2.42.12 General:**

The general specifications for erection shall be as per relevant I.S or as directed.

2.42.13 Materials equipment for erection:

The specification for materials and equipments for erection as shall be as per relevant I.S code or as directed by the Engineer.

2.42.14 Measurement and payment:

The payment shall be on the basis of the finished work in all respect at rate quoted for this item, on weight basis. The unit rate quoted shall include costs of all materials, transportation, fabrication, erection and commissioning of the structural steel works including embedded parts, supports etc.

SPECIFICATION NO: PAINTING AND PROTECTIVE COATINGS**2.43.0 General:**

The work included in this section consists of the furnishing of all labour, materials, apparatus, scaffolding and appurtenant work in connections with the painting, in accordance with these specifications, preparations for painting and works b to the requirement of IS 2395.

In general the following surfaces are to be pointed:

- a) All exposed piping and other metal surfaces, interior and exterior.
- b) All submerged metal surfaces.
- c) All structural and miscellaneous steel.
- d) The interior of tanks and wet wells as specified in the painting schedule.
- e) Exterior and interior above ground concrete and brick masonry as specified.

Materials specifications, surface preparations, application, instructions, colour card, sample cards shall be submitted to the Engineer for approval.

The contractor shall leave on the job site a minimum of five liters of each type and colour of finish paint used on the work. Each tin shall be properly labeled for identification.

2.43.1 Materials:

All paint material shall be first quality products manufactured for the exposure involved as approved by the Engineer. The materials used for (1) Prime coat, (2) Intermediate coat and (3) for finished coat and method of application will be as specified.

Workmanship:**2.43.2 Protection of the work:**

The contractor shall take the necessary steps to protect the work of others during the time his work is in progress. The contractor shall be responsible for any and all damages to the work. Paint shall be applied only during period of favourable weather.

2.43.3 Preparation of paint:

All materials specified or selected for use under these specifications shall be delivered up-opened, at the site in their original containers and shall not be opened, at the site in their original containers and shall not be opened until inspected by the Engineer. Paint container shall be opened only when required to use. Paint shall be thoroughly stirred or agitated to uniformly smooth consistency suitable for proper application. In all cases, paint shall be reduced or applied in any way except as herein specifically called for or shall be applied in accordance with the manufacturer’s recommendation.

2.43.4 Preparation of surface:

The contractor shall examine carefully all faces to be finished and before beginning any of his work shall see that the work of traders has been left or installed in workman like condition to receive paint. Metals shall be clean, dry and free from mill scale, rust, grease and oil.

23.03.5 Workmanship:

Each coat of paint shall be applied at the proper consistency and brushing evenly, free of brush marks sags runs with no evidence of poor workmanship. Care shall be exercised to avoid lapping paint on glass or hardness. Paint shall be sharply cut to lines. Finished paint surfaces shall be free from defects or blemishes.

2.43.6 Protective coverings:

Gunny bags or cloth rugs shall be used to protect floors, fixtures and equipment. Care shall be exercised to prevent paint from being spattered on to surfaces, which are not to be painted. Surface from which such paint cannot be removed satisfactory shall be painted or repaired as required to produce a satisfactory finish.

2.43.7 Brushing:

All paint shall be applied by brush unless specifically approved by the Engineer. The brush size and type shall be get approved.

2.43.8 Instruction:

All coatings shall be performed by personnel experienced in the application of said coating systems and in accordance with the manufacturer’s printed instructions. The final appearance shall exhibit uniformly textured and coloured coating free or excessive glass or dull spots, blemishes, sags, runs, pinholes and other defects.

2.43.9 Safety measures:

The Contractor shall take adequate safety measures while painting in enclosed places or when painting is carried out by spray gun.

2.43.10 Right of rejection:

No exterior painting finishing shall be done under conditions which may be jeopardise the appearance or quality of the painting or finished in any. The

Engineer shall have the right to reject all material of work that is unsatisfactory and require the replacement of either or both at the expense of contractor.

2.43.12 Oil painting:

The paint shall be of colour, shade and quality as approved by the Engineer. The paint shall comply with relevant IS depending on the type of paint (i.e. under-coating, finishing, purpose-wise) and mode of application (brush, by spraying etc.) as specified in the item. The paint shall show no curdling, caking, colour separation and shall be in a smooth and homogenous state. It shall show no running or sagging tendencies when applied to smooth and homogeneous state. It shall show no running or sagging tendencies when applied to smooth steel surfaces. The brand (manufacturer) and shade of the paint shall be got approved from the Engineer before procuring the paint. Ready mixed paint shall only be used.

2.43.13 Application:

The primer coat of the paint shall be applied as soon as the surface has been cleaned to avoid deterioration of surface by rust, dirt and dust. The paint shall not be applied when atmosphere conditions are misty to unsatisfactory in the opinion of the Engineer. The surfaces not accessible to brush shall be painted by sprayer or other approved method. The paint shall be applied to produce uniform even coating over the entire surface from streaks and other irregularities. In case of iron and steel works, red lead shall be used for primer coat unless other coat is specified. Painted surfaces shall be protected from Sun, rain, contamination and damage till they dry fully.

2.43.14 Painting new wood work:

The surface shall be finished smooth with plain and rubbed smooth with sand paper of coarse grade (2 ½) followed by rubbing with medium grade and paper (1 ½) No scratches should be left. Approved type of priming coat shall then be applied. The minor defects like small holes, cracks; open joints as already allowed by the Engineer shall be stopped with putty made from pure whiting mixed to proper consistency with raw linseed oil. The work shall be lightly rubbed down smooth before receiving subsequent coat. The coat shall be crossed (across grains) and laid off (along grains) to give uniform coating. The subsequent coats as specified shall be applied only after prior coat dries thoroughly and is lightly rubbed down. Unless otherwise specified the inner surfaces and exposed surfaces shall be applied two or three coats respectively exclusively of primer coat.

2.43.15 Scaffolding:

Specifications given under section of plastering shall apply. Please refer section 7.5.

Providing and applying washable Distemper washable oil bound distemper:

2.43.16 Distemper:

Washable distemper/washable oil bound distemper of approved make; colour and shade shall be used. Washable distemper shall conform to IS 427-1956 and washable oil bound distemper shall conform IS: 428-1969. The brand shall be got approved from the Engineer who shall if necessary call for the sample and ask for sample painting on the surface to be painted before approval.

- 2.43.17 Scaffolding:**
This may be double or single as per section of plastering i.e. Section 7.5.
- 2.43.18 Preparation of surface:**
The surface to be distempered shall be cleaned and all cracks, holes and surface defects shall be repaired with gypsum sand and allowed to set hard. All irregularities shall be sand prepared smooth and wiped clean. The surface so prepared must be completely dry before any treatment is attempted. For the old surface, which had earlier been distempered, the surface shall be cleaned of grease, dust etc. The flaking of previous coatings, if any shall be taken off. All cracks holes and surface defects shall be repaired with gypsum and wiped clean. But in case the surfaces are coloured or white washed, the wash must be removed thoroughly first.
- 2.43.19 Priming coat:**
The priming coat shall be applied over the completely dry surface in the manner recommended by the makers in cases of patented distempers. When no priming coat is specified by the manufacturer a finely powered chalk mixed with a thin solution of glue shall be applied to prepare a good hard background the coating when dry being rubbed as clean and smooth as possible.
- 2.43.20 Application:**
The instructions of makers shall be followed regarding preparation of the surface and application of priming and finishing coats. Distemper shall not be used in larger quantity than actually required for a day's work. Hot water should be used to prepare the mixture. Distempers shall be applied in dry weather with a broad, stiff brush in long parallel strokes. The treated surface shall be allowed to dry and harden. The next coat of distemper shall be laid on exact in the same manner as the first one but only after the earlier coat laid has thoroughly dried. The number of coats to be applied shall be as mentioned in the item. The brushes used should never be allowed to rest on the bristles and after the use they should be cleaned.
- 2.43.21 Cement painting in two coats:**
Cement paint, with a base of white Portland cement of approved make, colour and shade shall be used. Approved quality cement paint shall be only used and shall be brought to site in original airtight containers with seals intact.
- 2.43.22 Scaffolding:**
As per specifications under plastering, described in Section 7.5.
- 2.43.23 Preparing the surface:**
The surface to paint shall be cleaned of all loose dust and dirt, old paints and all cracks, holes and surface defects shall be repaired with cement plaster, cured and allowed to set hard. Before the painting in commenced, the surface is wetted well and water is allowed to run off. Any grease, oil paint, shall be removed by approved methods.
- 2.43.24 Application of paint:**
Mixing of paint and procedure of painting shall be as specified by the manufacturer. When no specifications are furnished, the following specification shall be used. The dry cement paint shall be thoroughly mixed with clean fresh water to produce paint of required consistency (normally that of ordinary paints).The paint shall be kept stirred and used within one hour of

mixing. Hardened or damaged paint shall not be used. The paint shall be applied by brushed in the manner specified by the manufacturer. The paint shall be applied by brushed in the manner specified by the manufacturer. The no. of coats shall be as mentioned in the working of the item. When more than one coat is to be provided, the subsequent coats shall be applied after the proceeding coat has thoroughly hardened, inspected and approved by the Engineer as per manufacture's specifications.

2.43.25 Curing:

Each application of paint should be wetted at the end of the day with a fine water spray. Depending on climate conditions, watering should be only after an interval of at least 6-8 hours after the application. In dry weather the painted surfaces shall be kept damp for at least two days and protected from direct Sun.

2.43.26 Providing and applying white wash in 1/2./3 coats:

General:

The item refers to white washing over old and new concrete, stone masonry, brick or plastered surfaces.

2.43.27 White Wash:

White wash shall be prepared from fresh burnt white stone lime or shell lime. The lime shall be dissolved in a tub with sufficient quantity of water (about 4.0 liters/Kg of lime) and the whole mass well and thoroughly mixed and stirred until it attains the consistency of thin cream. The wash shall be taken out in small quantities and strained through a clean coarse cloth. Alternatively red whiting complying with I.S. 63-1964 may also be used to clean gum dissolved in hot water shall then be added in proportion of 2 gm of gum to a litre of lime or whiting to prevent the site wash coming off easily when rubbed Rice paste may be used instead of gum.

2.43.28 Scaffolding:

This may be double or single according to requirement and shall conform to relevant specification given under section of plastering and described in section 7.5.

If ladders are used pieces of old gunny bags or cloth rags shall be tied on their tops to avoid damage or scratches to the wall. Proper stage scaffolding shall be erected when white washing the ceiling. The contractor shall be responsible for accidents, if any take place.

2.43.29 Preparation of surface:

The surface shall be prepared by removing all mortar dropping and foreign matter and thoroughly cleaned with wire or other means as may be directed by the Engineer to produce an approved and clean surface. All loose pipe and the scale shall be scraped off and the holes stopped with mortar. After cleaning the surface, the unwanted nail is removed and all nail holes, racks and crevices filled with mortar similar in composition to the surface to be filled. The mortar should be cured.

2.43.30 Application:

On the surface so prepared, the white wash shall be laid. Each coat shall be laid on with a brush.

The first stroke of the brush shall be from the top downwards and another from bottom upwards over the first stroke and similarly one stroke from right and another from left over the first brush, before it dry. These will from one

coat, each coat must be allowed to dry and shall be subject to inspection before the next coat is applied. When dry, the surface shall show no signs of cracking. It shall present a smooth and uniform finish free from brush marks and it should not come off easily when rubbed with finger. No portions in the surface shall be left out initially, to be patched up later on. For new work, patches and repairs shall be white washed first. Then after the whole surfaces shall be white washed with the required no. of coats.

Doors, windows, floors and other articles of furniture etc. shall be protected from being splashed upon. Splashing and dropping if any shall be removed and the surface cleaned.

SPECIFICATION NO: FLOORING

2.44.0 Scope:

This specification covers the following different flooring being encountered in Pump House, Control Room, other miscellaneous Building works etc.

- | | | |
|----|--|---|
| A. | Ordinary cement concrete flooring with plain cement finish (Stores area etc.) | - With granolithic (IPC) finish. |
| B. | Abrasion resistant flooring with ironite topping (Pump floor, DG set room etc.) topping. | -With hardonate or equivalent |
| C. | Decorative Flooring (Control room, office etc) Toilets etc.- | -Terrazo (mosaic) tile flooring
-Ceramic tile flooring |
| D. | Battery Room | -Acid resistance tile flooring. |

- 2.44.1** The materials and workmanship shall conform to the provision of the following codes and standard specifications in particular and with such other standards as are mentioned here-in-after.
IS: 269,385,515,653,712,809,1077,1195,1196,1197,1198,1237,1344,1443.

- 2.44.2** Flooring, specially in pump floors, may have to be done in discontinuous strips of areas to suit the needs of erection and commissioning of equipment. Flooring shall be done in close coordination with erection of equipment of other services and shall keep pace with the demands in respect of commissioning of individual equipment or plant units. No claims for extra shall be tenable for reasons for discontinuity of work or delay in having areas available for work.

No extra shall be payable for work such as forming cover at internal angles, nosing at plinths, steps, window sills and stair treads, dishing in bath rooms and toilet and cutting to line and fair finish to top edge of skirting and dado. Thickness mentioned shall be in the minimum.

General requirements:**2.44.3****Cement Concrete Flooring****2.44.4****General**

Flooring shall consist of a sub-base on the compacted earth or sand fill as required, a base course laid on the sub-base and then a finishing layer of concrete. Terrazo or any other material for filing shall be brought from the source as approved by the Engineer.

2.44.5**Filling**

All boulder filling earth as well as Sand shall be carried out as per Standard specification.

2.44.6**Preparation of Bed**

The bed for Flooring shall be prepared either level or sloped as relevant or as instructed by the Engineer. Care shall be taken that there are no roots, vegetation, foreign matter etc.

2.44.7**Sub-Base**

On other prepared bed as indicated above, boulder or gravel or sand or Cement Concrete (1:4:8 as per I.S: 456) shall be laid to thickness as specified in drawings. This layer shall be beaten up with rammers and thoroughly consolidated. All the material used shall conform to the required specifications. The materials, proportion, mixing, laying, curing etc. for cement concrete shall be carried out as specified.

The finished work shall be of uniform depth over the whole floor with surface even and parallel to the prepared bed as per drawing or as directed by the Engineer.

2.44.8**Boulders as Sub-base Coarse**

Boulders shall be laid over the prepared bed as per general specification and shall be of size 100 to 150mm and shall be of approved quality. Boulders being used shall be free from decay, weathering and stacked in such heaps in places as directed by Engineer-in-Charge. The boulders shall be as far as possible cubical in size with sharp angular edges. The boulder coarse shall be packed closely and wedges with hammer to obtain a close fit and rammed to a hard surface or rolled by the Roller as directed by Engineer. The thickness being as specified in the drawings. The boulder shall have mitres joints at the corners of rooms or enclosures and intermediate joints shall be in straight line with the panel joints.

2.44.9**Shuttering:**

The panels shall be bounded by wooden battens or flat iron having the same depth as the concrete floor. These shall be fixed in position, with their top at proper level, giving slope, where required. The surface of battens or flats, to come in contact shall be smeared with soap. Solution or non staining oil before concreting. The flooring shall but against masonry of wall, which shall not be plastered.

2.44.10**Concreting**

Cement Concrete shall be placed in position with or without M.S reinforcement as shown in drawings and beaten with trowel and finished smooth or left rough as directed by the Engineer. Beating shall cease as soon as surface is found covered with cream and mortar. The surface shall be checked with the help of straight edge and made true.

The shuttering shall be removed next day. Care shall be taken to see that edges are not damaged and fresh mortar from adjacent panel is not splashed over them. The joints between panels shall come out as fine straight line. M.S. reinforcement used for concrete base coarse shall conform to relevant IS code. Before placing of these reinforcements, they shall be cleared of scales with wire brush and oily stains removed.

- 2.44.11 Payment**
Base coarse shall be measured on cubic metre basis and the rate shall include shuttering but exclude reinforcement unless otherwise specified. Payment for M.S. reinforcement unless otherwise specified. Payment for M.S. reinforcement wherever used shall be made under the item of M.S. reinforcement irrespective of the size of M.S. rods used.
- 2.44.12 Flooring finish-Plain Cement Finish**
Finishing of the surfaces shall follow immediately after the completion of base coarse. The surface shall be left of sometime till the moisture disappears from it. Use or dry cement or cement and sand mixture sprinkled on the surface to stiffen the concrete or absorb excessive moisture, shall not be permitted.
- 2.44.13 Curing**
Each finished portion of floor, on completion, shall be kept wet with ponding or moist sand as per specifications. At no time, cement concrete layer, plain or reinforced, shall be allowed to dry during curing time.
- 2.44.14 Precautions**
Flooring in water closets and baths shall be laid after fixing of W.C. Pans (Indian type) and floor traps. Traps shall be plugged while laying the floors and opened after the floor is cured.
- 2.44.15 Payment**
Payment shall be made on square mere basis. Rate shall include cost of all materials, shuttering and labour involved in all operations but shall not include the cost of sub-base and base coarse under the finishing layer.
Cost of sub-base and Base Coarse Concrete under the finishing layer.
- 2.44.16 Granolithic-Flooring:**
- 2.44.17** The requirements for filing, preparation of bed, sub-base and base coarse concrete shall be same as in clause 2.0 above.
- 2.44.18 Finishing Layer**
Granolithic finish of the thickness consists of 2 layers of M-15 grade cement concrete.
The bottom layer of concrete shall be laid with 10mm to 6mm graded aggregate and well compacted. Within 15 minutes of laying this coarse, the top layer of 6mm thickness with 6mm down aggregates shall be laid. The cement and aggregates for the top layer shall be mixed dry. After mixing, sufficient quantity of washed sand and water shall be added to make the mix plastic but not following. The mixture shall be laid on the under layer so that the two layers firmly grip together. The top layer shall be well tamped, spaded, trowled and finished with a neat cement punning or with non-skid finish as required. At the junction of adjoining panels a thin string shall be given.
The casting of the granolithic finish layer shall be done in rectangular or square panels not exceeding 1.8 M on any side, using wooden strips of the height equal to the specified thickness of the floor finish. Required slope in the floor shall be given in the base coarse concrete without, reduction in thickness.
- 2.44.19 Curing**
Curing shall be done as per Cl. 2:3:2
- 2.44.20 Payment**
Payment shall be made on square meter basis. Rate shall include cost of all materials. Shuttering and Labour involved in all the operations but shall not include the cement at 2,2 Kg per square metre of flooring shall be mixed with water to form a thick slurry and spread over the surface, while the concrete is still green.
It shall be pressed twice by means of iron floats, once when the slurry is applied and second time when cement starts setting.

The junction of floor with wall plaster, clads or skirting shall be rounded off uniformly where so required up to 25mm radius or as directed.

The men engaged on finishing operations shall be provided with raised wooden platforms to sit on, so as to prevent damage to new work. Where chequering of floor finish is specified, the top surface of floor finish shall be chequered with diamond mesh or similar impression before the finish has set.

Ironite Topping

2.44.21 Mortar

One part of ironite and four parts of ordinary portland cement by weight shall be mixed dry thoroughly on a clean and dry platform. This dry mixture shall be mixed with stone grit 6mm and down size in the ratio of 1:2 (1 ironite cement mixture: 2 stone grit) by volume or as otherwise specified and well mixed over. Just enough water shall then be added to this dry mix for laying.

2.44.22 Laying

The mixture so obtained shall be laid in 13mm thickness or as specified in drawings or schedule of rates on cement concrete base course within 2 to 4 hrs of letter’s laying. The topping shall be laid true to line and level to provide a uniform and even surface. It shall be firmly pressed into bottom concrete so as to have good bond with it. After the starting of initial setting the surface shall be finished smooth and true with steel floats. The laying as usual shall be done in rectangular or square panels not exceeding 1.8m on any side, using wooden strips of height equal to the specified thickness of the floor finish.

2.44.23 Curing:

Curing shall be the same as described in clause 4.3

2.44.24 Terrazzo tile flooring:

2.44.25 Flooring shall consist of a sub-base laid on the compacted earth or sand fill as required, a base course laid on the sub-base and then a finishing layer of concrete. Terrazzo or any other material for filling (Earth or Sand as specified in Drawings) shall be brought from the source as approved by the Engineer-in-Charge.

2.44.26 Preparation of Surface

Base course concrete on which the tiles are to be laid shall be cleaned, wetted and mopped.

2.44.27 Terrazzo (Mosaic) Tile

The tiles shall be approximately 20mm thick of approved shade, colour and chips. The tiles shall be pressure made conforming in all respects of IS:1237

2.44.28 Laying

The bedding for the tiles shall be with cement mortar 1:3 (1 cement : 3 sand) mix as directed by the Engineer. The average thickness of bedding mortar shall be 25mm and the thickness at any place shall be spread, tamped and corrected to proper levels and allowed to harden for a day before the tiles are set.

Over this bedding neat cement slurry of honey like consistency shall be spread at the rate of 4.4 kg. Of cement per square metre. Tiles shall be soaked in water for 20 minutes before laying. Tiles shall be damp but not wet when they are laid. Tile shall be laid in the mortar bedding from centre of area outwards to obtain a symmetrical pattern, each tile being gently tapped with wooden mallet till it is properly bedded and is in level with adjoining tiles. The surface of the flooring during laying shall be frequently checked with a straight edge at least 2m long, so as to obtain true surface with required slope. Fractional tiles shall be used where full tiles cannot be used in the extra space. When extra space left out is less than 25 mm, it shall be filled with coloured mortar and finished to match tiled floor.

The floor shall then be kept wet for minimum period of 7 days. The surface shall receive a wash of neat cement mixed with or without pigment and cured before every grinding operation.

After final polish, surface shall be cleaned and oxalic acid shall be dusted over the surface @ 35 gms per Sq.mm sprinkled with water and rubbed hard with pad of wooden rags and wiped and dried with soft cloth. Finally the finished Terrazo surface is to be rendered with the wax mixed with turpentine or similar approved material. The surface after polishing shall present a glossy appearance. Where machine polishing cannot be done because of small areas, the surface shall be hand polished. In all other respects the process shall be similar as per machine polishing.

2.44.29 Payment

Payment shall be made on square metre basis of the finished work. The rate shall include the cost of all material, labour involved in all operations described above.

2.44.30 Terrazo (Mosaic) in Situ flooring:

2.44.31

Flooring shall consist of a sub-base laid on the compacted earth or sand fill as required, a base course laid on the sub-base and then a finishing layer of concrete. Terrazzo or any other material for filling (Earth or Sand as specified in Drawings) shall be brought from the source as approved by the Engineer-in-Charge.

2.44.32

Material:

Best quality marble chips of uniform tint and colour, 6mm maximum and 3mm minimum size, as approved by Engineer-in-Charge shall be used. They shall be machine crushed free from foreign matters and approved quality

2.44.33

Preparation of surface and Laying Over Base Coarse Concrete

Total thickness of cast-in-situ terrazzo shall be at least 40mm unless otherwise indicated in drawings or schedule of rates. This shall be in two layers, bottom layer 40mm thick of M-15 concrete bedding with 10mm down aggregate of specified thickness and the top layer 10mm thickness, consisting of a mix of cement and marble chips in the proportion of 1L:1/2:2 (1 Cement ; ½ Marble Powder: 2 Marble chips). The bottom layer shall be laid in bay not exceeding 1.2 m on either side and levelled 10mm below the finished floor level.

The cement and marble chips including powder shall be mixed dry. Water shall then be added gradually after thorough mixing until the mix become plastic but not flowing.

Within one hour of laying off the bottom layer of cement mortar, the upper layer of marble chips and cement shall be laid over a coat of cement slurry and the surface tamped lightly and finished to the required level and slope.

While the mortar bed is still plastic, glass dividing strips 35mm wide x 4mm thick shall be fixed on the base coarse concrete with proper anchoring features to allow top edge to be flush with the finished floor. The strip shall be laid forming panels not exceeding 1.2m x 1.2m size.

2.44.34

Curing, Polishing and Finishing

After two hours of laying, the surface shall be covered with wet bags and left undisturbed for six days then the surface shall be ground with carborandum stones.

2.44.35**Mosaic Finished Dado or Skirting**

For Skirting and Dado the brick work or concrete surface shall be raked or hacked as the case may be and shall be well watered for hours. A dubbing coat of cement mortar 1:3 (1 cement: 3 sand) of specified thickness shall be applied so as to bring the surface shall be scarified by lines with trowel so as to receive the top layer of cement and marble chips proportion of 1:1/2: 2 (1 cement: ½ Marble: 2 Marble chips) of 7mm thickness with 3.5mm size chips and shall be laid, polished etc as described above for flooring.

2.44.36**Payment**

Payment shall be made on metre basis of the finish work. The rate shall include the cost all material, labour involved in all the operation described above.

2.44.37**Ceramic tile flooring:**

Flooring shall consist of a sub-base laid on the compacted earth or sand fill as required, a base course laid on the sub-base and then a finishing layer of concrete. Terrazo or any other material for filling (Earth or Sand as specified in Drawings) shall be brought from the source as approved by the Engineer-in-Charge.

2.44.38**White/Coloured Glazed Tiles**

Tiles shall conform to relevant IS code in all respects and shall of approved quality and make These shall be flat, true to shape and of uniform shade. These shall also be free from cracks, spots, chipped edges and corners. Thickness of tiles shall be 10mm.

2.44.39**Preparation of Surface and Laying**

Base Coarse concrete of R.C.C slab on which tiles are to be laid shall be well cleaned, wetted and mopped. The bedding for the tiles shall be with cement mortar 1:3 or as specified. The average thickness of the bedding shall be 12mm while minimum under any portion of tile shall be not less than 10mm.

Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and also to enable the mason to place wooden plank across and to sit it for the work.

Over this mortar bedding neat grey/white cement slurry of honey like consistency shall be spread, at the rate of 3.3Kg per square metre. Tiles being gently tapped with a wooden mallet till it is properly bedded in level with adjoining tiles.

2.44.40**Joint**

The joints shall be uniform and as thin as possible and run in straight lines or to suit the required pattern. Where full size tiles cannot be fixed, these shall be cut to the required size and their edges rubbed smooth to ensure straight and true joints.

Tiles which are fixed in the floor adjoining the wall shall enter not less than 13mm under the plaster, skirting or dado. The junction between will plaster and tiled work shall be finished neatly and without wavings.

After the tiles have been laid surplus cement grout that may have come and of the joints shall be cleaned off.

- 2.44.41 Curing, Pointing and Finishing**
The joints shall be cleaned of the white/colour cement grout with a wire brush or trowel to a depth of 5mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement. Flooring shall be kept wet for 7 days. The tiled surface shall then be cleaned with a 3% solution of oxalic acid or neutral soap solution as directed by the Engineer.
- 2.44.42 Payment**
Payment shall be made on square metre basis of the finished work. The rate shall include the cost of all material, labour involved in all the operations described above.
- 2.44.43 Precast flooring;**
Precast R.C.C. floor panels of approximately 1.0 x 1.0M shall be cast true to dimensions as shown on drawing. The concrete grade shall be as specified on the drawing. Specification for Plain and Reinforced Concrete and for precast Concrete and 6-68-04 shall generally be followed. The top surface of the precast slabs shall be finished rough and hardened with sodium silicate solution. The sodium silicate solution shall be diluted with four times its volume of water, well stirred and sprayed over the surface with a watering can and brushed evenly with a soft broom. The solution shall be applied in three coats, each coat shall be allowed to dry for 24 hrs before the next coat is applied. Each coat shall be scrubbed with water after it has hardened for a better condition for the application of succeeding coats. The surface of concrete to be treated shall be thoroughly cleaned of any grease or dirt after completion of the curing period before the solution is applied. The floor panels shall be laid over a compact layer of sand cushion and keyed together. The joint between two panels shall be filled with bitumen sealing compound.
- 2.44.44 Payment**
Payment shall be made based on Cubic content of precast slabs. The rate quoted shall include cost of form work, finishing as specified, curing, handling and placing in final positions, bitumen sealing, preparation of casting and storage yard etc. inclusive of all labour and materials. Reinforcements shall be paid separately.
- 2.44.45 Kota stone flooring
Stone Slabs**
The slabs shall be selected quality, hard, sound dense and homogenous in texture, free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness varying from twenty-five (25) mm to forty (40) mm or as specified in schedule of rates and they shall be of uniform colour. The slabs shall have the top (exposed) face polished before being brought to site. Before starting the work Contractor shall get the samples of slabs approved by the Engineer-in-Charge.
- 2.44.46 Dressing of Slabs**
Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The slides (edges) shall be table rubbed with coarse sand or machine rubbed

before paving. All angles and edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane. For staircase treads, single pipe slab to full length and width of treads shall be provided. The nosing shall be rounded off and two parallel grooves ten by ten (10mm x 10mm) immediately behind the nosing edge shall be provided as per drawing to avoid skidding. Square or circular holes shall be made carefully to accommodate M.S. Baluster in position as indicated on drawings.

2.44.47

Preparation of Surface and laying

Sub-grade concrete of the RCC slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1;3 (1 cement : 3 Coarse sand) the average thickness of the bedding mortar under the slab shall be twenty (20) mm and thickness at any place under the slab shall not be less than twelve (12)mm.

The slabs be laid in the following manner:

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed and cleaned before laying. It shall be laid on top, pressed tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar is allowed to harden a bit and Slurry of honey like consistency shall be spread over the same at the rate of 4.4kg. of cement per square metre. The slab to be paved shall be lowered gently back in position bedded in level. Subsequent slabs shall be laid in the same manner and joints between adjacent slabs shall be thin as possible and run in straight line. After each slab has been laid, surplus cement grout coming out of the joints of the slabs shall be cleaned off. The surface of the flooring as laid shall be true to levels, lines and shapes as instructed by the Engineer-in-Charge.

The slabs shall be matched as shown in drawings or as instructed by the Engineer-in-Charge. Slabs which are fixed in the floor adjoining the wall shall enter not less than twelve(12) mm under the plaster skirting or dado. The junction between wall plaster and the floor shall be finished neatly with out waviness.

2.44.48

Curing, Polishing and Finishing

The floor shall be kept wet a minimum period of seven (7) days. The surface shall thereafter be ground evenly with machine fitted with fine grade grit blocks (No. 120). The final grinding with machine fitted with the finest grade grit blocks (No.320) shall be carried out the day after the first grinding described above or before handling over the floor, as ordered by the Engineer-in-Charge.

For small areas or where circumstances so require, hand polishing may be permitted in lieu of machine polishing after laying. For hand polishing the following carborundum stones, shall be used.

1 st grinding	-	Medium grade stone (No.8)
Final grinding	-	Fine grade (No.120)

In all other respects, the process shall be similar as for machine polishing.

After the final polish, oxalic acid shall be dusted over the surface at the rates of thirty three (33) gms per square metre sprinkled with

water and rubbed hard with pad of wooden rags. The following day the floor shall be wiped with a moist rag and dried with a soft and finished clean.

If any slab is disturbed or damaged, it shall be refitted or replaced, properly jointed and polished. The finished floor shall not sound hollow when tapped with wooden mallet.

2.44.49**Payment**

The stone flooring shall be measured in square metre (M2). Length and breadth shall be measured between the finished faces of skirting, dado or wall plaster as the case may be, correct to a cm. No deduction shall be made upto 0.050 Sq. m. No extra shall be paid for laying the floor at different levels in the same room. Steps and treads of stairs paved with stone slabs also be measured under the item of “Stone Flooring.”

The rate shall include the cost of all materials and labour involved in the operations described above.

2.44.50**Acid proof tile flooring:**

This shall conform to relevant I.S code, including laying, mortar, curing, payment etc.

SPECIFICATION NO: GLAZED/CERAMIC TILE WORK**2.45.0 Scope:**

This specification covers the item of.

Providing and laying Ceramic tiles of BELL or equivalent quality using 200 x 200mm sized tiles of approved colour for dadoing, set over a bed of 1.5 to 2cm thick C.M 1:3 proportion including pointing, curing, cutting chase in walls, where so specified, including the cost of all materials, labour with all leads and lifts etc.

2.45.1**Glazed/Ceramic tile work:**

The glazed tiles in paving and dado shall be of the best available first class quality approved by the Engineer and they should be laid on a base of 20mm thick cement mortar of 1:3 proportion. The tiles shall be of standard size without warp and with straight edges true and even in shape and size and of uniform colour. They shall be laid truly vertical on walls and truly horizontal on floors or to slopes as directed. The joint shall be very thin uniform and perfectly straight. The joint shall be floated with white cement as approved by the Engineer. At the top of dado work, a coloured glazed tile border 75 mm deep shall be provided as approved by the Engineer. The rate quoted for paving and dado work shall be inclusive of angles, corner pieces and approved colour border on top. Glazed tiles shall conform to I.S: 177

2.45.2**Payment**

All work shall be measured in sqm unless otherwise stated. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding to 0.1 sqm.

SPECIFICATION NO: LIME TERRACING CONCRETE (FOR FLAT ROOF)**2.46.0 Material**

Brick ballast shall be 25mm nominal size and lime Mortar shall be 1;2 Mix (1 lime putty: 2 surkhi). The volume of wet mortar to be mixed shall be 50 percent of stacked volume of brick ballast. For specification of the material and method of preparation of lime concrete relevant IS: 2250 and IS: 1625 shall be referred.

2.46.1 Preparation of Surface

The surface shall be cleaned with wire brush to receive Lime Concrete above it.

2.46.2 Laying

Lime Concrete shall be laid in a single layer and spread and lightly rammed with .5 kg rammers to the specified average thickness, slopes and levels.

The Lime Concrete shall be then further consolidated by two rows of labourers sitting close and beating the same in unison using wooden beaters across the entire width of the roof surface and this should progress slowly along the length of the roof. This beating shall be continued for three to four days or until the Mortar is almost set. Always fresh Concrete shall be used.

While the beating is in progress, the surface shall be liberally sprinkled with a mixture of Molasses and boiled solution of bael fruit in the proportion of 1.75Kg of Molasses to 1.0g. Bael fruit boiled in 60 litres of water.

As soon as the beating is completed to the satisfaction of the Engineer, the slurry that has come on the top shall be softened by the addition of the solution of molasses and Bael and smoothed with a float or trowel to a fine polish. No plaster shall be used on any account for finishing the roof.

2.46.3 Curing

The lime concrete shall be kept wet after each days work and for a period of 25 days or as the Engineer may direct.

2.46.4 Finish:

The slope of the finished terrace shall not be less than 1 in 120 unless a flatter slope is permitted by the Engineer in writing. The roof surface shall slope from all sides towards the outlets. The lime Concrete shall be rounded at the junction of roof slab and parapet. The finish shall present a smooth surface with correct slopes and uniform roundings. The lime concrete should be leak proof and free of cracks.

The average finished thickness of the laid lime concrete over the entire area shall conform to the average thickness specified in the item.

2.46.5 Payment

Payment shall be made on the basis of covered area in Square metre including cost of preparation and treatment of corners edges and openings, water proofing as specified, labour, material etc. complete.

2.46.6 Water proofing of roofs bitumen felts (for flat for inclined roof):

The surface to be treated shall have minimum slope 1 in 80. This grading shall be carried out with lime concrete cement concrete, light-weight foam concrete, or cement plaster with coarse sand to the average thickness required and finished smooth.

Tucking of the water proofing felt will be required where the parapet wall exceeds 450mm in height from graded surface. For this a horizontal groove 75 x 75mm section with its lower edge at not less than 140mm above the graded roof surface shall be left during construction or cut out neatly if it has not been provided during the construction of the parapet wall.

Where the height is 450mm or less water proofing treatment shall be carried over the top of parapet or dwarf walls to its full thickness and on horizontal grooving in parapet wall is needed for tucking.

The graded surface of the roofs shall be thoroughly cleaned with brush and all loose scales etc. removed. Any cracks in roof shall be cut to ‘V’ section and filled up with cement-Mortar slurry 1:4 or an air blow bitumen of IS; 85/25 grade or equivalent conforming to I.S: 702

2.46.7 Priming Coat

Priming coat consisting of a bituminous solution of suitable viscosity shall be applied on the roof and wall surface at specified weight per unit area.

2.46.8 Under lay

Where water proofing treatment is required to be isolated from structure a layer of bitumen saturated felt (under lay) shall be spread over the roof surface and tucked into the flushing groove. No bonding material shall be used below the under lay in order to keep under lay free of the structure.

The adjoining strips of under-lay shall overlap 75mm at sides and 100mm at ends. The over lap shall be sealed with sealed with the same bonding material as used for self finished felt treatment. Underlay shall be type-1 saturated felt conforming to IS: 1322 in all respects.

2.46.9 Water Proofing Treatment

The water proofing shall consist of a four layer self finished bitumen felt treatment as directed by Engineer.

A four layer self finished bitumen felt treatment shall consist of the following coarses:

Course	Kg/M2	Coating Material
	0.50	Asphalt Primer
1 st	1.20	Hot applied bitumen
2 nd	-	Self finished bitumen felt of type II grade I
3 rd	1.20	Hot applied bitumen
4 th	-	Self finished bitumens felt of type III grade I
5 th	1.20	Hot applied Bitumen
6 th	-	Self finished bitumen felt of type III grade I
7 th	1.20	Hot applied bitumen
8 th	-	Self finished bitumen felt of type III grade I
9 th	1.20	Hot applied bitumen
10 th	0.006 M3/M2	Stone grit or pea gravel

-----26.02.05

Asphalt Bonding Material

This shall consist of Air blown bitumen conforming to IS: 702

The penetration of bitumen used shall not exceed 40 in any case. Generally blown bitumen of low penetration shall be used for the base and intermediate layers of bonding material.

2.46.10 Self finished Bitumen Felt

The selffinished felt, shall be of brand and manufacture conforming to the type and grade as specified by the approved manufacturer's or directed by Engineer. They are fibre base or hessian base felts. These shall conform in all respects to IS: 1322.

2.46.11 Stone Grit and Pea Gravel

Stone grit shall conform to specifications of stone aggregate and shall be 6mm down size. Where peagravel is used it shall be hard, round and free from dust , dirt etc. Stone grit or pea-gravel shall be spread uniformly at the specified volume per unit area. This shall not be spread over vertical and sloping faces and at drain mouths. At these places the surface shall be painted with two coats of bituminous solution.

2.46.12 Payment

Payment shall be on the basis of covered area in square metre including coat of preparation and treatment of corners, edges and openings, water proof layers as specified. Mortar screed, unless otherwise specified, shall be paid separately on cubic metre basis.

Contractor shall give gurantee against any leakage and rectify any defect in water proofing for a minimum of 5 years from the date commissioning of the Plant.

2.46.13

Payment for foam concrete shall be done on volume basis over the actual area insulated and finished as per above clauses. The volume shall be measured considering the thickness of foam concrete only.

SPECIFICATION NO: G.I PIPE RAILING**2.48.0 Material:**

The G.I. Pipes to be used for railing shall be 40mm diameter and class B. The pipes and other materials for support such as angle iron or channel shall be brought by the contractor.

The railing shall be 40mm diameter and class B. The pipes and other materials for support such as angle iron or channel shall be brought by the contractor.

The railing shall be in two rows and height of the railing shall not less than 1 metre.

The supports shall be welded to base plates of adequate size and thickness and bolted properly to the foundation block.

The supporting angle shall not be less than 60 x 60 x 8mm size and fixed at 1,5 meters apart.

The welds shall be ground and finished smooth.

2.48.1 Structural angles:

The M.S. angle conform I.S. 226 and I.S. 800 and shall be free from defects and shall have smooth uniform finish. All the necessary accessories such as flange base, elbows four way connects Tees etc. shall brought by the contractor and shall be as per relevant standards.

All uneven out surfaces and rugged shall be made smooth by filling.

- 2.48.2** The pipes and supports shall be painted coat of red oxide and two coats of synthetic enamel paint of approved make.

SPECIFICATUION NO: MILD STEEL LADDER

2.49.0 Materials:

M.S. Ladder shall be fabricated from M.S. angles of size 50 x 50 x 6mm thick and steps from the 16 mm dia bars (double).For stringer M.S. flat of equivalent size may be used if approved by the Engineer. The bars shall be spaced at a distance of not more than 30cms.

- 2.49.1** The M.S ladder shall be 500mm wide. The bars shall be adequately welded to stringers. The ladder shall be supported by anchor blocks in M-150 concrete on ground and by welding to the flats securely in the wall.

2.49.2 Fabrication

- 2.49.3** The ladder shall be clean of foreign matter, dust, grit etc. and shall be painted with primary coat of red oxide, over at least two coats of anticorrosive or synthetic enamel paint.

SPECIFICATION NO: M.S. CHEQUERED PLATES

- 2.50.0** Chequered plates complete with cut out in size suitable for removal by hand shall be of mild steel and of required thickness to carry a loading of 750/kg/M².

- 2.50.1** For trench or opening of width 500mm or less the thickness of the plate shall be 5mm and for the width exceeding 500mm the thickness shall be 7mm or more.

- 2.50.2** Each length shall have two tapped holes for screwing in or providing lifting hooks. Two pairs of the lifting hooks shall be provided for every 5 sqm area of plate. Where a single area is covered by several pairs of plates, directions of the placing of all plates shall be same.

- 2.50.3** During the execution and the discretion of the Engineer in charge, the bridging and binding joints of adequate size shall be provided and fixed for supporting chequered plates by the contractor.

- 2.50.4** In the opening of floors or slabs, the groove of the approved dimensions shall be cut along the edges of the opening to serve as seats for chequered plate. If directed by Engineer edge angles shall be provided. The grooves shall be finely finished to the line and level. If suitable size and type of bridging and binding joints are to be placed across the opening, these shall be provided with protective anticorrosive treatment.

- 2.50.5** The chequered plates shall be either placed on the bridging joints or with drilled holes on the embedded and threaded bolts in the grooves as directed by the Engineer.

The nuts shall be on the embedded bolts on plate in such a manner as not cause any obstacle to operating staff.

SPECIFICATION NO: CHAINLINK FENCING AND GATES**2.51.0****Scope:**

This specification specifies the requirements of chain link fences for security purposes. The height of the fence shall be approximately 2.00m to the top of the chain link fencing at the posts and approximately 2.5m in vertical height at the top line of barbed wire attached to the cracked tops of posts.

Earth work for civil works:

2.51.1

Earth work shall be done as per specification under excavation.

2.51.2**Cement concrete in foundation and sill**

The concrete shall be placed on a clean bed having the designed level and without any interruption. Concrete in no case shall be dropped from a height of more than 1 metre.

Stone aggregates for concrete shall be of good approved quality and shall be of size as per schedule of item.

All concrete work shall strictly be carried out as per IS: 456

Payment for this item shall be made on cubic metre basis and the rate includes labour, materials mixing, placing, curing, fixing staples, leaving pockets etc. complete.

2.51.3**Cement concrete in precast post/ struts**

(Straining posts, intermediate posts and struts)

Cement concrete shall be of M-15 grade with 20mm and down size crushed stone aggregates conforming to IS: 383

The work shall be carried out as per IS: 456 in all respects.

Necessary moulds shall be provided for casting the concrete posts and the same shall be smooth finished with 1.3 cement sand mortar as directed the Engineer.

The concrete shall be cured for a minimum period of 14 days.

Payment for this item shall be made on cubic metre basis and the rate shall include labour, materials, mixing, places leaving pockets, fixing chain link fencing, line wires , barbed wires inserts in concrete post while casting as shown in the drawing or as per the directions of Engineer, keeping the concrete post in the proper position while concreting, scaffolding, all moulds, curing, etc., complete including handling and transportation from pre-casting yards to place of fixing, preparation of pre-casting yards etc, but excluding cost of reinforcement.

2.51.4**Reinforcement**

The steel for reinforcing bars shall be in form of MS round bars conforming to IS: 432 grade -1 or high yield deformed bars conforming to IS: 1786 or 1139.

All reinforcement shall be free from loose rust or scales oil, grease and other harmful matter.

The steel reinforcement shall be secured to one another with 1.65mm dia SWG black annealed binding wire.

Rate quoted shall include cost of material, cleaning, cutting, bending, placing binding with Contractor's own binding wire, providing necessary cover blocks, chairs, spacer bars where specified and fixing of reinforcement with necessary supports etc. complete.

CHAIN LINK FENCING AND BARRED WIRE FENCING AT THE CRANKED TOP

2.52.0

Materials:

2.52.1

Chain Link Fencing

The material requirement shall conform to IS: 2721 latest edition. The chain link fencing shall be woven from 3.55mm dia wire with mesh size of 50mm. The mesh wire shall not vary from the specified dia by more than $\pm 0.05\text{mm}$.

2.52.2

Galvanised Wires

All steel wires shall be not dipped galvanised wire and dia of the wire shall be 3.55mm. The dia shall be measured over the galvanised coating.

The line wire shall be 4mm dia mild steel.

The stirrup wire for securing the line wires to the concrete intermediate posts shall be 2.5mm diameter mild steel.

The tying wire for securing the chain link fencing to the line wire shall be 1.6mm diameter mild steel.

Hair pin staples for fastening down the bottom of galvanised chain line fencing to the concrete sill shall be of 3.55mm wire. The ends shall be bend outwards to secure anchorage.

Cleats for eye bolts shall be of uniform size and shall consists of mild steel angle 75 x 50 x 6mm.

2.52.3

Eye Bolt Strainers

The eye bolt strainer shall consist of bolts with welded eye sufficiently threaded and fitted with a nut and a washer.

Two-way eye bolt strainer shall have suitable ring nuts, fitted after wires have been strained on one side.

Stretcher bar shall consist of mild steel flats 25mm x 4.75mm They shall be secured to the cleats by steel bolts.

Droppers for barbed wire shall be of M.S not less than 25mm x 4.75mm thick with 38mm x 4.85mm half round staples for fastening the barbed wire to them.

2.52.4

Barbed Wire

Barbed wire shall conform to IS: 278. The coating on the wire shall be smooth and relatively free of lumps, globes or points, wire with excessive roughness blisters; salammoniac spots shall be rejected Barbed wire shall be made from two standards of galvanised, twisted 2.5 mm (12 gauge) steel wire with 4 points of barbs. Each barb shall have two turns, tightening around one or both line wires making altogether four complete turns. The barb shall be so finished that four points are set and looked at right angles to each other. Bracing of the rows of barbed wire shall be as shown in drawing.

The barbs shall have a length of not less than 13mm and not more than 18mm.

2.52.5

Erection

Straining posts shall be provided at all ends and corners of fences, at changes in direction or acute variations in level and at intervals not exceeding

66mm on straight lengths of fence. Intermediate posts shall be spaced at regular intervals not exceeding 3m.
Struts shall be fitted to all straining posts behind the chain link fabric in the direction of the line of fence.

2.52.6 Fixing chain link fencing

There shall be four evenly spaced rows of line wire. The top wire shall be doubled, making five line wires in all. The bottom wire shall be close to the ground.

Each line wire shall be strained lightly by means of eyebolt strainers or winders at each straining point.

2.52.7 Each line wire shall be secured to each intermediate post by a wire stirrup passed through a hole in the posts and secured to the line wire by three complete turns on each side of the post.

The chain link fencing shall be strained between each pair of straining posts and secured to each straining post by means of a stretcher bar. One of the top line wires shall be threaded through the appropriate adjacent rows of mesh, care being taken that no meshes in the rows are by passed by the line wire except where deviation is necessary at the straining posts. The second top line wire shall be strained in front of the fencing. The fencing shall be attached to the top and bottom line wires by wire ties spaced 150mm apart and to the other line wires by wire ties spaced 150mm apart and to the other line wires by wire ties spaced 450mm apart.

2.52.8 The bottom of the fencing shall be treated as follows:

Continuous concrete sill 125mm wide x 225 high for full length between post shall be cast with the top 25mm above G.L. and 25mm below the chain link fencing. Hair pin staples shall be threaded through the bottom row of mesh at 0.75m c/c and set in the sill to a depth of 150mm.

2.52.9 Payment

Payment for chain link fencing shall made on running metre basis for bottom 2.0 metre height of the total fence height including supply or chain link fencing in 1.9 metre width roll, fixing in position true to line and as per drawing. The rate shall include supplying and fixing necessary galvanised line wires, stirrup wires, tying wires, hair pin staples for fixing the fence in concrete sill, etc, tensioning the line wire and fencing, all materials and labour etc, required to complete the job as per drawings and direction of Engineer.

2.52.10 Fixing barbed wires to cranked tops

Three lines of barbed wire shall be provided as shown in drawings. The wires shall be attached by eye bolts to the cranked tops of straining posts. On concrete intermediate posts they shall be secured to cranked tops with stirrup wires. The barbed wire shall be fitted with one dropper at the centre of each bay, secured to the wires so that they cannot be bunched together.

2.52.11 Payment

Payment for barbed wire shall be made on running metre basis of two ply, four points barbed wire fixed in position. The rate shall include supply and fixing necessary droppers, straining bolts tensioning the barbed wire etc, and all materials and labour etc. required to complete the job.

SPECIFICATION NO: R.R. MASONRY CHAMBER**2.53.0 Providing and constructing R.R. Masonry Chamber:****2.53.1 Size and construction of chamber**

The size of the chamber shall be as per valve dimension to ensure easy operation and installation. The item covers excavation required in wet and dry conditions in all strata, C.R. at bottom on well rammed surface and R.R, masonry walls with inside cement plaster and cement painting from outside, C.R. Masonry shall be carried out as per detailed specifications from respective items. The Covers shall be of C.I. M.H. framed cover or precast slab as specified in description of item, C.I. M.H. frame and cover of specified duty conforming to IS 1726 (Part I to VII) as relevant, shall be provided. The frame shall be embedded in top coping concrete properly, including applying two coats of anticorrosive black paint to frame and covers, providing locking arrangement as directed.

The work shall be carried out as per detailed drawing or the chamber to be supplied by the Contractor. The chamber shall be flush with road surface and shall not cause any hindrance to the traffic. The measurements shall be on the basis of completed number of chambers.

2.53.2 Covers

The precast covers shall be of the dimension as specified in the drawings. Wooden or steel formwork shall be built up to give the required dimension of the slab. The reinforcement as specified will be fabricated and placed in the form keeping the specified cover. The slab shall be then cast. The concrete may be mixed and compacted manually. Side forms shall be removed after 24 hours and finished with 1:2 cement mortar immediately, top of slab should be suitably marked when the colour is green. The bottom form if provided may be removed carefully after 7 days. The necessary bars may be inserted for lifting of slab. The slab shall be fixed with the marked top over the chamber. This shall include the cost of reinforcement precasting, curing, conveyance and fixing the precast cover.

SPECIFICATION RCC PIPE CULVERTS AND EREC CROSSINGS ETC.**2.54.0 General:**

The scope of this specification covers R.C.C. pipe culverts and E.R.C. crossing etc.

2.54.1 Materials

For pipe materials, the following Specifications shall apply:

RCC Pipes and collars	IS: 458
Laying of Pipes	IS: 783

All pipes must be new and perfectly sound, free from cracks, cylindrically straight and of standard nominal diameter and length with even texture. Each pipe shall have one collar with it.

The Contractor shall submit a Manufacturer’s Test Certificate whenever demanded by Engineer or his authorised Representative.

Spun yarn for pipe joints shall be of best quality. It shall be free from dust etc.

2.54.2 Transportation and Stacking:

The Transportation of materials to the worksite and stacking shall be done in a manner to cause minimum inconvenience to the traffic and other construction work.

The pipe shall be protected during handling against impact, shocks and free fall to avoid cracks and damage.

The Contractor shall be fully responsible for the safety and security of materials transported and stacked in the field.

2.54.3 Earthwork

Earth work shall be carried out as described else wherever under item excavation.

Lowering and laying of pipes:**2.54.4 General**

The laying and jointing of pipes shall conform to IS: 783. Pipes shall be jointed by collar joints.

The trench shall be checked for proper level, grade and alignment before lowering the pipes.

2.54.5 Lowering:

The pipes shall be lowered cautiously to prevent disturbance of the bed and sides of the trench. The heavy pipes shall be lowered by means of proper tripods, chain pulley blocks or as directed by Engineer. Great care should be taken to prevent sand, etc. from entering the pipes.

2.54.6 Laying:

Laying up pipes shall proceed up grade of slopes.

The error of grade shall not be rectified by packing up earth underneath the pipes. If required. Concrete shall be used for packing.

The ends of the pipes shall be kept closed to keep dirt, mud and foreign materials out. Adequate provision shall be made to prevent floating of pipe in the event of flooding of trenches.

The body of the pipe for its entire length shall rest on an even bed in the trench and places shall be excavated to receive the Collar for the purpose of jointing.

2.54.7 Jointing of Pipes:

A few skeins of spun yarn soaked in neat cement wash shall be inserted in the groove at the end of the pipe and the two adjoining pipes butted against each other. The collar shall then be slipped over the joint covering equally both the pipes. Spun yarn soaked in neat cement wash shall be passed round the pipes and inserted in the joint by means of caulking tools from both ends of the collar. More skeins of yarn shall be added and well rammed home. The object of the yarn is to centre the two ends of the pipes within the collar and to prevent the cement mortar of the joint penetrating into the pipes.

Cement Mortar 1:2 (1 cement: 2 sand) shall be slightly moistened and must on no account be soft or sloppy and shall be carefully inserted by hand into the joint. The mortar shall then be punched and caulked into the joint and more cement mortar added until the space of the joint has been filled completely

with tightly caulked mortar. The joint shall be finished off nearly outside the collar on both side at an angle 45 degree.

2.54.8 Curing:

The cement mortar joints shall be cured atleast for seven days.

2.54.9 Testing:

All joints in culvert pipe lines shall be tested to a head of 1.5 Meters of water above the top of the highest pipe.

2.54.10 Payment:

Payment shall be made on Running Meter basis which includes supplying, lowering, laying, jointing, curing all complete.

SPECIFICATION NO: FORMATION OF ASPHALT MACADAM ROADS

2.55.0 Work Included:

The contractor shall furnish materials, labour, equipment and tools to complete the work as specified herein and/or as shown in the approved drawings.

2.55.2 Materials

Stone for soling: Stone for soling shall be rubble or boulders of depth as shown on drawings. The length and breadth of each boulder shall not be more than twice its depth. The stones shall be hard, tough and durable and free of earth. Loam or vegetable matter. Flaky material shall not be used.

2.55.3

Stone for soling: stone for soling shall be rubble or boulders of depth as shown on drawings. The length and breadth of each boulder shall not be more than twice its depth. The stones shall be hard, tough and durable and free of earth, loam or vegetable matter. Flaky material shall not be used.

2.55.4

Stone metal

Road metal shall be crushed or broken stone, hard, tough and durable. Flat, elongated or flaky materials shall not be used. The physical requirements shall be as per Table 1 of IRC Code 19-1972 when tested in accordance with IS: 2386 or IS: 5640.

The grading of coarse aggregates shall be one of the following as detailed in Table 2 of IRC Code 19-1972.

90mm to 40mm: 63mm to 40mm: 50mm to 20mm.

Approximate loose quantities required for 10 sq.m of 100 mm compacted thicknesses are:-

For sub-base WBM	1.2 to 1.4 cum
For base/surfacing course	0.9 to 1.7cum

2.55.5

Screenings: Needed to fill voids in the coarse aggregates shall generally be of the same material as the coarse aggregates. Where drawings specify a non-plastic material like murrum, the liquid limit and plasticity index (P.I) of such material shall be below 20 and 6 respectively and the fraction passing a 75 micron sieve shall not exceed 10 percent.

Generally screenings of size 1.25mm (Table 3 of IRC Code19) shall be used with the first coarse aggregate grade and those of 10m with the last grade mentioned. For the intermediate grade either type of screenings is suitable. Approximate quantities are indicated at Table 5 of IRC Code 19.

Workmanship:**2.55.6 Surface excavation**

The section to be constructed shall be excavated or formed to levels shown on the drawings. The bottom of the excavation shall be compacted as specified and the bottom and sides checked for conformance to drawings in respect of cross section and gradient with a scratch template moving over guides located suitably. The template shall have points placed not more than 200mm apart and shall be an exact elevation of the cross section. All high points shall be removed and low areas backfilled after scarifying and providing proper bond. The surface shall be rolled with a 6 ton power roller to attain the compaction. Haulage of materials over the formed surface shall not be permitted.

The sub-grade shall comply with the following requirements;

- a) No soft spots shall be present;
- b) It shall be kept properly drained during construction;
- c) The minimum modulus of sub-grade reaction to be obtained with a plate bearing test shall be 5.5 kg per cum.

2.55.7 Formation of shoulders

To continue the aggregates laterally, the side shoulders grade to the required cross-section and water and rolling it in a single layer with a powder roller.

This shall be done by spreading murrum on the prepared sub-grade to the required cross-section and water and rolling it in a single layer with a power roller.

Construction of WBM in a trench section excavated in the finished formation must be avoided.

2.55.8 Curb stones:

These shall be laid to proper alignment and level with sufficient in the soil carriage way.

2.55.9 Soiling:

The soiling shall be laid as per the cross-section shown on the drawings and the finished thickness after consolidation shall be 250mm unless otherwise directed. The boulders shall be laid flat with their broad faces resting over the sub-grade to have good seating. The voids in the soiling shall be filled with stone chips and small stones and hammered and wedged into position. Gauge pegs shall be driven in to indicate the thickness of stones to be laid. Any hollows formed during rolling shall be filled in with spalls during the process of consolidation, so as to conform with the gradient, camber and cross-section of the road and leave an even finished solid surface.

The soiling shall be rolled by a 10 to 12 tons power roller after blinding with approved quality murrum. The shoulders shall be rolled first to wedge the stones firmly at the edges and then rolling shall proceed towards the centre. The rolling shall be done longitudinally at the shoulder and worked towards the centre of the pavement overlapping on each successive trip by at least one-half of the width of the roller while starting and 300mm width while finishing. In case of super elevated strips the rolling shall commence from the inner edge and proceed towards the outer edge.

The roller shall be operated at the lowest speed possible. The speed in any case shall not be greater than 3 km per hour. Rolling shall be continued till a satisfactory surface is obtained.

2.55.10 Macadam Work:

The coarse aggregates shall be spread uniformly upon the compacted soling in required quantities. Proper profile shall be maintained by using templates placed across the road about 6 meters apart. The aggregates shall normally not be spread in lengths exceeding three days average work ahead of the rolling and bonding of the preceding section.

After laying, the road metal shall be compacted to full width by rolling with a 10 to 12 ton power roller.

The WBM coarse shall be constructed in layers of not more than 75mm compacted thickness and the total finished thickness shall be 150 mm.

The rolling shall begin from edges with roller running forward and backward until the edges have been compacted. The roller shall then progress gradually from the edges towards the centre parallel to the centre line of the road, uniformly lapping each proceeding near wheel track by one half widths. Rolling shall be discontinued when the aggregates are partially compacted with sufficient void space in them to permit application of screenings. On super elevated portions of the road, rolling shall commence from the lower edge and progress gradually towards the upper edge of the pavement.

Rolling shall not be done when the subgrade is soft or yielding nor when it causes a wave-like motion in the base course or subgrade, If irregularities develop during rolling which exceed 12 mm when tested with a 3 metre straight edge, the surface shall be loosened and aggregates added or removed as required before rolling again. In no case shall the use of screenings to make up depressions be permitted.

After coarse aggregates have been rolled, screenings to fill the interstices shall be applied gradually over the surface. Dry rolling shall be done when the screenings are being spread so that the jarring effect to roller causes them to settle into the voids of the coarse aggregates. The screenings shall not be dumped in piles but applied uniformly in successive thin layers by the spreading motion of hand shovels. Trucks playing over the base coarse to spread screenings shall be equipped with pneumatic tyres and so operated as not to disturb the coarse aggregates.

2.55.11 Grouting and buildings:

After application of screenings the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into the voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued and additional screenings applied where necessary until the coarse aggregates are well bonded and firmly set and a grout of screenings and water from ahead of the wheels of the roller. Care shall be taken that the base or sub grade does not get damaged due to addition of excessive quantities of water during the construction.

After the application of screening, binding material where specified shall be applied at a uniform and slow rate in two or more successive thin layers. After each application of binding material, the surface shall be copiously sprinkled with water and the resulting slurry swept in with hand brooms/ mechanical brooms so as to fill the voids properly. This shall be followed by rolling with a 10-12 tonne roller during which water shall be applied to the wheels to wash down the binding materials that may get struck to them. The spreading of

binding material, sprinkling of water, sweeping with brooms and rolling shall continue until the slurry of binding material and water forms a save ahead of the wheels of moving roller.

**2.55.12 Asphalt paving on water bound Macadam surface:
General**

Applicable provisions of conditions of contract shall govern under this section.

2.55.13 Work included

The Contractor shall furnish labour, materials and tools to complete the work as specified herein and/or as shown in drawings.

2.55.14 Materials

Aggregates: Coarse aggregate shall be broken stone of best quality granite or trap obtained from approved quarries and shall be clean, dry, hard and free from dust and any other foreign material. The stone shall be of angular shape with rough surface and free from flaky and laminated pieces. The sand shall be clean, dry and coarse grained.

Bitumen: Bitumen for surfacing shall be cutback bitumen of grade MC3 conforming to IS: 217. Bitumen for priming coat shall consist of cutback bitumen of grade MC O and MC O and MC I conforming to IS-217. Bitumen shall be obtained from approved manufacturer in sealed drums.

Size and proportion of aggregates.

The size and proportions of aggregates used for asphalt paving shall be as follows:

Coarse aggregate (Broken Stone)	-	25mm -40%
		by volume
		20mm-27%
		by volume
Fine aggregates (coarse-grained sand)		33% by volume

Preparation of surface. The work on asphalt paving on existing water bound macadam surface has been exposed to traffic for quite a considerable period and at a approved time. The existing water bound surface shall be made clean with wire brushed so as to remove all blinding murrum and dust and the metal surface shall be exposed to a depth of about 12mm.

Priming: A thin coat of hot approved primer as specified above heated to a temperature of 163 (C to 177 (C shall be applied uniformly by pouring cans or sprayers over the prepared base at the rate of one kg per sq.mm of surface and shall be allowed to soak into the surface thoroughly. A light sand blindage shall be applied to bolt up excess primer remaining unabsorbed on the prepared surface.

Preparation of mix: The bitumen shall be mixed at the rate 56 kg per cum of coarse aggregate and 112 kg per cum of sand. The stone and sand shall be measured in standard measuring boxes. The bitumen shall be weighed in buckets against a spring balance and the correct quantity of bitumen for each batch shall be heated to temperature of 163 (C TO 177 (C in a bol.ier. The broken stone shall be first put into the mixer and two-third of total quantity of heated bitumen required for that batch shall be added to it and stone an bitumen shall be well mixed. When the stone is well coated with bitumen and the mixtureis uniformly mixed.

Laying and consolidation: Before spreading the bitumen mix the curb stone shall be painted with hot bitumen. The surface on which bitumen mix is to be laid shall be dry and clean. Any depression on the water bound macadam surface shall be made up with pre-bitumen coated metal before laying bitumen mix. The mixed materials shall be conveyed by suitable means (e.g. wheel barrow) to the road surface. The mix shall be spread, shaped and levelled to proper width between the curbs and to such depth that no completion of consolidation the consolidated thickness shall conform to the specified. The consolidated thickness shall be 50mm, unless otherwise directed. The surface shall conform to line, level, grade and cross-section within a limit of 6mm to 3mm.

The surface shall be rolled with a 8 to 10 ton power roller and rolling shall be continued until maximum consolidation is obtained, rolling shall always proceed in the longitudinal direction beginning at the outer edges and working towards the centre line of the road, each trip overlapping the previous trip by about one-half of the width of a rear wheel. The speed of the roller shall be sufficiently slow to prevent any pushing under the wheels. Should the mixture put ahead of the roller, rolling shall be discontinued immediately until the mixture has sufficiently cured to overcome any such tendency. A long curbs, manholes etc and at all places not accessible to the roller, through compaction shall be done by means of rammers. The wheels of the roller shall be moistened with water whilst rolling to prevent the wheels from picking up the bitumen mix. The surface shall be frequently checked by means of 3mm straight edge and uneven areas corrected by addition or removal of the mixture after raking the areas loose. The finished surface shall be thoroughly compacted and uniformly dense and made true to the required line, grade, cross-section and level according to the drawings.

2.55.15 Joints

At the end of day’s work transverse joints shall be formed by rolling over edge and then cutting a vertical joint at full depth.

For joining the new work with the old work, the end and portion of the old work shall be cut back by 600m m at 45 (C to the section of the road up to the bottom. The cut surface shall then be painted with hot primer as specified above, the new mix shall be spread over this and the joint shall be rammed with iron rammers and finally rolled with power roller.

2.55.16 Edging

The carpet shall be protected on either side by curb stones as shown in drawings well fixed into the sub-grade and sunk flush with the finished asphalted surface. The curbing shall be fixed in advance of laying the asphalt paving.

2.55.17 Payment

Payment is made as per IS: 1200.

SPECIFICATION NO.: PLUMBING AND BUILDING DRAINAGE

2.56.0 General:

This specification is intended to establish and define the materials and constructional requirements for plumbing and building drainage work.

All materials, fixtures and workmanship shall be in accordance with the relevant Indian Standards Specifications and Codes of practices.

2.56.1 Sanitary fittings

All glazed earthen ware shall be Hindustan twyfords or equivalent approved make, white in colour and of one piece construction. All metallic fixtures like taps, stop cocks, soap holders etc. shall be of CP brass and 'Ego' Essco or approved make. All wall fittings shall be fixed with wooden cleats and CP brass and washers.

2.56.2 Indian type water cost

Squatting Pan shall be 580 mm long conforming to IS: 2556 Part III. This shall be fixed with a pair of glazed earthen-ware footrests. The closet shall be fixed in the floor with 150mm thick sand cushion and shall be connected with 100mm dia C.I. or stone ware S or P trap. The closet shall also be fitted with 10 litres valve less symphonic type, a low level plastic/ PVC flushing cistern of approved make conforming to IS: 774, 15 mm dia. PVC inlet with brass union, PVC ball valves, metallic handle telescopic 32mm dia C.P. flushing pipe with union. 15mm dia P.V.C. overflow pipe and fixed with mosquito proof cover. The cistern shall be fixed rawl plug at a minimum height of 900mm from top of pan or as directed by the Engineer. The cistern interior shall be painted with two coats an anticorrosive paint of approved quality.

Payment shall be made on unit basis. Rate quoted shall include providing and fixing water-closet and Plastic-PVC flushing cistern with all accessories, breaking wall and floors and making good the same, all inlet and outlet connections of cistern and water closet of all connections etc. complete.

2.56.3 Wash down type water closet:

Wash down water closet shall be pattern-I conforming to IS: 2556 Part II. Water closet shall be of piece construction. This shall be fixed with plastic seat and cover as per IS: 2548 of Brite or approved equivalent make, fixed with CP brass hinges and rubber buffers and the integral 100 mm dia 'S' or 'P' with antisiphonage vent horn.

A low level Plastic/ PVC cistern conforming to IS: 774 of about 10 liters capacity, with 15mm dia PVC Inlet pipe and brass union with wiped solder joint, internal overflow arrangement, 32mm dia CP brass flushing pipe, CI or MS supporting brackets shall be fixed with the water closet. The closet shall be fixed firmly in the floor with matching

Cement mortar. All exposed metallic Surfaces shall be painted with two coats of white enamel paint of approved quality over a coat of primer. The cistern shall be fixed at a height not exceeding 300 mm between the top of the pan and the underside of the cistern, the closet shall be fixed firmly in the floor with the cement mortar.

2.56.4 Payment

Payment shall be made on unit basis. The rate shall include providing and fixing of all

Fittings, breaking floors and wall, making good the same, making inlet and outlet connection to the cistern and the closet, testing of joints, painting the exposed metallic surfaces with two coats of white enamel paint over a coat of primer etc. complete.

2.56.5 Urinals

Half stall type urinal shall be conforming to IS: 2556 Part VI. Urinals shall be of a single piece construction with integral flushing box rim. These shall be mounted on walls. The flushing inlet pipe shall be of CP brass 15mm dia and waste pipe 32mm dia G.I. 750 mm long, with necessary unions and CP bottle trap.

Rawl plugs with CP brass screws shall be used for fixing the urinal. Fixing shall ensure that no liquid is left over in the pan after flushing. Unless otherwise indicated height above finished floors shall be 650mm.

Urinals shall be connected to automatic flushing cisterns either individually or in groups, where individually connected to flushing cistern the cistern capacity shall be 5 litres. For two urinals, once cistern of 10 litres capacity and for three urinals, one cistern of 15 litres, capacity shall be provided.

Cistern inlet shall be 15mm dia PVC pipe with brass union. Outlet pipe from cistern shall be 25mm Cp brass main, with 15mm CP distributor pipe of sufficient lengths to reach each bowl. Where individual cisterns are provided the outlet shall be of 15mm CP brass. All expose metallic surfaces shall be painted with two coats of approved white enamel paint over a coat of primer cistern interior shall be painted with coats of anticorrosive paint of approved quality.

Payment for set of urinals shall be of unit basis. Rate quoted shall include cost of urinals inlet and outlet pipes, flushing cistern, breaking and making good the walls and flooring, making inlet and outlet connections, paining exposed brackets and G.I pipes etc.

2.56.6 Wash basins:

This shall be flat back wash basin with one tap hoe conforming to IS: 2556 Part IV. Wash basins shall be of one piece construction including a combined overflow. A slot type of overflow having an area of not less than 5sq.cm, shall be provided in the front or back of the bowl and it shall be so designed as to facilitage cleaning of the overflow. This shall be fitted on CI or MS brackets. Brackets shall conform to IS: 775. The brackets shall be given two coats of white enamel paint or aluminium paint, over a coat of primer.

The wall side shall be fixed well flushed with the plaster of wall and the joint if any, shall be properly stopped with mortar and painted white. One pillar cock, PVC connecting pipe with brass union, a CP brass bottle trap with union. CP brass chain and rubber PVC stopper, 32mm dia, GI waste pipe shall also be supplied and fitted with the wash basin. The top of rim of the wash basin shall be fixed at 800mm above finished floor level, unless otherwise specified.

Payment shall be made on unit basis. The rate shall include provision and fixing of wash basin with all accessories, providing stop cocks and pillar cocks, breaking and making good walls, fixing and making good walls, fixing and making inlet and outlet connections for stop cock, pillar cock and waste pipe, providing and fixing M.S or C.I. brackets painted as mentioned above etc. completed.

Bevelled edge mirror:

The bevelled edge mirror shall be of best quality of HINDUSTAN PILKINGTON or equivalent, approved by the Engineer, the size of the mirror shall be 600 x 600mm and of thickness 5.5 mm. It shall have asbestos sheet/plywood ground and fixed to wooden class with CP brass screws and CP washers in proper line. The payment shall be made on unit basis. Rate shall include mirror. AC sheet backing, fixing etc, complete.

2.56.7 Glass shelf:

The glass shelf is of size 60cm x 12cm x 4.0mm thick, clear with edges ground smooth and corners rounded. Quality shall be got approved from the Engineer.

Glass sheet shall be fixed to wall with CP brass brackets.

Brackets shall be fixed to wall through wooden cleans and CP brass screws and washers. Bracket shall have guard rail running around three sides of glass.

Payment shall be on unit basis. Rate shall include providing glass brackets, guard, rail, cleat, breaking walls and making good the same, all labour and materials etc. complete.

Payment shall be on unit basis. Rate shall include providing glass brackets, guard, rail, cleat, breaking walls and making good the same, all labour and materials etc.

2.56.7 Tower rail:

Towel rail shall be of aluminium/C.P. brass pipe with suitable brackets. The towel rail shall be 20mm dia and 1.25mm thick 600 mm long as approved by the Engineer. It shall be fixed at specified place as shown in drawing or as directed by the Engineer. Payment shall be made on unit basis, the rate include cost of all materials, fixing the towel rail in position, labour et complete.

2.56.8 Liquid soap container:

The liquid soap container shall be of superior quality chromium plated brass of Ego's make or equivalent as approved by the Engineer. It shall be fixed with C.P. brass screws on wooden cleat.

The payment shall be made on number basis and the rate shall include supplying and fixing C.P. brass soap container of approved quality with brackets. C.P. Screws and wooden plugs etc. all complete including cutting walls and making good the same.

2.56.9 Bib and stop cock:

Bib and stop cocks of screw-down type shall be of Essco or equivalent make conforms to IS; 781. All taps shall be heavy grade. The taps shall be chromium plated brass or ordinary brass easy cleaning type as specified.

The payment shall be made on units basis. The rate quoted shall include supplying and fixing bib or stop cocks with white zinc and yarn etc complete.

2.56.10 H.C.I. Nahnhi Trap (Floor trap)

Nahnhi trap shall be of heavy cast iron as per IS: 3989 with 100mm Inlet and 80/100mm outlet with CP pressed steel grating. It shall be of self-cleaning design. Grating shall be of either hinged or screwed down type.

It shall be fixed in cement mortar 1:2 and as directed by Engineer.

The payment will be made per number basis. The rate include supplying and fixing Nahnhi trap, including cement mortar, cutting walls and floors and making good the same, providing and fixing chromium plated pressed steel grating all complete.

2.56.11 Stone ware gully trap chamber:

The square mouth gully trap shall be of 100mm dia, conforming to IS: 651 of specified and or approved quality software complete with iron grating and shall be got approved by the Engineer. The size of CI frame and cover shall be of 3000 x 300 mm. It shall be properly fixed as directed by the Engineer.

The size of the chamber shall be 300 x 300 x 675mm (internal). It shall be constructed of brick masonry walls 115mm thick in 1:4 cement mortar and M-15 concrete foundations. Inside and outside faces of the masonry walls shall be plastered with 1:3 cement mortar. The top of the chamber shall be provided with Ci cover and frame.

The payment shall be made on per number basis. The rate shall include supplying and fixing stoneware gully trap, CI grating, construction of masonry chamber, providing and fixing CI frame and cover, earthwork in excavation, foundation concrete and backfilling, removal or surplus earth upto a lead of 30 M etc all labour and materials complete.

2.56.12 Brick masonry (manhole/inspection chamber and valve chamber):

The size of the manholes and valve chambers shall be as specified in the drawings or items. It shall be constructed of brick masonry walls 230mm thick in Cm 1:4 (1 cement, 4 sand) resting on M-15 concrete foundations. The inside and outside face of the masonry wall shall be plastered with 13mm thick plaster of cement mortar 1:3 (1 cement: 3 sand).

The top of the chamber shall be provided with reinforced concrete 150M grade slab as per drawing and directions of the Engineer.

M.S rungs made out of 16 mm dia M.S bars shall be fixed inside the manhole as shown in the drawing after applying two coats of anti-corrosive paint.

Valve chambers shall be provided and fixed with light duty CI cover and frame.

The top of chamber shall be provided with reinforced cement concrete M-15 grade as per drawings and direction of Engineer.

The C.I. manhole covers and frames shall conform IS: 1726. The type size and grade shall be as per drawing, schedule of items and the directions of the Engineer.

The C.I manhole covers and frames shall conform to IS: 1726. The type size and grade shall be as per drawing, schedule of items and the directions of the Engineer.

The frame shall be fixed in position during concreting of top-slab, inside faces of frame and cover shall be given two coats of approved anti-corrosive paint.

The specification for brick masonry, plastering, concreting, excavation and backfilling etc as given two coats of approved anti-corrosive paint.

The specification for brick masonry, plastering, concreting, excavation and backfilling etc as given under relevant clause shall be applicable for this work also.

2.56.13 Payment shall be made as per number basis including excavation, backfilling, removal of earth, construction of the chamber manhole, making connections of pipes through the walls, cost of M.S. rugs, cover slab, cost of CI cover and frame, etc as per directions of the Engineer.

The rate shall include breaking concrete or brick masonry work and making good the same with 1:4 cement mortar if necessary, finishing, painting etc. as per directions f the Engineer.

2.56.14 C.I. Soil/waste pipe:

Cast iron pipe, socket and spigot shall be standard quality conforming to IS: 486 (heavy duty.)

The spigot of the pipe shall be placed full resting inside the socket and hemp caulked home to leave space for lead depth as specified Lead conforming to IS: 782 in molten state shall then be poured into the joint filling the same in one pouring. The lead shall be caulked by proper tools to make it even all-round. Depths of lead in the joints from the top of the socket shall be 37mm for 150 mm dia pipes. 25mm for 100mm and 50mm dia pipes. All pipes shall be fixed 25mm clear of the wall with M.S holder bat clamps or as approved by the Engineer. All holes in walls and floors shall be made good by cement concrete M-15 grade and should be leak proof. All soil and waste pipes shall be tested for leakage by hydraulic test. All pipes shall be painted with two coats of paint of approved make and shade over a coat of primer. Earthwork in excavation, backfilling and removal of surplus earth shall be considered as a part of the work. No separate payment will be made for the same.

The payment shall be made per running metre of pipe laid with fitting as required on site.

The rate quoted shall include supplying and fixing of pipes and necessary specials including cowl with hemp and lead, jointing and testing, bat clamps, fixtures painting, cutting of walls, floors and making good the same and necessary scaffolding, earthwork in excavation, backfilling and removal or surplus earth etc. complete.

2.56.15**CI/Soil/vent pipe:**

CI pipes shall be standard quality conforming to IS: 1729. The supply shall include all necessary accessories e.g. bends, tees etc complete.

Jute yarn gasket of suitable diameter shall be used as required to support the spigot of the pipe at the proper grade and make truly concentric joints single piece of sufficient length shall be used to pass around the pipe and lap at the top and shall be thoroughly saturated in bitumen. This gasket shall be laid in the socket for lower third of the circumference of the joint and covered with cement mortar. The spigot of the pipe thoroughly cleaned with wet brush, inserted and carefully driven home, after which a small amount of cement mortar (1:2) shall be inserted in the annular space around the entire circumference of pipe and solidly rammed into the joint with caulking tool. The joint shall then be completely filled with mortar and bevelled of at angle 45 degree with outside of the pipe: Cement used for joint shall conform to IS: 269.

All holes in walls and floors shall be made good by cement concrete M-15 grade.

All CI pipes shall be painted with two coats of anticorrosive bituminous paint externally.

The payments shall be on running metre basis of pipes laid. The rate shall include supplying and fixing pipes jute gaskets dipped into bitumen and cement mortar and necessary specials including jointing with clamps, painting, cutting of walls, floor and making good the same, necessary scaffolding etc. complete.

2.56.16**G.I Pipe and fittings:**

All G.I. pipes and fittings shall conform to IS: 1239 and shall be of medium grade for water supply system.

All screwed tubes and sockets shall have pipe threads in accordance with the requirements specified in IS: 554. Unless specified otherwise pipes shall be supplied screwed with taper threads and sockets parallel thread.

All fittings shall be malleable galvanised Iron approved by the Engineer. Fittings in G.I. line shall include all couplings, elbows tees, bends, unions, nipples, reducers, flanges with nuts bolts and rubber insertions, bushers and all other fittings to make a complete job.

Screwed G.I pipes shall be jointed with screwed socket joints, using screwed fittings. Care shall be taken to remove any burr from the end of the pipes after threading. White lead with a few strands of the hemp shall be applied while tightening. Compounds containing red lead shall not be used.

All pipes above ground shall be fixed with G.I. holders but clamp clear off the wall of 1.2M centres. If the pipes are fixed in enclashed or embedded in wall, they shall be secured in position by iron horns at 1.2 centres. All coats of white paint or aluminium paint as directed by the Engineer. No extra payment shall be made for clamps, hooks, cutting holes in walls, chasing and making good the same.

All underground pipes shall have a minimum earth cover of 600mm or as directed by the Engineer. No extra payment shall be made for excavation in trenches, refilling the same and removal of surplus earth. Before any pipes are painted or covered up they shall be tested to a hydro-static pressure of 6kg/sq.cm

Payment shall be on running metre basis of actual pipeline laid. In addition to the Sectional testing of water supply piping the contractor shall test entire installation on completion of the job to satisfaction to the Engineer. No extra payment shall be made for testing. The contractor shall make his own arrangement for supply of water for testing at his own cost. The rate for this item shall include supply and laying of G.I. pipes with necessary fittings, cutting of pipes to required lengths, threadings: making holes in walls and floors and making good the same, jointing, painting, excavation and refilling including the testing and directed by the Engineer.

2.56.17 Gunmetal valve:

All full way and globe valves shall be of heavy gunmetal and tested at 300 psi and shall be approved by the Engineer. Valves shall conform to IS; 778. Size of valve chamber shall be as per item description, construction of valve chamber shall be carried out as detailed in clause 13 above. Valve chamber shall be provided and fixed with heavy duty C.I. surface box conforming to IS:3950. The surface box shall be hinged pin open type and shall be fixed in the chamber slab. It shall have a hole for opening.

The payment shall be made per number basis including valve chamber and surface box. The rate shall include construction of valve chamber supplying and fixing valves and surface box in position as per drawings and directions of Engineer.

2.56.18 Half round channel:

Half round channel shall be plain or with stop end and shall include all labour, material etc complete including laying, jointing etc.

2.56.19 Marble partitions:

The marble partition shall be 25mm thick and approved by the Engineer.

The edges of marble shall be cut by machine to have proper smooth edges.

Vertical face shall be fixed in position with cement mortar (1:3) as by directed by Engineer for minimum depth of 100mm in the wall. It shall be polished after fixing. Two horizontal faces shall be supported by M.S. Channels of size 35mm deep embedded in wall.

The payment shall be made on square metre basis. The rate shall include the cost of partitions cutting of walls and making good the same as in its original condition. M.S. brackets, painting and polishing the partition etc complete.

2.56.20**Showers:**

The shower head shall be chromium plated brass, 100/150 mm dia with holes of one millimetre diameter each, is sufficiently large for all ordinary requirements. It shall be fixed at a height of 2.0M from floor level or as directed by Engineer. It shall conform to IS: 2064

The payment shall be made on unit basis.

2.56.21**Toilet paper holedr:**

Toilet paper holders shall be chromium plated brass as approved by the Engineer. It shall be 100mm long. It shall be fixed on wooden cleats as directed by Engineer.

2.56.22**Coat and hat hooks:**

Coat and hat hooks shall be chromium plated brass of ‘Ego’ or equivalent as approved by the Engineer. They shall be fixed on teak wood plate of 75mm x 75mm and 12mm thick. Teak wood plate shall be properly polished. Wooden cleats shall be inserted in wall in wall to fix wooden plates. C.P. brass screws shall be used.

2.56.23**M.S. Rungs/C.I steps:**

The rungs for pits/ manholes and septic tanks shall be of M.S. conforming to Indian Standard and to the shape and size as shown in drawings.

C.I. steps for manholes if needed shall be as per IS-5455

M.S rungs shall be coated with 2 coats of approved bituminous paint.

Payment for rungs steps shall be made as per number and the rate shall include supply, fixing, finishing the walls, painting etc complete.

2.56.24**Soakpits:**

All earthwork in excavation, brick work etc shall conform to relevant I.S. standard.

The brickbats should preferably be slightly overburnt or thoroughly well burnt, deep red in colour with some proportion of deep blue or black veins. Spongy or vitrified material as a result of excessive over burning is useless and shall be rejected. Brick bats bigger than specified size shall be reduced to required size (40 to 50mm) before filling in soak pit and extra payment shall be made for this. It shall be stacked at site as directed by Engineer, soak pit and no extra payment shall be made for this. It shall be stacked at site as directed by Engineer, soak pit and septic tank shall be connected with required piping.

Payment of soak pit shall be made per number basis. Rate quoted shall include brick masonry work, providing and filling brick bats, earth work in excavation backfilling making inlet connection with pipe and connecting same to septic tank etc complete as shown in drawing.

Ready made septic tank of M/s. Indian hume pipe or any equivalent make, consisting of dewage receiving chamber inspection doors, vent pipe, inlet and outlet connections, manhole cover, C.I. shall be used.

Design, testing and commissioning shall conform to IS: 2470 Part I.
Access opening shall be provided for desludging and inspection.

The ventilating pipe shall be provided with pipe of atleast 50mm dia extended 2 meters above the nearest platform level.

Payment of septic tank shall be made per number basis and Rate shall include all accessories like, inlet, outlet, vent pipe, manhole cover and C.I. steps , earthwork in excavation and backfilling removal of surplus earth etc. complete.

SPECIFICATION NO: TRASH RACKS

2.57.0

Scope:

This specification covers the items of Design, fabrication, supply, erection, painting, testing and commissioning of the following equipments.

- i) Embedded parts for trash rack grooves.
- ii) Trash rack panels for trash rack openings.
- iii) Automatic lifting beam for operation of trash rack panels.

2.56.1

General description;

Reinforced concrete trash rack structures are proposed in front of intake. Each trash rack structure consists of 2 trash rack bays as indicated in the drawing. In each trash bay 2 steel trash rack panels are proposed to prevent entry of floating debris.

2.56.2

Applicable publication:

All the materials, design, fabrication, transportation, painting and erection of trash rack embedded parts, panels and lifting beam shall conform to the latest revision of the relevant Indian standards Specification s or other Internationally recognised standard specifications.

Detailed specifications pertaining to structural steel, fabrication, erection , painting, commissioning etc shall be carried out as per specification under painting or as directed by the Engineer.

2.56.3

Design considerations and Data for design

The embedded parts and trash rack panels shall be fabricated as per the drawings approved by the Department. The contract shall also prepare the detailed drawings required for fabrications showing of lifting arrangements. The lifting beam shall be designed by the Contract.

2.56.4

Designs and Drawings:

All components of the trash rack structure including the lifting beam will be designed by the Contractor. The general drawings showing the major components submitted by the Contractor will be scrutinised by the Department. The Contractor shall prepare further fabrication drawings based on these general drawings and get the same approved by the Engineer.

2.56.5

Materials:

All structural steel sections like angles, channels, flats, I-section and other sections used for fabrication of trash rack embedded parts, panels and lifting beam shall conform to relevant Indian Standards. The sections shall be well and clearly rolled in full sections and shall be of the correct size as shown in the drawings. All the members shall be free from scales, blisters, laminations, cracked edges and defects to any other sort.

- 2.56.6 Fabrication:**
The trash rack panels, embedded parts and the lifting beam shall be fabricated to the dimensions and shape as shown in the drawings or as directed by the Engineer made out of appropriate materials.
- 2.56.7 Shop assembly:**
The specifications for shop assembly shall be as per standards or as approved by the Engineer, this shall also apply to the components/equipments to be supplied under this section to the extent they are relevant.
- 2.56.8 Shop painting:**
The specifications for shop painting as furnished indicated under painting specification.
- 2.56.9 Shop inspection and testing:**
The specifications for shop inspection and testing shall be as per relevant IS or as directed by the Engineer.
- 2.56.10 Transformation and storage:**
The specification for transportation and storage shall be got approved by the Engineer.
- 2.56.11 Field painting:**
The specifications for field painting shall be as per relevant IS or as directed by the Engineer.
- 2.56.12 Erection:**
General:
The general specifications for erection shall be as per relevant IS or as directed by the Engineer.
- 2.56.13 Materials and equipment for erection:**
The specifications for materials and equipments for erection shall be as per relevant IS or as directed by the Engineer.
- 2.56.14 Erection, testing and commissioning:**
The specifications for erection, testing and commissioning shall be as per relevant 1.5 or as directed by the Engineer.
- 2.56.15 Measurement and payment**
The measurements and payment shall be on the basis of the finished work in all respect at rate quoted for this item on weight basis. The unit rate quoted shall include all costs on account of materials, transportation, fabrication, erection and commissioning of the trash rack panels including embedded parts, hoisting mechanisms and

SPECIFICATION NO: GANTRY**2.57.0 Requirements:**

The tender shall furnish all technical and others details along with drawings in his offer of the manually operated overhead, double girder gantry crane of required safe working load capacity of not less than 10MT for Raw water and clean water Pump Houses 5MT for V.T. Pump Room and 3 MT in chlorine room generally conforming to IS: 466 and 3177. The ring rail gantry with chain pulley block shall be provided for jack well pump house. The gantry crane

shall run on steel rails fixed to corbels on the walls of pump house. The gantry crane shall run on steel rails fixed to corbels on the walls of pump house. The height of the building and location of the crane shown on the tender drawings are tentative but the exact dimensions shall be computed with all necessary slings, spreader beams, other tackles required for erection and maintenance. In case of double girder gantry, the Crane Bridge shall consist of double girder carrying two wheels at each end of the span. The girders shall have adequate strength to carry the test load without causing undue stresses or deflection and shall be designed in accordance with IS: 807-1963.

The gantry crane beam and rails shall be set in position on the corbels on the walls of pump house. The rail shall be complete with end stops, holding down bolts, tap washers and other fixing requirement.

All the motions of the crane shall be provided with efficient manually operated wheels with chains.

The crane in the Raw Water and Clear Water Pump Houses shall have 2 Nos. of chain pulley blocks of (Spur gear type) one of 10 Tonne capacity and another of 3 Tonne capacity of suspended from separate pins. 1 Ton each at Durtlang and Sihpir Booster Pump Houses. The operating shall be fully enough for manual operation from the Pump House Floor. The lightning hooks chain shall also be long enough for lightning the materials such as Pumps, Mortar Engines valves, Panels etc. clearing of the Ground and to a height of at least 1.8 metre above ground.

The crane shall be tested for overload test of 110% overload of the rated capacity of crane over the entire length of travel after erection. Individual components shall be tested to relevant of I.S. at the equipment manufacturer’s works and copies of the test certificate shall be furnished.

All the structural steel shall be painted with primary coat of red oxide and at least two coats of oil paints of approved make and colour as directed by the Engineer. The painting work shall be carried out as per specification given in section 3 Part II

SPECIFICATION NO: GATES, EMBEDDED PARTS AND HOSTS

2.57.0 Scope of works:

This specification covers the item of, Design, fabrication, supply, erection, painting, testing and commissioning of the following equipments.

- i) Embedded parts for Intake Gates
- ii) Vertical sliding Gates.

2.56.1 General description

The embedded parts, gates and the hoisting mechanism shall be complete with all parts which are necessary for efficient operation of the system fulfilling all the functional requirements. They supply of all parts necessary for the successful commissioning of the gates shall be deemed to be within the scope of work whether specially mentioned or not.

2 Nos. Vertical sliding lift, gates are proposed in the in the intake structure for a clear vent size of 1.6m x 2.5m. In addition, the purpose of intake gates is to isolate the jack well pit from the flow of water from the river for maintenance. The operation of the gate is by bevel gear with grease lubricated gear box.

2.56.2 Applicable publications

All the materials, designs, fabrication and erection of embedded parts, gates and hoists shall conform to the latest revision the relevant Indian standard Specifications unless otherwise specified or other Internationally recognised standard specifications.

2.56.3 Design consideration and Data for design

Generally the gates shall be fabricated out of structural steel with mild steel skin plate forming the water side surface. This skin plate shall be adequately supported by a system of vertical stiffeners and horizontal girders, so that the water load is transmitted to the end girders. Each gate shall be provided with end girders, along with the tie flats etc., for safe transmission of water thrust to the roller track girders embedded in the gate grooves. The gates shall be equipped with rubber seals securely bolted to the skin plate on the sides, top and along the bottom edge.

2.56.4 Designs and drawings

The drawings showing the general arrangement of gates and bevel gear and grease lubricated hoists are included in the Bid documents. These drawings are merely illustrative and can be modified with the concurrence of the Engineer to suit the design of the equipment to be supplied. It is binding on the part of the Contractor to adhere to these drawings as far as clear vent openings and levels are concerned. The Contractor shall prepare detailed designs and drawings and get the same approved by the Engineer. The equipment shall be modified at the convenience of the Engineer if required for operational and maintenance facilities.

The Contractor shall furnish complete detailed designs and drawings in three sets for approval of the Engineer as per the schedule for preparation and submission of designs and drawings for various components.

The design and drawings will be scrutinised by the Engineer and approval will be communicated. Any changes, additions, alterations in the designs and drawings considered necessary in the opinion of the Engineer shall be incorporated by the Contractor in the final designs and drawings. The Contractor shall submit revised drawings duly incorporating all such changes, additions, alterations etc., proposed by the Engineer for final approval.

The drawings when approved in writing by the Engineer shall form part of the Contract. The Contractor shall furnish final approved drawings to the Engineer for record and construction.

The Contractor shall fabricate and supply the gates/embedded parts/hoists etc, as per his designs supported with detailed drawings and calculations and as approved by the Engineer. In general, the designs submitted by the Contractor shall conform to these specifications and approved drawings. Any variation from these cannot be permitted without prior approval of the "Engineer." Any fabrication done before the design and drawings are approved, will be at the Contractor's risk. Dimensions, tolerances and material specifications for various components shall be shown in sufficient details to enable the 'Engineer' to make a complete review and to thoroughly check the drawings and designs. The 'Engineer' shall, without additional cost to the Engineer have the right to ask the Contractor to make any change in Contractor's fabrication details which may be necessary in the opinion of the 'Engineer' to make the finished equipment conform to the requirements and intent of these specifications. Approval of the Contractor's design and drawings by the 'Engineer' shall not relieve the contractor of any part of his responsibility for the corrections of design and drawings. All parts of the gates, hoists and embedded parts shall be fabricated in accordance with these specifications and approved drawings, except for minor details, which may be revised with the prior approval of the 'engineer' to meet the standard practice of the manufacturer, provided the strength and operational utility of the parts are not adversely affected.

The Contractor shall prepare all necessary shop drawing, covering the equipment to be furnished under these specifications and shall be responsible for the correct fitting of all parts. Unless otherwise specifically provided for in the schedule or in the specifications or on the drawings, the Contractor shall furnish all the materials, accessories and appurtenant parts called for in the specifications or shown in the drawings any anything shown on the drawings and not mentioned in the specifications or required by the specifications and not shown on the drawings as if required or shown in both. The Contractor shall furnish such other parts and accessories not explicitly shown on the drawings or mentioned in the specifications if such parts are essential in the Contractor's opinion for satisfactory performance of the equipment.

2.56.5 Erection and commissioning

This is done as per relevant IS-standards including testing.

3. SPECIFICATION FOR VALVES

1 GENERAL SPECIFICATION FOR VALVES

1.0 Scope:

This specification covers the design, materials construction features, manufactures, inspection and testing at the Contractor's and his sub contractor's works, delivery to site and performance testing of valves and specialties.

2.0 Codes and Standards:

The design, material construction, manufacture, inspection, testing and performance of valves and specialties shall comply with all currently applicable status, regulations and safety codes in the locality where the equipment will be installed. The equipment shall be constructed to relieve the Contractor of this responsibility.

3.0 Design and Construction Features:

3.1 All valves and specialties shall be so located that they are readily accessible for both operation and maintenance. The valve shall be suitable for installation with the valve shaft in any position.

The suction and delivery sluice valve shall also be provided with electrically operated actuator for operation from the actuator panel. The valves shall be provided with suitable gear box operation with Actuator. In addition manual operation facility with suitable clutch arrangement shall also be provided.

3.2 The features of construction shall be generally conforming to the standards specified. Valves shall be of short body type.

3.3 Check valves shall be suitable for smooth functioning under the maximum design pressure. The valve shall have no slam closing characteristic without external dampening arrangement.

3.4. All valves shall be arranged so that the hand wheel moves in a clockwise direction to close the valve. The face of each wheel shall be clearly marked with the words OPEN and CLOSE and shall be provided with an arrow to indicate the direction for opening.

3.5 All suction and delivery valves shall be provided with position indicators.

3.6 All suction and delivery branch valves shall be provided with extension spindle and floor stand wherever the valves are located in a duct so that the actuator and manual operation wheel are at a height of 0.7m to 0.8m above the operating floor. The floor stand shall have a valve position indicator. In addition to the above a remote valve position indicator shall be provided to these valves by a suitable transducer/ potentiometer for indication in the master control room.

3.7 valve ends shall have flat/ raised face flanges as specified in Data Sheet A. Flanges shall be drilled to suit ANSI B 16.5 of class specified in Data Sheet.

3.8 Unless otherwise specified, all valve hand wheels inside the plant building associated with valves of 150mm bore and above shall be of the capstan type. All valve hand wheels shall have fully machined hubs and rims and chromium plated spokes and rim. Valve hand wheels located external to plant buildings may be of the rim and internal spoke type. All hand wheels shall be fitted with name plates.

3.9 Unless otherwise specified all valves of 50mm bore or more shall have bodies of cast steel. They shall be butt welded taper faces, wedge type valves having renewable stainless steel seats and spindles.

3.10 Valves that are to be kept locked in the OPEN/ CLOSE position shall be provided with a non detachable locking arrangement comprising a chain and padlock.

3.11 Gear unit of valves shall be grease lubricated, packed with grease for life time service.

3.12 The tolerance on valve dimension shall be as per relevant standard/ code but not exceeding the following.

a. Face to Face	+3mm -0mm
b. O.D. of flanges	-3mm -0mm
c. Bolt circle dia	+2mm -0mm
d. Thickness of flange	+2mm -0mm

3.13 Each valve shall be provided with lifting lugs

4.0 tests and Inspection:

4.1. All valves shall be tested hydro statistically for strength, tightness of seats and tightness of back seating at pressure not less than 1.5 times of pump delivery pressure for body and one time the head for seat. In case of delivery side valves and 7.5 kg/sqcm for body and 5kg/sqcm for suction side valves.

4.2 The procedure for testing the tightness of seats of valves shall be as follows. The valves shall be subjected to city water to or a minimum of 2.812 kg/sqcm (40psig). The pressure shall then be increased to the specified seat test pressure. Valves shall then be cracked open at this pressure to determine the tightness of the seat ring in the body. Gate valves shall be tested on both sides of the disc and globe valves shall be tested under the disc.

4.3 Unless otherwise specified in Data Sheet A, all cast steel valves a rating of 1500 lbs ASA rating or equivalent and higher shall receive 100% radiographic examination.

4.4 Unless otherwise specified in Data Sheet A, magnetic particle inspection shall be performed on all machined surfaces of valves having a rating of 1500lbs ASA rating or equivalent and higher.

4.5 The contractor shall furnish five (5) sets of the following certificates for all types of valves

a. Certified physical and chemical analysis certificates metallurgical test reports of all components of the valves and specialities.

b. Certified hydrostatic test reports for all body casting.

5.0 Painting and Corrosion Protection:

Unless otherwise specified in Data Sheet A Section B shop coat of paint shall be applied to all steel and cast iron exposed surfaces as required to prevent corrosion after release has been given for painting and before despatch. All parts shall be adequately protected for rust prevention. Grease shall not be used on machined surfaces.

6.0 Drawings and manual:

6.1 The tenderer shall furnish along with his tender dimensioned outline and cross sectional drawings, if called for in Data Sheet A/ Section C

6.2 Instruction manuals shall be furnished by the contractor after award of the contract.

7.0 Name Plates:

All valves and specialities shall have permanent name plates indicating the service for which they will be used and the primary pressure and temperature rating. In addition they shall have a permanent brass or stainless steel tag fixed in the valve body indicating valve tag number.

8.0 Valve List:

The Contractor shall submit valve list for approval of the department.

3.0 SPECIFICATIONS FOR SUPPLY AND LAYING, JOINTING OF PIPES AND SPECIALS**3.1 Standards**

Except as otherwise specified, the Indian/International Standards and Codes of Practice in their latest version shall be adhered to for the design, manufacturing, inspection, factory testing, packing, handling and transportation of product. Should any product be offered conforming to other standards, the equipment or products shall be equal to or superior to those specified and the documentary confirmation shall be submitted for the prior approval of the Engineer in Charge.

3.2 LAYING, JOINTING AND TESTING OF PIPE LINE SYSTEM**Preparatory Work**

The contractor will inspect the route along which the pipe line is proposed to be laid. He should observe/ find out the existing underground utilities/ construction and propose an alignment along which the pipeline is to be laid. He should make all efforts to keep the pipe as straight as possible with the help of ranging rods. Where ever there is need for deviation, it should be done with the use of necessary specials or by deflection in pipe joints (limited to 75% of permissible deflection as per manufacturer). The alignment as proposed should be marked on ground with a line of white chalk and got approved from Engineer Incharge. The Contractor will then prepare an L-Section along this alignment showing the location of proposed pipe line. The L-section should be got approved from the site Engineer. The position of fittings, valves, should be shown on the plan.

Alignment and The L-Sections

The alignments, L-section (depth of laying) and location of specials, valves and chambers may be changed at site in co-operation with and after approval of the Engineer in Charge.

Standards

Except as otherwise specified in this technical specification, the Indian Standards and Codes of Practice in their latest version, National Building code, PWD specification of the state of Mizoram and Manual of water supply of GOI shall be adhered to for the supply, handling, laying, installation, and site testing of all material and works. The pipe laying work shall generally conform to IS: 12288.

Tools and Equipment

The contractor has to provide all the tools and equipment required for the timely, efficient and professional implementation of the work as specified in the various sections of the contract and as specified by the instructions of manufacturers of the pipes and other material to be handled under this contract. On demand he shall provide to the Engineer in Charge a detailed list of tools and equipment available. If in the opinion of the Engineer in Charge the progress or the quality of the work cannot be guaranteed by the available quantity and type of tools and equipment the contractor has to provide additional ones to the satisfaction of the Engineer in Charge. The Contractor will always have a leveling instrument on site.

Handling And Laying Of Pipes

Transportation of pipes and specials

The Contractor has to transport the pipes and other materials from manufacturer to the site of laying as indicated by the Engineer in Charge. Pipes should be handled with care to avoid

damage to the surface and the socket and spigot ends, deformation or bending. Pipes shall not be dragged along the ground or the loading bed of a vehicle. Pipes shall be transported on flat bed vehicles/trailers. The bed shall be smooth and free from any sharp objects. The pipes shall rest uniformly on the vehicle bed in their entire length during transportation. Pipes shall be loaded and un-loaded manually or by suitable mechanical means without causing any damage to the stacked pipes. The transportation and handling of pipes shall be made as per IS 12288. Handling instructions of the manufacturers of the pipes shall be followed. All precautions set out shall be taken to prevent damage to the protective coating, damage of the jointing surfaces or the ends of the pipes. Whatever method and means of transportation is used, it is essential that the pipes are carefully placed and firmly secured against uncontrolled movement during transportation to the satisfaction of engineer in charge. Cranes or chain pulley block or other suitable handling and lifting equipment shall be used for loading and un-loading of heavy pipes. Where using crane hooks at sockets and spigot ends hooks shall be broad and protected by rubber or similar material, in order to avoid damage to pipe ends and lining. Damage to lining must be repaired before pipe laying according to the instructions of the pipe manufacturer. Pipes shall not be thrown directly on the ground. When using mechanical handling equipment, it is necessary to employ sufficient personnel to carry out the operation efficiently with safety. The pipes should be lifted smoothly without any jerking motion and pipe movement should be controlled by the use of guide ropes in order to prevent damage caused by pipes bumping together or against surrounding objects.

Rolling or dragging pipes along the ground or over other pipes already stacked shall be avoided too.

Stringing Of Pipes along the Alignment

The pipes shall be laid out properly along the proposed alignment in a manner that they do not create any significant hindrance to the public and that they are not damaged.

Stringing of the pipes end to end along the working width should be done in such a manner that the least interference is caused in the land crossed. Gaps should be left at intervals to permit the passing of equipment across the working area. Pipes shall be laid out that they remain safe where placed and that no damage can occur to the pipes and the coating until incorporated in the pipeline. If necessary, pipes shall be wedged to prevent accidental movement. Precautions shall be made to prevent excessive soil, mud etc. entering the pipe.

Generally, the pipes shall be laid within two weeks from the date of their dispatch from the manufacturer/store. The joint gaskets shall be kept in wooden boxes or their original packing and stored in cool conditions and not exposed to direct sunlight. Gaskets must not be deformed. They shall be taken out only shortly before they are needed.

Trench Excavation

The trench excavation of pipe line shall be in accordance with IS 12288. Pipe trenches shall be excavated to the lines and levels shown on the drawings or as directed by the Engineer in Charge. The depth of the excavated trench shall be as given in the drawings or as directed by the Engineer in Charge. The width of the trench at bottom between the faces of sheeting shall be such as to provide 200/150 mm clearance on either side of the pipe except where rock excavation is involved. No pipe shall be laid in a trench until the section of trench in which the pipe is to be laid has been approved by the Engineer in Charge.

In agricultural land the depth should be sufficient to provide a cover not less than 900 mm so that the pipe line will not interfere with the cultivation of land. It may be necessary to increase the depth of pipeline to avoid land drains or in the vicinity of roads, railways or other crossings. Care should be taken to avoid the spoil bank causing an accumulation of rainwater.

The bottom of the trench shall be trimmed and levelled to permit even bedding of the pipes. It should be free from all extraneous matter which may damage the pipe or the pipe coating. Additional excavation shall be made at the joints of the pipes, so that the pipe is supported along its entire length.

All excavated material shall be stacked in such a distance from the trench edge that it will not endanger the work or workmen and it will avoid obstructing footpaths, roads and drive ways. Hydrants under pressure, surface boxes, fire or other utility controls shall be left

unobstructed and accessible during the construction work. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural water-courses shall not be obstructed.

To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, torches, red lanterns and guards, as required, shall be placed and maintained during the progress of the work and until it is safe for traffic to use the roadways. All materials, piles equipment and pipes which may serve as obstruction to traffic shall be enclosed by fences or barricades and shall be protected by illuminating proper lights when the visibility is poor.

As far as possible, the pipe line shall be laid below existing services, like water and gas pipes, cables, cable ducts and drains but not below sewers, which are usually laid at greater depth. Where it is unavoidable, pipe line should be suitably protected. A minimum clearance of 150 mm shall be provided between the pipe line and such other services.

Trees, shrubbery fences, poles, and all other property and surface structures shall be protected. Tree roots shall be cut within a distance of 50 cm from pipe joints in order to prevent roots from entering them. Temporary support, adequate protection and maintenance of all under ground and surface structures, drains, sewers and other obstructions encountered in the progress of the work shall be provided. The structures, which will be disturbed, shall be restored after completion of the work.

Where water forms or accumulates in any trench the Contractor shall maintain the trench free of water during pipe laying.

Wherever necessary to prevent caving, trench excavations in soils such as sand, gravel and sandy soil shall be adequately sheeted and braced. Where sheeting and bracing are used, the net trench width after sheeting shall not be less than that specified above. The sides of the excavation shall be adequately supported at all times and, except where described as permitted under the Contract, shall be not battered.

The Engineer in Charge in co-operation with the Contractor shall decide about the sheeting/ bracing of the trench according to the soil conditions in a particular stretch and taking into account the safety requirements of the Contractor’s and ENGINEER- IN-CHARGE’s staff. Generally, safety measures against caving have to be provided for trenches with vertical walls if they are deeper than 2.0 m.

Trench Excavation To Commensurate With The Laying Progress

The work of trench excavation should be commensurate with laying and jointing of the pipe line. It should not be dug in advance for a length greater than 500 m ahead of work of laying and jointing of pipeline unless otherwise defined by the Engineer in Charge. The Contractor has to ensure the following:

- safety protections as mentioned above have to be incorporated in the work process
- hindrances to the public have to be minimized
- the trench must not be eroded before the pipes are laid
- the trench must not be filled with water when the pipes are laid
- the trench must not be refilled before laying of the pipes

The bed for the laying of the pipes has to be prepared according to the L-Section immediately before laying of the pipes.

Bedding of the Pipes

The trench bottom shall be even and smooth so as to provide a proper support for the pipe over its entire length, and shall be free from stones, lumps, roots and other hard objects that may injure the pipe or coating. Holes shall be dug in the trench bottom to accommodate sockets so as to ensure continuous contact between the trench and the entire pipe barrel between socket holes.

Laying and Jointing Of Pipes

General

The pipes will be cleaned in the whole length with special care of the spigot and sockets on the inside/ outside to ensure that they are free from dirt and unwarranted projections. The

whole of the pipes shall be placed in position singly and shall be laid true to profile and direction of slope indicated on longitudinal sections. The pipes shall be laid without deflection in a straight alignment between bends and between high and low points. Vertical and horizontal deflections between individual pipes need the approval of the Engineer in Charge. In no case the deflection shall be more than 75 % of those recommended by the manufacturer.

Before pipes are jointed they shall be thoroughly cleaned of all earth lumps, stones, or any other objects that may have entered the interior of the pipes, particularly the spigot end and the socket including the groove for the rubber ring. End caps are removed only just before laying and jointing

Pipes and the related specials shall be laid according to the instructions of the manufacturers and using the tools recommended by them.

Cutting of pipes shall be reduced to a minimum required to conform with the drawings. Cutting has to be made with suitable tools and according to the recommendations of the manufacturer. The spigot end has to be chamfered again at the same angle as the original chamfered end. Cutting shall be perpendicular to the centre line of the pipe. If there is no mark for the insertion depth on the spigot ends of the (cut) pipe it shall be marked again according to the instructions of the manufacturer.

All specials like bends, tees etc. and appurtenances like sluice or butterfly valves etc. shall be laid in synchronization with the pipes. The Contractor has to ensure that the specials and accessories are ready in time to be installed together with the pipes.

At the end of each working day and whenever work is interrupted for any period of time, the free ends of laid pipes shall be protected against the entry of dirt or other foreign matter by means of approved plugs or end caps.

When pipe laying is not in progress, the open ends of installed pipe shall be closed by approved means to prevent entrance of trench water and dirt into the line.

No pipe shall be laid in wet trench conditions that preclude proper bedding, or when, in the opinion of the Engineer in Charge, the trench conditions or the weather are unsuitable for proper installation.

The pipe line laid should be absolutely straight unless planned otherwise. The accuracy of alignment should be tested before starting refilling with the help of stretching a string between two ends of the straight stretch of pipes to rectify possible small kinks in laying.

All construction debris should be cleared from the inside of the pipe either before or just after a joint is made. This is done by passing a pull-through in the pipe, or by hand, depending on the size of the pipe. All persons should vacate any section of trench into which the pipe is being lowered

On gradients of 1:15 or steeper, precautions should be taken to ensure that the spigot of the pipe being laid does not move into or out of the socket of the laid pipe during the jointing operations. As soon as the joint assembly has been completed, the pipe should be held firmly in position while the trench is back filled over the barrel of the pipe.

The designed anchorage shall be provided to resist the thrusts developed by internal pressure at bends, tees, etc.

Where a pipeline crosses a watercourse, the design and method of construction should take into account the characteristics of the watercourse to ascertain the nature of bed, scour levels, maximum velocities, high flood levels, seasonal variation, etc. which affect the design and laying of pipeline.

The assembly of the pipes shall be made as recommended by the pipe manufacturer and using the suitable tools.

The socket and spigot ends of the pipes shall be brushed and cleaned. The chamfered surface and the end of the spigot end has to be coated with a suitable lubricant recommended by the manufacturer of the pipes. Oil, petroleum bound oils, grease or other material which may damage the rubber gasket shall not be used as lubricant. The rubber gasket shall be inserted into the cleaned groove of the socket. It has to be checked for correct positioning.

The two pipes shall be aligned properly in the pipe trench and the spigot end shall be pushed axially into the socket either manually or with a suitable tool specially designed for the assembly of pipes and as recommended by the manufacturer. The spigot has to be inserted up to the insertion mark on the pipe spigot. After insertion, the correct position of the socket has to be tested with a feeler blade

Deflection of the pipes -if any- shall be made only after they have fully been assembled. The deflection shall not exceed 75 % of the values indicated by the pipe manufacturer.

Anchoring of the pipeline

Thrust blocks shall be provided at each bend, tee, taper, end piece to prevent undue movements of the pipeline under pressure. They shall be constructed as per design of ENGINEER- IN- CHARGE according to the highest pressure during operation or testing of the pipes, the safe bearing pressure of the surrounding soil and the friction coefficient of the soil.

Backfilling of the pipe trench

For the purpose of back-filling, the depth of the trench shall be considered as divided into the following three zones from the bottom of the trench to its top:

Zone A: Back-filling by hand with sand, fine gravel or other approved material placed in layers of 150 mm and compacted by tamping. From the bottom of the trench to the level of the centre line of the pipe simultaneously. Special care shall be taken to avoid damage of the pipe and the coating or moving of the pipe.

Zone B: Back-filling and compaction shall be done by hand or approved mechanical methods in layers of 150 mm, special care shall be taken to avoid damage of the pipe and the coating or moving of the pipe. From the level of the centre line of the pipe to a level 300 mm above the top of the pipe

Zone C: Back-filling shall be done by hand or approved mechanical methods in 15 cm layers after compacting and carried to the level necessary to allow for the temporary restoration of road and path surfaces, and also for hard-core (if and where ordered) on roads or to such level as will leave the requisite space for the top soil, road surface etc. to be reinstated as directed by the Engineer in Charge. From a level 300 mm above the top of the pipe to the top of the trench.

In case of agricultural or waste land and after approval by the Engineer in Charge back-filling may be made in thicker layers and with less compaction up to 200 - 300 mm above the initial ground level.

Where the excavation is made through permanent pavements, curbs, paved footpaths, or where such structures are undercut by the excavation, the entire back-fill to the subgrade of the structures shall be made with sand in accordance with IS 12288.

The excavated material may be used for back-fill in the following cases, provided it complies with IS 12288 Clause 4.11.1:

- a) In Zone C: In cases where settlement is unimportant the back-fill shall be neatly rounded over the trench to a sufficient height to allow for settlement to the required level.
- b) In any zone, when the type of back-fill material is not indicated or specified, provided that such material consists of loam, clay, sand, fine gravel or other materials which are suitable for back-filling in the opinion of the Engineer In Charge.

All excavations shall be backfilled to the level of the original ground surfaces unless otherwise shown on the drawings or ordered by the Engineer in Charge, and in accordance with the requirements of the specification. The material used for backfill, the amount thereof,

and the manner of depositing and compacting shall be subject to the approval of the Engineer in Charge, but the Contractor will be held responsible for any displacement of pipe or other structures, any damage to their surfaces, or any instability of pipes and structures caused by improper depositing of backfill materials.

Trenches crossing a road shall be backfilled with selected material placed in layers not exceeding 15 cm in thickness after compacting, wetted and compacted to a density of not less than 90 percent of the maximum dry density at optimum moisture content of the surrounding material. Any deficiency in the quantity of material for backfilling the trenches shall be supplied by the Contractor at his expense.

The Contractor shall at his own expense make good any settlement of the trench backfill occurring after backfilling and until the expiry of the defects liability period.

On completion of pressure and leakage tests exposed joints shall be covered with approved selected backfill placed above the top of the pipe and joints in accordance with the requirements of the above specifications. The Contractor shall not use backfilling for disposal of refuse or unsuitable soil.

Sequence of Works for Ensuring Good Pipe Laying

a) The required fittings, valves and jointing material should be carefully worked out in beginning. This material should be received in full first of all on site and stored as per directions of manufacturer or as directions given elsewhere in this manual on Standards. The pipes should be received on site only after the above fittings, valves and material for joints has been received and all necessary preparation for laying has been made. The material received should be checked for inspection certification as per contract and damage during transportation. All damaged material should be separated and not used. The pipes received should be stored strictly as per directions of the manufacturer or as mentioned elsewhere in this manual or standards. The pipes and other material should be again inspected for any damage before use in the trench. The fittings and valves should be installed in sequence with the laying of pipes without leaving any gaps. It is desirable to lay the pipe lines from the end from where it can be connected to the water source to enable regular flushing of laid pipes. The entry of dirt or any foreign material in the pipe should be religiously prevented. Each joint should be carefully checked for its completeness before covering up. There should be a commensurate progress in trench excavation, laying and jointing of pipes, fittings, valves etc. and testing of laid pipes in sections so as to complete testing of all pipes laid in quick follow up of completing laying and jointing.

b) Installation of valves

The installation of valves shall be made between flanges and shall be according to the instructions of the manufacturer and the Engineer. Valves shall be placed on a support of concrete so that no shear stress occur in the flanges. In case of axial thrust due to closure of a valve against pressure, the valve shall be anchored in the support in a suitable manner to transfer the thrust into the floor slab of the chamber.

c) Other civil and related works

i) Crossing of existing Distribution Pipes, connecting pipes and other underground service components

Existing transmission and distribution pipes and connecting pipes of standpipes have to be protected during the laying of the pipes. In case of impossibility of deviation, the pipes have to be replaced according to the instructions of the Engineer and in co-operation with the local representative (e.g. Assistant Engineer of PHED). The Contractor shall be fully responsible in case of damage of pipes or any other item due to inattention of his staff. All costs for the reinstatement of the original status to the pipes or any other item in case of damage have to be borne by the Contractor at his cost. Similarly the contractor shall have to reinstate in the original status, other services damaged by him such as power or telephone cables etc.

ii) Poles of electrical or telephone lines, if coming in the alignment, will be got shifted through the respective agencies, as per approval of the Engineer.

Testing of the pipelines

- **Sectional tests**

After laying and jointing the pipeline shall be tested for tightness of barrels and joints, and stability of thrust blocks in sections approved by the Engineer in Charge. The length of the sections depends on the topographical conditions. Preferably the pipeline stretches to be tested shall be between two chambers (air valve, scour valve, bifurcation, other chamber). At the beginning, the Contractor shall test stretches not exceeding 2 km. After successful organization and execution of tests the length may be extended to more than 2 km after approval of the Engineer in Charge.

The water required for testing shall be arranged by the contractor himself. The Contractor shall fill the pipe and compensate the leakage during testing. The Contractor shall provide and maintain all requisite facilities, instruments, etc. for the field testing of the pipelines. The testing of the pipelines generally consists in three phases: preparation, pre-test/saturation and test, immediately following the pre-test. Generally, the following steps are required which shall be monitored and recorded in a test protocol if required:

- Complete setting of the thrust blocks.
- partial backfilling and compaction to hold the pipes in position while leaving the joints exposed for leakage control
- opening of all intermediate valves (if any)
- fixing the end pieces for tests and after temporarily anchoring them against the soil (not against the preceding pipe stretch)
- at the lower end with a precision pressure gauge and the connection to the pump for establishing the test pressure
- at the higher end with a valve for air outlet
- If the pressure gauge cannot be installed at the lowest point of the pipeline, an allowance in the test pressure to be read at the position of the gauge has to be made accordingly
- Slowly filling the pipe from the lowest point(s).
- the water for this purpose shall be reasonably clear and free of solids and suspended matter
- Complete removal of air through air valves along the line.
- Closing all air valves and scour valves.
- Slowly rising the pressure to the test pressure while inspecting the thrust blocks and the temporary anchoring.
- Keeping the pipeline under pressure for the duration of the pre-test / saturation of the lining by adding make-up water to maintain the pressure at the desired test level. Make up water to be arranged by Contractor himself at his own cost.
- Start the test by maintaining the test pressure at the desired level by adding more make-up water; record the water added and the pressure in intervals of 15 minutes at the beginning and 30 minutes at the end of the test period.
- Water used for testing should not be carelessly disposed off on land which would ultimately find its way to trenches.
- The testing conditions for the pipelines shall be as per the test conditions laid out in IS.

The pipeline stretch will pass the test if the water added during the test period is not exceeding the admissible limits. No section of the pipe work shall be accepted by the Engineer in Charge until all requirements of the test have been obtained.

On completion of a satisfactory test any temporary anchor blocks shall be broken out and stop ends removed. Backfilling of the pipeline shall be completed.

- **Leakage Test**

After the successful completion of the pressure test (i.e. pressure testing at factory/works), Leakage test at site after proper installation of pipeline shall be conducted at a pressure specified above for duration as specified below:

- **Pre test and saturation period** with addition of make-up water
 - Pressure : Test Pressure
 - Duration : 3 hrs for pipes without cement mortar lining / 24 hrs for pipes with cement mortar lining
- **Pressure test / Leakage Test** with addition of make-up water
 - Pressure : Test Pressure
 - Duration : 3 hrs

All pressure testing at site should be carried out hydrostatically. The pipes shall be accepted to have passed the pressure test satisfactorily, if the quantity of water required to restore the test pressure does not exceed the amount ‘Q’, calculated by the above formula. Where any test of pipe laid indicates leakage greater than that specified as per the above formula, the defective pipe(s) or joints(s) shall be repaired/replaced as per the satisfaction of engineer in charge until the leakage is within specified limits. The Contractor has to make his own arrangements for water of approved quality, required for testing pipeline

If it is required to test a section of a pipe line with a free end, it is necessary to provide temporary support against the considerable end thrust developed by the application of the test pressure. The end support can be provided by inserting a wooden beam or similar strong material in a short trench excavated at right angle to the main trench and inserting suitable packing between the support and pipe end.

Failure to pass the test

All pipes or joints which are proved to be in any way defective shall be replaced or remade and re-tested as often as may be necessary until a satisfactory test shall have been obtained. Any work which fails or is proved by test to be unsatisfactory in any way shall be redone by the Contractor.

Flushing And Disinfection Of Pipelines

After testing and commissioning the contractor shall flush the pipes with a velocity not less than 1 m/s or as approved by the Engineer in Charge.

The pipeline shall be flushed prior to disinfection except when the tablet method is used. After initial flushing, the hypochlorite solution shall be applied to the water main with mechanically or electrically powered chemical feed pump designed for feeding chlorine solutions. For small applications, the solutions may be fed with a hand pump.

In the case of pipeline of large diameter, water from the existing distribution system or other approved source of supply shall be made to flow at a constant measured rate into the newly laid pipe line. The water shall receive a dose of chlorine also fed at a constant measured rate. The two rates shall be proportioned so that the concentration in the water entering the pipeline is maintained at no less than 300 mg/l. The chlorine shall be applied continuously and for a sufficient period to develop a solid column of ‘Slug’ of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 300 mg/l. for at least 3 hours. As the chlorinated water flows past tees and crossings, related valves and hydrants shall be operated so as to disinfect the appurtenances.

In the case of newly laid pipeline in which scrupulous cleanliness has been exercised the tablet method can be adopted and in this method, the initial flushing is dispensed with. The calcium hypochlorite tablets are placed in each section of pipe and also in hydrants, hydrant branches and other appurtenances. The tablets shall be attached by an adhesive and must be at the top of the main. The main shall then be filled with water and the water shall remain in the pipe for at least 24 hours.

After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until the chlorine concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or less 1 mg/l.

After final flushing and before the water pipeline is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriological quality and shall show the absence of coliform organisms. If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory; the pipeline may be placed in service.

The Contractor is expected to carry out the disinfection work as a part of laying the pipes and his rates for laying the pipes should include the disinfection and other connected works including arrangement and cost of water and other relevant material till the main placed in service other wise specified.

COMMISSIONING

General

After successful sectional tests and other pre-commissioning tests, flushing, disinfection etc. and after physical completion, the pipeline shall be commissioned by the Contractor. Dynamic commissioning shall be made in conjunction with or after the commissioning of the respective system.

During testing/commissioning, the Contractor shall supply all material and labour to supervise, adjust, test, repair and do all things necessary to maintain the testing/commissioning. This shall include labour on a 24 hour-a-day basis during the test period and for such other period of continuous operation as the Engineer may consider necessary to establish the efficient operation of the cluster distribution system.

If any test result shows noticeable variation from the specification requirements for the system, the Contractor shall immediately take steps to rectify the deficiency without any extra cost to Engineer.

The Contractor shall test and commission the system for 7 days at a stretch, from the date of commissioning. On expiry of this period the system shall be taken over by the Engineer and a taking-over certificate shall be issued by the Engineer, provided all defects and/or deficiencies noticed are rectified to the satisfaction of the Engineer.

Should the supply of water from the pumping station fail or should any other event beyond the Contractor’s control, the commissioning shall be during such a number of operational periods as the Engineer may consider equivalent. Any repairs or replacement required during this period shall be done by the Contractor at his own cost.

The main indicators for the successful commissioning are:

- no leaks in pipes, joints, specials and valves
- all valves are properly installed and operational
- execution of the entire work including finishing according to the drawings and the specifications
- submission of as built drawings

Dynamic commissioning

The dynamic commissioning shall commence after the work has been physically completed to the satisfaction of the Engineer. It shall simulate the design and operation conditions which are as follows:

- All branches into existing lines (if already in position) to be shut off.
- Pump in operation, pump discharging into the transmission main. This is for the commissioning of the transmission pipe only.
- Water being put into the system through overhead tank or direct pumping as the case maybe.
- Closing of the valves against full static or dynamic pressure.
- Operation of all valves including scour valves (open-close-open).
- Operation of all air valves.
- Operation of all locking arrangements of valve chambers.
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3.3 INSPECTION REQUIREMENTS

3.3.1 GENERAL

All inspection and testing shall be carried out in accordance with the Specification and in absence of Specification relevant Indian Standard or internationally approved equivalent standard.

The Employer shall be entitled to attend the aforesaid inspection and/or tests by his own duly authorized and designated representatives.

The Employer and his duly authorized representative shall have access to the Contractor’s

premises at all suitable times to inspect and examine the material and workmanship of the mechanical and electrical plant and equipment during its manufacture there. If part of the plant and equipment is being manufactured on other premises, the Contractor shall obtain permission for the Employer or his duly authorized representative, to inspect as if the plant and equipment was manufactured on the Contractor's own premises. Testing (including testing for chemical analysis and physical properties) shall be carried out by the Contractor and certificates submitted to the Engineer's Representative who will have the right to witness or inspect the above mentioned inspection / testing at any stage desired by him.

The procedure for the testing and inspection to be carried out during or following the manufacture of the materials to ensure the quality and workmanship of the materials and to further ensure that they conform to the Contract in whatever place they are specified shall be as described below. The Contractor shall give the Employer at least 21 clear days notice in writing of the date and the place at which any plant or equipment will be ready for inspection / testing as provided in the Contract. The Employer or his duly authorized representative shall thereupon at his discretion notify the Contractor of his intention either to release such part of the plant and equipment upon receipt of works tests certificates or of his intention to inspect. The Employer shall then give notice in writing to the Contractor, and attend at the place so named the said plant and equipment which will be ready for inspection and/or testing. As and when any plant shall have passed the tests referred to in this section, the Engineer's Representative shall issue to the Contractor a notification to that effect.

The Contractor shall forward to the Employer 3 duly certified copies of the test certificates and characteristics performance curves for all equipment. If the Engineer's Representative fails to attend the inspection and/or test, or if it is agreed between the parties that the Employer's Representative(s) shall not do so, then the Contractor may proceed with the inspection and/or test in the absence of the Engineer's Representative and provide the Employer with a certified report of the results. If any materials or any part of the works fails to pass any inspection / test, the Contractor shall either rectify or replace such materials or part of the works and shall repeat the inspection and/or test upon giving a notice. Any fault or shortcoming found during any inspection or test shall be rectified to the satisfaction of the Engineer before proceeding with further inspection of that item. Any circuit previously tested, which may have been affected by the rectification work, shall be re-tested. Where the plant and equipment is a composite unit of several individual pieces manufactured in different places, it shall be assembled and tested as one complete working unit, at the maker's works.

Neither the execution of an inspection test of materials or any part of the works, nor the attendance by the Engineer's Representative(s), nor the issue of any test certificate shall relieve the Contractor from his responsibilities under the Contract.

The test equipment, meters, instruments etc., used for testing shall be calibrated at recognized test laboratories at regular intervals and valid certificates shall be made available to the Engineer's representatives at the time of testing. The calibrating instrument used as standards shall be traceable to National / International standards. Calibration certificates for test instruments shall be produced from a recognized Laboratory for the Engineer's consent in advance of testing and if necessary instruments shall be recalibrated or substituted before the commencement of the test.

The Contractor shall not pack for shipment any part of the Plant until he has obtained from the Employer or his authorized representative his written approval to the release of such part for shipment after any tests required by the Contract have been completed to the Employer's satisfaction.

The following Testing shall be carried out for all the equipment as applicable

- Visual Inspection.
- Material Certificates for all the specified material shall be furnished.
- Welding Qualifications
- Dimension Checking

- Stage Inspections (in process inspection)
- Hydrostatic / Leak testing for all pressure parts, Pneumatic Leak Test wherever applicable
- Operation check
- Radiographic testing for all but welded parts, as per applicable codes.
- Hardness tests for all Hardened surfaces.

The Contractor shall maintain proper identification of all materials used, along with reports for all internal / stage inspection work carried out, based on the specific job requirement and or based on the data sheets / drawings / specifications.

3.3.2 INSPECTION

The following inspection and test categories shall be applied prior to delivery of the equipment, of various categories as indicated in the technical specifications for each type of the equipment.

The drawing of the equipment have to be submitted and approved by the Employer’s Representative prior to manufacture. The materials has to be tested by the manufacturer and the manufacturer’s test certificates are to be submitted and approved by the Employer’s Representative before dispatching of the equipment. Notwithstanding the above, the Employer’s Representative, after examination of the test certificates, reserves the right to instruct the Contractor for retesting, if required, in the presence of the Contractor’s representative.

For material / equipment under Category “A” and “B”, the Employer’s Representative will provide an authorization for packing and shipping after inspection.

The testing and approval for dispatching shall not absolve the Contractor from his obligations for satisfactory performance of the plant.

3.3.4 Anchor Blocks, Thrust Block, Scour Protection & Bends

Anchor blocks shall be provided at all bends exceeding 6° in the up- or downward directions or as directed by the Engineer. Pipes shall be anchored with the MS clamps to the anchor blocks.

Anchor blocks shall be constructed as per design of the Engineer according to the highest pressure during operation or testing of the pipes, the safe bearing pressure of the surrounding soil and the friction coefficient of the soil.

Thrust blocks shall be provided at each bend exceeding 6° horizontal deviation to prevent undue movements of the pipeline under pressure. At every bend and junction on pressure pipelines the Contractor shall construct a thrust block in concrete M20. The additional excavation required to obtain a firm thrust face against undisturbed ground shall be made after the thrust block is cured. The concrete backfill to the excavation shall be placed the same day as the additional excavation is carried out. No pressure is to be applied to thrust blocks until concrete has matured

All vertical or horizontal bends more than 6° shall be encased in thrust/anchor blocks as per typical drawings in the Bid Document, except where these are to be placed in trenches excavated in firm, un-fractured rock. The details of thrust /anchor blocks have been rendered on Drawing.

It is of note that these design-drawings may be modified by the Engineer after determining the actual soil bearing capacity (SBC) and other relevant parameters obtained at representative locations and the Contractor shall be required to follow the modified drawings. However, rates shall be quoted on the basis of drawings provided herewith. Excavation for construction of thrust blocks shall be carefully carried out to prevent damage to the adjacent Drain and the erosion prone hillside.

3.3.5 Auxiliary Works

Crossing of Existing Distribution Pipes and Connecting Pipes

Existing water distribution pipes or other services, conduits and cables and domestic connections shall be protected during the laying of the pipe line. The existing pipes, cables or other services which are disturbed / damaged shall be repaired or replaced according to

the instructions of the Engineer and in co-operation with the local service provider representatives. The Contractor shall be fully liable for damages to existing pipes /other installations due to negligence of its staff. All costs for the reinstatement to the original status of the pipes or services in case of damage shall be borne by the Contractor.

If there is a conflict in line or level between an existing service and the proposed pipeline which requires the existing service to be re-located permanently the cost for such shifting shall be borne by the employer through provisional sum.

Power or Telephone Poles and Lines

In case pipeline alignment requires relocation of electric / telephone poles / OH lines, or other cables, the Contractor shall inform the Engineer and the concerned line agency. These works shall be executed by the respective department or according to its instructions, by the Contractor. The expenditure on such works shall be made through provisional sums. Contractor shall be fully liable for damages to existing pipes or structures due to negligence of its staff. All costs for the reinstatement of the original status of the pipes, poles, equipment or structures in case of such damage shall be borne by the Contractor. If the payment by the executing agency would not be made within 15 days of giving the notice, the employer will have right to deduct the amount mentioned in the demand note from the subsequent running bill of the contractor and will be deposited in the concerned department

3.3.6 Valve Chambers:

Cast iron valve chambers will be provided for installing sluice valves, pressure reducing valves and kinetic air valves.

Valve chambers shall be constructed according to the typical drawings suitable for the respective valve and special arrangement if any shall be approved by Engineer. They shall be constructed as shown in the drawing. The chambers shall be constructed after the laying of the pipes and the assembly of specials and valves. The size of the chambers shall be according to the following criteria/ as per direction of Engineer.

- Minimum distance of flanges from walls : 30 cm
- Minimum distance of sockets from walls : 30 cm
- Minimum distance between highest point of equipment and roof slab : 10 cm
- Maximum distance between highest point of equipment and roof slab : 30 cm

Pipes passing through walls should be coated by two layer of soft material (Hessian felt) to allow for differential settling and longitudinal expansion if directed by Engineer. The work shall include excavation, consolidation, leveling, lean concrete as per drawing in foundations, finishing, refilling. It shall include all labour and material required for the complete chamber.

3.3.7 REINSTATING THE ROAD SURFACE

3.3.7.1 Temporary Road Restoration

Temporary road restoration should be done just after proper backfilling of trenches. About 100mm thick layer of stone dust/Zeera gitti should be filled in the trench and making level with adjacent road. Any settlement in trench should be immediately filled with stone dust/Zeera gitti. Temporary restoration will be completed within 10 days of laying of pipes failing which penalty of Rs. 5 per meter per day shall be imposed to the contractor. **The measurement for temporary road reinstatement will neither be made nor be paid, therefore the contractor is advised to ascertain the quantum and cost of such work and include this cost in their offer.**

3.3.7.2 Permanent Road Restoration

Reinstatement of road/footpath shall be done as per the requirements of local authorities and the relevant specifications after the completion of work. Permanent restoration (making good the same) will be completed within 20 days of laying of pipes, failing which penalty of Rs. 10/m/day shall be imposed to the contractor.

All reinstatement of bituminous road shall include the following.

3.3.7.3 Granular Sub Base

250mm thickness of Granular Sub Base of Grading –I (as per Table 1 400-1 of MORTH(4th revision) specification.

3.3.7.4 WBM Reinstatement

- 1) 100mm thickens with 90 - 45 mm GRADING I (hand broken) complete as per MORTH(4th revision) specification. Section 404. (Bottom Layer)
- 2) 75mm thickens with 63 - 45 mm GRADING II (hand broken) complete as as per MORTH(4th revision) specification. Section 404.(Middle Layer)
- 3) 75mm thickness with 53 – 22.4 mm GRADING III (crusher broken) complete as as per MORTH(4th revision) specification. Section 404.(Top Layer)

3.3.7.5 Prime Coat

As per section 502 of MORTH(4th revision) specification. The bituminous emulsion of complying with IS 8887 of Medium Setting type

3.3.7.6 Tack Coat

As per section 503 of MORTH(4th revision) specification. The bituminous emulsion of complying with IS 8887 of Rapid Setting type

3.3.7.7 Bituminous Macadam (BM)

A bearing surface 50 mm thick Bituminous Macadam (as per clause 504 of Mo.R.T.H Specifications). For all bituminous works, bitumen of penetration grade of 60/70 shall be used.

3.3.7.8 Bituminous Concrete (BC)

A wearing and profile corrective courses Bituminous Concrete (BC) of 100 mm thick, complete as per the section 509 of Mo.R.T.H Specifications, as directed by the Engineer. For all bituminous works, bitumen of penetration grade of 60/70 shall be used.

3.3.7.9 There should be a overlap with the existing road of minimum 200 mm on both side of the trench for which no additional payment will be made.

3.3.7.10 Reinstatement of Cement Concrete Roads**3.3.7.11 Dry lean Cement concrete Sub-Base**

Construction of dry lean cement concrete sub base complete as per section 601 of MORTH specification over a prepared sub grade with coarse and fine aggregate confirming to IS:383, the size of coarse aggregate not exceeding 25mm, aggregate cement ratio not to exceed 15:1, aggregate gradation after blending to be as per table 600-1, cement content not to be less than 150 Kg/Cum, optimum moisture content to be determine during trial length constrction, concrete strength not to be less than 10 MPA at 7 days, mixed in a batching plant, transported to site, laid with paver with electronic sensor, compacting with 8-10tonne vibratory roller, finishing and curing 75mmthick Concrete roads shall be reinstated with 100 mm thick bottom layer of cement concrete mix of 1:3:6 with 40 mm nominal size crusher broken aggregate and 150 mm thick top layer of cement concrete mix of 1:1.5:3 with 20 mm nominal size crusher broken aggregate to be flushed with existing road surface. The top surface of the CC road shall be better or similar finish as compared to the existing road.

3.3.7.12 Cement Concrete Pavement

Construction of unreinforced, dowel jointed, plain cement concrete pavement (Pavement Quality Concrete) complete as per section 601 of MORTH specification over a prepared **Dry lean Cement concrete** sub base with 43 grade cement at 400 kg/cum, coarse and fine aggregate conforming to IS 383, maximum size of coarse aggregate not exceeding 25mm, mixed in a batching and mixing plant as per approved mixed design, transported to site, laid with a fixed formed or sleep form paver, spread, compacted and finished in a continuous operation including provision of contraction, expansion, construction and longitudinal joints, joint filler, separation membrane, sealant primer, joint sealeant, debonding strip, dowel bar, tie rod, admixtures as approved, curing compound, finishing line to grade as per drawing. 25cm thick

Measurement of Works:

3.3.7.13 The measurements for excavation in trenches shall be made in following manner and will be paid accordingly.

- 1) Length: As per actual length of pipe and fittings/specials laid at work site
- 2) Width and cross section: As per drawing.
- 3) Depth: Average depth of the trench from ground level to invert of pipe plus thickness of bedding if any.

3.3.7.14 Excavation of asphalt road will be measured in soft rock whereas the excavation of CC road will be measured in hard rock. For reinstatement of road the length and width at top of trench shall be considered same as those mentioned for excavation of trench. If excess excavation done beyond the cross section of the trenches mentioned in the drawing, measurement for the same will neither be made and nor be paid for, whereas the reinstatement of the road will be done as per the provision of the contract on the full width of actual excavation and no extra payment will be made for the additional excavation beyond standard trench section.

3.3.7.15 The road restoration (Permanent) has to be done in the whole trench width as excavated by the contractor, but the payment for the road restoration will be restricted to width as paid for excavation of trench for pipeline. If any part of the road is damaged due to movement of equipments of the contractor, full width of the road will be restored by the contractor and for this no payment will be made.

3.3.7.16 The measurement for backfilling of the trenches shall be made by deducting the quantity of road reinstatement (temporary and permanent), the volume of pipes and pipe bedding from the quantity of excavation of the trench.

3.3.7.17 The permanent reinstatement of road can be done simultaneously after proper backfilling of the trench so that the backfilling of the trench from selected soil upto the top of trench could be avoided. However if the contractor is unable to complete the permanent reinstatement simultaneously with the backfilling, temporary road reinstatement will have to be done as mentioned above and for this, payment for backfilling upto top of trench and temporary reinstatement of road will not be made. Also, the payment of re-excavation of trench for achieving the section of permanent road reinstatement will not be made. Therefore the contractor is advised to ascertain the quantum and cost of such work and include this cost in their offer.

3.3.7.18 Details of payment for civil works and supply of material are as follows:

The terms of payment certificates shall be as under:

- I. The payment of the civil works shall be made as per actual work done and measured for item rate Contract as per the provision of this Contract.
- II. Payment Schedule for pipe line. Break up schedule for Payment for supply and laying, jointing testing & commissioning of pipes, specials and valves shall be as follows:
 - a) Against supply of materials on site with required certificates in original from manufacturer and third party inspection certificate - 60% of the BOQ rate
 - b) After laying /jointing / Installation - 25% of the BOQ rate
 - c) After testing - 10 % of the BOQ rate
 - d) After Completion of Commissioning - 5% of the BOQ rate

Supply of pipes shall be commensurate with laying and jointing of pipes.No payment for supply shall be considered when pipe length of unutilized pipes is more than 20 Km. for HDPE pipe and 5 Km. for DI pipes.

3.3.7.19 The Testing charges by approved/government laboratory/third party for items shall be borne by the contractor.

4. Personnel Requirements

Using Form PER-1 and PER-2 in Section 4 (Bidding Forms), the Bidder must demonstrate it has personnel that meet the following requirements:

S/No.	Position	Total Work Experience [years]	Experience In Similar Work [years]
1	Project Manager (Graduate Civil Engineer) - 1	7	3
2	Project Engineers-2 (Graduate Civil Engineer – 1 & Graduate mechanical/Electrical-1)	3	2
3	Civil Supervisors (Diploma in Civil Engineering)- 4 numbers	3	2
4	Quality Control Engineer (Diploma in Civil Engineering)- 1 number	3	2
5	Quantity Surveyor (Diploma in civil Engineering)-1 number	3	2

5. Equipment Requirements

Using Form EQU in Section 4 (Bidding Forms), the Bidder must demonstrate it has the key equipment listed below:

S/No.	Equipment Type and Characteristics	Minimum Number Required
1	Cranes 20 T capacity	2 Nos.
2	Excavator Cum Loader	2 Nos.
3	Tippers 9-10 T capacity	5 Nos.
4	Welding machines	2 Nos.
5	Concrete weigh batch mixers & Vibrators	1 No. Each

6	Reciprocating Pump capable of raising pressure at 16 kg/cm ² /Minute	2 Nos.
7	Dewatering pump with accessories	2 Nos.
8	Total station Survey equipment with all accessories	1 no.
9	Auto level	1 no.

6. DRAWINGS

(Drawing as available and as require may be provided)