RAJKOT MUNICIPAL CORPORATION

e - Tender No.RMC/PWD/WZ/20-21/

Bid Documents For

Contract for Design, Supply, Installation, Testing and Commissioning of Electric and gas based cremation furnace System with related comprehensive Electrical, Mechanical and Civil Work including all necessary equipments with 5 (five) years comprehensive O&M at Raiya in Rajkot. (Re-Tender)

Milestone Dates for e-tendering is as under	
1. Downloading of e-Tender documents	08-01-2021 To 28-01-2021 upto 1800 Hrs.
2. Pre-bid meeting in the office of the City Engineer at West Zone Office	15-01-2021 at 1700 Hours
3. Online submission of e - Tender	28-01-2021 upto 1800 Hrs.
4. Submission of EMD, Tender fee and other required documents as per Financial, Experience etc. in Person /by Regd.A.D./ Speed Post / Courier.	30-01-2021 up to 1800 Hrs.
5. Opening of online Primary Bid	30-01-2021 at 1800 Hours onwards
6. Verification of submitted documents	01-02-2021 at 1030 Hours onwards
7. Agency to remain present in person along with original documents for verification	02-02-2021 between 16.00 to 17.00 Hours
8. Opening of online PriceBid	03-02-2021 at 1100 Hours onwards (If Possible)
9. Bid Validity	180 Days

VOLUME-II

2020-21

CITY ENGINEER
RAJKOT MUNICIPAL CORPORATION
CONSTRUCTION BRANCH
SHRI HARISINHJI GOHIL ZONAL OFFICE,
WEST ZONE, BEHIND BIG BAZAAR
150 FEET RING ROAD, B/H.BIG BAZAAR,
RAJKOT - 360 005 (GUJARAT)

Introduction

EXTENT OF WORK

1.0 GENERAL

The extent of the work that may have to be provided by the bidders as given below is only suggestive. The bidder can review and refine the components so as to ensure the inlet at below mentioned locations not less than specified.

2.0 PLOT AT RAIYA

The land is acquired for this proposed crematorium premises.

3.0 DETAILS OF PROPOSED WORK

Civil work related to the electric crematorium extension work as shown in the drawings.

4.1 Design Considerations

All the RCC work shall have to carried out in M-20 as per the relevant BIS code where there is no detailed specification available in the document. In this case, a standard Engineering practice shall have to be followed.

4.2 ELECTRIC SYSTEMS

All supply and installation works required for appropriate functioning of the plant.

5.0 SUPERVISORY /ANNUNCIATION SYSTEMS

The mechanical and electrical work related to electrical crematorium will be carried out by other agency. The civil contractor shall have to co-operate with the agency.

CONTENTS

Drawings, Documents, Certificate, Manuals

1.1 Submission and review of Engineering Documents

1.1.1 All the structural design and working drawings shall have be provided bidder from the qualified structural engineer, for which no any payment will be made by Rajkot Municipal Corporation.

1.2 Form of Drawings

1.2.1 All drawings submitted for approval shall be ISO standard size sheets, prepared on computer AutoCAD. Every drawing shall have a title block in the bottom right corner showing:

Employer	:	City Engineer Rajkot Mahanagar Seva Sadan
Contract No.	:	
Contractor	:	
Project	:	Contract for Design, Supply, Installation, Testing and Commissioning of Electric and gas based cremation furnace System with related comprehensive Electrical, Mechanical and Civil Work including all necessary equipments with 5 (five) years comprehensive O&M at Raiya in Rajkot
Drawing Title	:	
Drawing Number	:	
Revision Number	:	
Date	:	

1.2.2 Each drawing shall bear the signature of the Project Manager on behalf of the Contractor to the effect that the drawing (whether his own or from any other source) has been checked by the Contractor before submission to the Engineer Executive / Consultant.

1.2.3 Each revision shall be properly recorded to show the number, date, specific description of revision/s carried out, and signature of the Project Manager in the revision block. The Contractor shall be responsible for incorporating all the comments issued by the City Engineer in the subsequent revision.

1.3 Program of Submission

1.3.1 The Contractor shall furnish a program for submitting all designs, drawings, and documents to City Engineer / Consultant within three weeks of award of Contract for pre-construction review. The program shall make reasonable provision for re-submission of unapproved designs, drawings and documents and for the time needed to review and transmit such designs, drawings and documents. No designs, drawings and documents will be accepted for review until the program for submission has been approved by City Engineer**.**

1.3.2 The Contractor shall provide three copies of all submissions for review / approval. Two copies will be returned to the Contractor with comments / approval.

1.3.3 The review period of pre-construction documents shall be as per conditions of contract Part-I Clause 5.2.

1.3.4 After approval, the Contractor shall submit to City Engineer one tracing, computerised drawing soft copy and five copies of all approved drawings with the date of approval marked.

1.4 Approval of Designs and Drawings

1.4.1 Approval from City Engineer to the Contractor's design or drawings shall not relieve the Contractor of any of his contractual obligations or liabilities under the Contract or his responsibilities for correctness of dimensions, materials of construction, weights, quantities, design details, assembly fits, performance particulars and conformity of the suppliers with the Indian statutory laws as may be applicable, nor does it limit the City Engineer's rights under the Contract.

1.4.2 Should it be found at any time after approval has been given by City Engineer that any designs, drawings or documents submitted by the Contractor are not consistent with any design, drawings or documents submitted or approved previously or deviate from any major aspect of the Contract Document, then such alternations or additions as may be deemed necessary by the City Engineer shall be made therein by the Contractor and the works carried out accordingly.

1.4.3 No revision shall be made by the Contractor after a design, drawing or document is "approved" by the City Engineer. In case the Contractor desires to incorporate any minor amendments in an "approved" drawing, he shall re-submit the same for formal approval. Contractor shall not make any revision in design/drawings, which is not related to the comments conveyed by City Engineer.

1.4.4 The approval of all the design will be given within 7 days. The Employer will accept the same within maximum 10 days for review with maximum one set of revisions.

1.5 Certificates

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

1.5.2 Manufacturer's and supplier's test certificates shall be submitted as soon as the tests have been completed and in any case not less than seven calendar days prior to the time that the materials represented by such certificate are needed for incorporation into the Works.

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

1.6 Instruction Manuals (DELETED)

1.7.1 General Instructions (DELETED)

1.7.2 Maintenance Instructions (DELETED)

(a) **Maintenance Manual (DELETED)**

(b) **Manufacturer's Instructions (DELETED)**

TECHNICAL SPECIFICATIONS (GENERAL)
CIVIL
CONTENTS

1.0 CIVIL AND BUILDING WORKS

1.1 Design Submissions

Complete detailed design calculations of foundations and superstructure together with general arrangement drawings and explanatory sketches shall be provided by Rajkot Mahanagar Seva Sadan.

The design considerations described hereunder establish the minimum basic requirements of plain and reinforced concrete structures, masonry structures and structural steel works. However, any particular structure shall be designed for the satisfactory performance of the functions for which the same is being constructed. The Contractor shall also take care to check the stability of partly completed structures.

1.2 Design Standards

All designs shall be based on the latest Indian Standard (I.S.) Specifications or Codes of Practice. The design standards adopted shall follow the best modern engineering practice in the field based on any other international standard or specialist literature subject to such standard reference or extract of such literature in the English language being supplied to and approved by City Engineer. In case of any variation or contradiction between the provisions of the I.S. Standards or Codes and the specifications given along with the submitted tender document, the provision given in this Specification shall be followed.

All reinforced concrete structural design shall generally conform to the following publications of the Indian Standards Institution :

I.S. 456	Code of Practice for plain and reinforced concrete
I.S. 875	Code of Practice for design loads for buildings and structures (Part 1 to 5)
I.S. 3370	Code of Practice for concrete structures for the storage of liquids (Part I to IV)
I.S. 1893	Criteria for earthquake resistant design of structures
I.S. 2974	Code of Practice for design and construction of machine foundations (Part 1 to 4)

All structural steel design shall generally conform to the following publications of the Indian Standards Institution:

I.S. 800	Code of Practice for general construction in steel
I.S. 806	Code of Practice for use of steel tubes in general building construction

1.3 Design Life

The design life of all structures and buildings shall be 60 years.

1.4 Design Loading

All buildings and structures shall be designed to resist the worst combination of the following loads / stresses under test and working conditions; these include dead load, live load, wind load, seismic load, stresses due to temperature changes, shrinkage and creep in materials, dynamic loads, impact load and other specific loads.

1.4.1 Dead Load

This shall comprise all permanent construction including walls, floors, roofs, partitions, stairways, fixed service equipment and other items of machinery.

The following minimum loads shall be considered in design of structures :

Weight of water	9.81 kN/m^3

Weight of soil (irrespective of strata available at site and type of soil used for filling etc). However, for checking stability against uplift, actual weight of soil as determined by field test shall be considered.	20.00 kN/m^3
Weight of plain concrete	24.00 kN/m^3
Weight of reinforced c	25.00 kN/m^3
Weight of brickwork (exclusive of plaster)	22.00 N/m^2 per mm thickness of brickwork
Weight of plaster to masonry surface	18.00 N/m^2 per mm thickness
Weight of granolithic terrazzo finish or rendering screed, etc.	24.00 N/m^2 per mm thickness

1.4.2 Live Load

Live loads shall be in general as per I.S. 875. However, the following minimum loads shall be considered in the design of structures:

i) Live load on roofs (accessible) : 1.50 kN/m^2
(Non-accessible) : 0.75 kN/m^2

ii) Live load on floors supporting equipment such as pumps, blowers, compressors, valves, etc. : 10.00 kN/m^2

iii) Live load on all other floors walkways, stairways and platforms.: 5.00 kN/m^2

In the absence of any suitable provisions for live loads in I.S. Codes or as given above for any particular type of floor or structure, assumptions made must receive the approval of City Engineer prior to starting the design work. Apart from the specified live loads or any other load due to material stored, any other equipment load or possible overloading during maintenance or erection / construction shall be considered and shall be partial or full whichever causes the most critical condition.

1.4.3 Wind Load

Wind loads shall be as per I.S. 875.

1.4.4 Earthquake Load

This shall be computed as per I.S. 1893 considering earthquake 2001. An importance factor appropriate to the type of structure shall be considered for design of all the structures.

1.4.5 Dynamic Load

Dynamic loads due to working of items such as pumps, blowers, compressors, switch gears, travelling cranes, etc. shall be considered in the design of structures as per manufacturer's data.

1.5 Joints

Movement joints such as expansion joints, complete contraction joints, partial contraction joints and sliding joints shall be designed to suit the structure. However, contraction joints shall be provided at specified locations spaced not more than 7.5 m in both right angle directions for all walls and rafts.

Expansion joints of suitable gap at suitable intervals not more than 30 m shall be provided in all walls, floors and roof slabs of water retaining structures.

Construction joints shall be provided at right angles to the general direction of the member. The locations of construction joints shall be decided on convenience of construction. To avoid segregation of concrete in walls, horizontal construction joints are normally to be provided at every 2-m height. PVC water-stops of 150 mm width shall be used for walls and 230 mm width for base slabs. Alternatively contractor can use G.I. Sheets of 18 gauge and 200 mm wide.

Expansion joints for non-liquid retaining structures shall be provided as per IS 3414.

1.6 Design Conditions for Underground or Partly Underground Liquid Retaining Structures

All underground or partly underground liquid containing structures shall be designed for the following conditions:

(i) Liquid depth to be considered up to full height of wall and no relief due to soil pressure from other side to be considered.

(ii) Structure empty condition (i.e., empty of liquid, any material, etc.)**:** full earth pressure with saturation and surcharge pressure wherever applicable, to be considered.

(iii) Partition wall between dry sump and wet sump **:** to be designed for full liquid depth up to full height of wall.

(iv) Partition wall between two compartments **:** to be designed as one compartment empty and other full for both the directions.

(v) Structures shall be designed for uplift in empty conditions with no live load with the appropriate water table.

(vi) Walls shall be designed under operating conditions to resist earthquake forces from earth pressure mobilization and dynamic water loads.

(vii) Underground or partially underground structures shall also be checked against stresses developed due to any combination of full and empty compartments with appropriate ground/uplift pressures from below to base slab. A minimum factor of 1.2 shall be ensured against uplift or floatation.

(viii) For tender evaluation, the Soil bearing capacity is to be consider 10 MT/Sq.mt for sump and pump house foundation but on award of the work, contractor shall have to carry out detailed soil analysis & based on actual S.B.C. structure shall have to be designed.

1.7 Foundations

(i) The minimum depth of foundations for all structures, equipment, buildings and frame foundations and load bearing walls shall be as per IS 1904.

(ii) Maximum safe bearing capacity of soil strata shall be taken as indicated in geo-technical reports.

(iii) Care shall be taken to avoid the foundations of adjacent buildings or structure foundations, either existing or not within the scope of this Contract. Suitable adjustments in depth, location and sizes may have to be made depending on site conditions. No extra claims for such adjustments shall be accepted by City Engineer.

(iv) Special attention is drawn to danger of uplift being caused by the ground water table. All underground structural slab wherever applicable shall be designed for uplift forces due to ground water pressure.

(v) Where there is level difference between the natural ground level & the foundations of structure or floor slabs, this difference shall be filled up in the following ways:

- In case of non-liquid retaining structures the natural top soil shall be removed till a firm strata is reached (minimum depth of soil removed shall be 500 mm.) and the level difference shall be made up by compacted backfill as per specifications. However the thickness of each layer shall not exceed 150 mm. The area of backfilling for floor slabs shall be confined to prevent soil from slipping out during compaction.

The safe bearing capacity of this well compacted backfilled soil shall not exceed 100 kN/sq.m.

- In case of liquid retaining structures, the natural top soil shall be removed as described above and the level difference shall be made up with Plain Cement Concrete (1:5:10)

1.8 Design Requirements

The following are the design requirements for all reinforced or plain concrete structures:

a) All binding and leveling concrete shall be a minimum 100 mm thick in concrete grade 1:3:6.

b) All structural reinforced concrete for water retaining structures shall be of a minimum M25 grade with a maximum 20 mm aggregate size for footings and base slabs and with a maximum 20 mm aggregate size for all other structural members. For non water retaining structures the concrete shall be of M 20 grade. The structures shall have to be designed as per IS : 3370 (Part I-IV).

c) The reinforced concrete for water retaining structures shall have a minimum cement content of 360 kg/m^3 with a maximum 20 mm size aggregate and 330 kg/m^3 with a maximum 40 mm size aggregate as per IS : 3370 (Part I-IV).

d) The minimum reinforcement for water retaining structures in each direction should be 0.35% of cross section. The minimum clear cover to all reinforcement including stirrups and links shall be 50 mm for all water retaining structures.

e) All buildings shall have a minimum 1 meter wide, 100 mm thick plinth protection paving in M15 grade concrete or stone slabs/tiles. All plinth protection shall be supported on well compacted strata.

f) Any structure or pipeline crossing below roads shall be designed matching classification of road (anything from Class A to AA of IRC loading)

g) The bridges & bridge supporting structures shall be designed to safely withstand the loading.

h) All pipes & conduits laid below the structural plinth & road works shall be embedded in reinforced concrete of grade M15 of minimum thickness 150 mm.

i) Approved quality water proofing compound (chloride free) shall be added during concreting of all liquid containing structure in the proportions specified by manufacturer or 2 % by weight of cement whichever is higher.

- The wall and floor panels shall be poured in sequential order with a minimum time gap of 4 days.

The following minimum thickness shall be used for different reinforced concrete members, irrespective of design thickness:

(i) Walls for liquid retaining structures	:	250 mm
(ii) Roof slabs for liquid retaining structures : (other than flat slabs)		150 mm
(iii) Bottom slabs for liquid retaining structures	:	200 mm
(iv) Floor slabs including roof slabs, walkways, canopy slabs	:	100 mm
(v) Walls of cables / pipe trenches, underground pits etc.	:	125 mm
(vi) Column footings	:	300 mm
(vii) Parapets, chajja	:	100 mm
(viii) Precast trench cover	:	75 mm

- In Mix design, the water cement ratio should not exceed 0.45. The expose condition to be considered severe as chlorinated water is to be stored.

- The inside surface of the container of ESR and GSR shall be provided 20 mm thick water proof cement mortar plaster in CM 1:3 whereas outside surface of the GSR shall be sand faced and that of all surfaces of ESR i.e. container, shaft, etc. shall be exposed finished.

1.9 Materials in General

The term "materials" shall mean all materials, goods and articles of every kind whether RAW, processed or manufactured and equipment and plant of every kind to be supplied by the Contractor for incorporation in the Works.

Except as may be otherwise specified for particular parts of the works the provision of clauses in "Materials and Workmanship" shall apply to materials and workmanship for any part of the works.

All materials shall be new and of the kinds and qualities described in the Contract and shall be at least equal to approved samples.

As soon as practicable after receiving the order to commence the Works, the Contractor shall inform City Engineer of the names of the suppliers from whom he proposes to obtain any materials but he shall not place any order without the approval of City Engineer which may be withheld until samples have been submitted and satisfactorily tested. The Contractor shall thereafter keep City Engineer informed of orders for and delivery dates of all materials.

Materials shall be transported, handled and stored in such a manner as to prevent deterioration, damage or contamination failing which such damaged materials will be rejected and shall not be used on any part of the Works under this contract.

1.10 Samples and Tests of Materials

The Contractor shall submit samples of such materials as may be required by City Engineer and shall carry out the specified tests directed by City Engineer at the Site, at the supplier's premises or at a laboratory approved by City Engineer. City Engineer may appoint separate third party inspection for the material testing to ensure the quality of the work. The Contractor shall replace the defective material as an outcome of these tests.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by City Engineer.

The Contractor shall give City Engineer seven days' notice in writing of the date on which any of the materials will be ready for testing or inspection at the supplier's premises or at a laboratory approved by City Engineer. Representative of City Engineer shall attend the test at the appointed place within seven days of the said date on which the materials are expected to be ready for testing or inspection according to the Contractor, failing which the test may proceed in his absence unless instructed by City Engineer to carry out such a test on a mutually agreed date in his presence. The Contractor shall in any case submit to City Engineer’s Representative within seven days of every test such number of certified copies (minimum six) of the test results as City Engineer may require.

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

The provisions of this clause shall also apply fully to materials supplied under any nominated sub-contract.

1.11 Standards

Materials and workmanship shall comply with the relevant Indian Standards (with amendments) current on the date of submission of the tender. All the governing items, materials, goods and equipments shall bear ISO-9001-2000 certification.

Where the relevant standard provides for the furnishing of a certificate to City Engineer, at his request, stating that the materials supplied comply in all respects with the standard, the Contractor shall obtain the certificate and forward it to City Engineer.

The specifications, standards and codes listed below are considered to be part of this Bid specification. All standards, specifications, codes of practices referred to herein shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy between the Bid Specification and the Standards referred to herein, the Bid Specification shall govern.

a) Materials

IS : 269	Specification for 33 grade ordinary Portland cement
IS : 383	Specification for coarse and fine aggregates from natural sources for concrete
IS : 428	Specification for distemper, oil emulsion, color as required
IS : 432	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement (Parts 1 & 2)
IS : 455	Specification for Portland slag cement
IS : 458	Specification for precast concrete pipes(with and without reinforcement)
IS : 650	Specification for standard sand for testing of cement
IS : 651	Specification for salt glazed stoneware pipes and fittings
IS : 777	Specification for glazed earthenware tiles
IS : 808	Specification for dimensions for hot rolled steel beam, column, channel and angle sections
IS : 814	Specification for covered electrodes for manual metal arc welding of Carbon and Carbon Manganese steel
IS : 1003	Specification for timber paneled and glazed shutters(Parts 1 & 2)
IS : 1038	Specification for steel doors, windows and ventilators
IS : 1077	Specification for common burnt clay building bricks
IS : 1398	Specification for packing paper, water proof, bitumen laminated
IS : 1489	Specification for Portland pozzolana cement (Parts 1&2)
IS : 1566	Specification for hard drawn steel wire fabric for concrete reinforcement
IS :1580	Specification for bituminous compounds for water proofing and caulking purposes
IS : 1786	Specification for high strength deformed steel bars and wires for concrete reinforcement
IS : 1852	Specification for rolling and cutting tolerances for hot rolled steel products
IS : 1948	Specification for aluminium doors, windows and ventilators
IS : 1977	Specification for structural steel (ordinary quality)
IS : 2062	Specification for steel for general structural purposes
IS : 2185	Specification for concrete masonry units (Parts 1 & 2)
IS : 2202	Specification for wooden flush door shutters (Parts 1 & 2)
IS : 2645	Specification for integral cement water proofing compounds
IS : 2750	Specification for steel scaffoldings
IS : 2835	Specification for flat transparent sheet glass
IS : 3384	Specification for bitumen primer for use in waterproofing and damp roofing
IS : 3502	Specification for steel chequerred plates
IS : 4021	Specification for timber door, window and ventilator frames
IS : 4350	Specification for concrete porous pipes for under drainage
IS : 4351	Specification for steel door frames
IS : 4990	Specification for plywood for concrete shuttering work
IS : 8112	Specification for 43 grade ordinary Portland cement
IS : 9862	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and chlorine resisting
IS : 10262	Recommended guidelines for concrete mix design
IS : 12269	Specification for 53 grade ordinary Portland cement

IS : 12330 Specification for sulphate resisting Portland cement
IS : 12709 Glass fibre reinforced plastics (GRP) pipes, joints and fittings for use for potable water supply

b) Tests

IS : 516 Method of test for strength of concrete
IS : 1182 Recommended practice for radiographic examination of fusion welded butt joints in steel plates
IS : 1199 Methods of sampling and analysis of concrete
IS : 2386 Methods of test for aggregates for concrete(Parts 1 to 8)
IS : 2720 Methods of test for soils (Parts 1 to 39)
IS : 3025 Methods for sampling and test (physical and chemical) for water and wastewater (Parts 1 to 44)
IS : 3495 Method of test for burnt clay building bricks(Parts 1 to 4)
IS : 3613 Acceptance tests for wire flux combination for submerged arc welding
IS : 4020 Methods of tests for wooden flush doors Type tests
IS : 4031 Methods of physical tests for hydraulic cement (Parts 1 to 15)
IS : 5807 Method of test for clear finishes for wooden furniture (Parts 1 to 6)
IS : 7318 Approval tests for welders when welding procedure approval is not required (Parts 1 and 2)

c) Codes of Practice

IS :456 Code of practice for plain and reinforced concrete
IS : 783 Code of practice for laying of concrete pipes
IS : 800 Code of practice for general construction in steel
IS : 806 Code of practice for use of steel tubes in general building construction
IS : 816 Code of practice for use of metal arc welding for general construction in mild steel
IS : 817 Code of practice for training and testing of metal arc welders
IS : 875 Code of practice for design loads (other than earthquake) for building structures(Parts 1 to 5)
IS : 1081 Code of practice for fixing and glazing of metal (steel and aluminum) doors, windows and ventilators
IS : 1172 Code of practice for basic requirements for water supply, drainage and sanitation
IS : 1477 Code of practice for painting of ferrous metals in buildings (Parts 1 & 2)
IS : 1597 Code of practice for construction of stone masonry (Parts 1 &2)
IS : 1742 Code of practice for building drainage
IS : 1893 Criteria for earthquake resistant design of structures
IS : 2065 Code of practice for water supply in buildings
IS : 2212 Code of practice for brickwork
IS : 2338 Code of practice for finishing of wood and wood based materials (Parts 1 & 2)
IS : 2394 Code of practice for application of lime plaster finish
IS : 2395 Code of practice for painting, concrete, masonry and plaster surfaces (Parts1 & 2)
IS : 2470 Code of practice for installation of septic tanks (Parts 1 & 2)
IS : 2502 Code of practice for bending and fixing of bars for concrete reinforcement
IS : 2571 Code of practice for laying in situ cement concrete flooring
IS : 2595 Code of practice for radiographic testing
IS : 2751 Recommended practice for welding of mild steel plain and deformed bars for reinforced construction
IS : 2974 Code of practice for design and construction of machine foundations (Parts 1 to 4)
IS : 3114 Code of practice for laying of Cast Iron pipes

IS : 3370 Code of practice for concrete structures for the storage of liquids (Parts 1 to 4)
IS : 3414 Code of practice for design and installation of joints in buildings
IS : 3558 Code of practice for use of immersion vibrators for consolidating concrete
IS : 3658 Code of practice for liquid penetrant flaw detection
IS : 3935 Code of practice for composite construction
IS : 4000 Code of practice for High strength bolts in steel structures
IS : 4014 Code of practice for steel tubular scaffolding (Parts 1 & 2)
IS : 4111 Code of practice for ancillary structures in sewerage system (Parts 1 to 4)
IS : 13920 Code of practice for laying of glazed stoneware pipes
IS: 4326 Code of practice for Earthquake Resistant Design and Construction of Buildings
IS : 4353 Recommendations for submerged arc welding of mild steel and low alloy steels
IS : 5329 Code of practice for sanitary pipe work above ground for buildings
IS : 5334 Code of practice for magnetic particle flaw detection of welds
IS : 5822 Code of practice for laying of welded steel pipes for water supply

IS : 7215 Tolerances for fabrication of steel structures
IS : 9595 Recommendations for metal arc welding of carbon and carbon manganese steels
IS : 10005 SI units and recommendations for the use of their multiples and of certain other units

d) Construction Safety

IS : 3696 Safety code for scaffolds and ladder (Parts 1 & 2)
IS : 3764 Safety code for Excavation work
IS : 7205 Safety code for erection of structural steel work

1.12 Orientation

The works shall be laid out within the confines of the Site in order to interface to the existing infrastructure of roadways and inlet and outlet pipe work Underground services requiring to be relocated in order to accommodate the proposed site layout shall, with the approval of City Engineer, be relocated by the Contractor.

1.13 Buildings and Structures

1.13.1 All the building and structure works shall generally comply with the following City Engineer's requirements unless otherwise specified elsewhere.

1.13.2 All building works shall be of reinforced concrete framework.

1.13.3 All external walls shall be in 230 mm thick brick masonry built cement mortar in 1:6.

1.13.4 All internal partition walls except for toilets shall be in 230 mm thick brick masonry built in cement mortar 1:6 .

(a) Finishes to concrete liquid retaining structures (for details, refer clause 3.16 of this volume) shall be :

F1 - External surfaces, buried
F2 - External surfaces exposed and up to 300 mm below ground level
F2 - Internal surfaces

(b) Finishes to other concrete structures (for details, refer clause 3.16 of this volume) shall be :

F1	-	Buried
F1	-	Exposed, where plastering is specified
F2	-	Exposed

1.13.5 All internal masonry surfaces finish shall have 13 mm thick plain faced cement plaster in cement mortar (1:4) with neat lime or neeru finish on top. Over this, one coat of primer and two coats of plastic emulsion paint of approved quality and shade shall be provided.

1.13.6 All external masonry surfaces shall have 20 mm thick sand faced cement plaster in cement mortar (1:3) in two coats. Waterproofing compound of approved make and quality shall be added to the cement mortar in proportions as specified by the manufacturer.

All external surfaces above ground level shall have one coat of primer and two coats of waterproof cement based paint of approved quality and shade. A coat of silicone water repellent paint shall also be applied thereon.

1.13.7 Toilet areas, walls and ceilings, shall have one coat of primer and two coats of plastic emulsion paint.

For pumping station foundation and plinth will be in UCR masonry in C.M. 1:4 and 600 mm wide where as all external wall for super structure will be 230 mm thick in Brick masonry in C.M. 1:6.

1.13.8 Toilet floor slab shall be filled with brickbat coba (broken bricks in lime) and provided with waterproofing as per the specifications of an approved specialist waterproofing company.

1.13.9 The finished floor level in toilet areas shall be 25 mm below general finished floor level elsewhere in the building.

1.13.10 The flooring in all areas shall be in 600 mm x 450 mm x 20-mm thick polished kota stone placed in C.M. to give overall thickness of 50mm.

1.13.11 Toilet areas shall have 450 mm x 450 mm x 25 mm thick polished marble Kota stone tiles placed in cement mortar or lime mortar to give an overall thickness of 50 mm. 2200 mm high ceramic tile (size 200 mm x 200 mm x 6 mm thick) dado placed in cement mortar shall also be provided in these areas. In W.C. areas, the flooring and 2200 mm high dado shall be provided with 200 mm x 200 mm x 6 mm thick coloured ceramic tiles.

(i) The toilet facilities for pump house complex shall be separate as per the drawing attached

1.13.12 All staircases shall have 25 mm thick chequered mosaic tiles for treads and 25 mm thick plain mosaic tiles of approved shade for risers set in cement mortar or lime mortar to give an overall thickness of 50 mm.

1.13.13 Stairways shall be provided to permit access between different levels within buildings. All roof tops and overhead tanks shall be made accessible with ladder provision. Vertical ladders fitted with landing point extensions will be permitted where considered appropriate by the City Engineer to access areas not frequently visited.

1.13.14 All floor cut-outs and cable ducts, etc. shall be covered with pre-cast concrete covers in outdoor areas and mild steel chequered plates of adequate thickness in indoor areas. All uncovered openings shall be protected with M.S. hand railing of 32 NB (M).

1.13.15 All staircases shall be provided with 32 NB (M) galvanised M.S. pipe hand railing for protection.

1.13.16 The reinforced concrete roofs shall be made waterproof by application of an approved roof polythene / bitumen membrane. The finished roof surface shall have adequate slope to drain quickly the rainwater to R.W down take inlet

points.

1.13.17 For roofing drainage, cast iron rainwater down takes with C.I. bell mouth and C.I. grating at top shall be provided. For roof areas up to 100 sq.m minimum two nos. 100 mm diameter down take pipes shall be provided. For every additional area of 100 sq.m or part thereof, at least one no. 100 mm dia. down take pipe shall be provided.

1.13.18 Top surfaces of chajjas and canopies shall be made waterproof by providing a screed layer of adequate slope or application of an approved roof membrane and sloped to drain the rain water. Chajjas, canopies and roof projections shall have drip moulds.

1.13.19 Building plinth shall be minimum 1000 mm above average finished ground level around building.

1.13.20 All doors, windows, rolling shutters shall have lintels above. Chajja protection to lintels on external walls shall be such as to prevent the rain water splashing into the building.

1.13.21 All windows and ventilators shall have 25 mm thick marble stone sills bedded in cement mortar (1:3)

1.13.22 All concrete channels and ducts used for conveying liquid shall have inside finish of type F2. The width of concrete channels shall not be less than 500 mm. All open channels shall be provided with hand railings.

1.13.23 Kerbs to be provided below the hand railing on the catwalks/pathways should be as per relevant sections of Factory Act.

1.13.24 All rooms in the buildings shall be provided with appropriate sign boards indicating the function of the rooms involved.

1.13.25 Wherever equipment and machinery are to be moved for inspection, servicing, replacement etc., suitable movable gantry in the form of EOT crane shall be provided. Minimum capacity of 5 tonnes or more as required shall be provided for monorail.

1.13.26 The design of buildings shall be suitable for the climatic conditions existing on site. Buildings shall as far as is possible permit the entry of natural light.

1.13.27 Emergency exit doorways with Signboards shall be provided from all buildings in order to comply with local and international regulations. Stairways and paved areas shall be provided at the exit points.

1.13.28 Toilet blocks in pump house buildings shall be provided with a sink with one drinking water taps of 15 mm size with adequate inlet and outlet connections.

1.13.29 The side walls of buildings shall, comprise at least 15% ventilated brickwork or louvers. Ventilated brickwork or louvers shall not be used where the ingress of driven rain could affect equipment or stored materials.

1.14 Roadways, & Pathways

A comprehensive network of roadways shall be provided around the structures to link in with the existing road network and permit access to the units for necessary maintenance, delivery of consumables and personnel access. All roads shall be of asphalt macadam and minimum 5 meters wide. Vehicular access shall be provided for all Plant structures and buildings. All roads shall be provided with drainage and shall be constructed to prevent standing water.

1.15 Site Drainage

The contractor shall provide a site drainage system which shall comprise of the Storm Water Drainage and Foul Drainage.

1.15.1 Storm Water Drainage

Storm water drains adjacent to the existing and proposed roads (under this Contract) shall be sized for a rainfall intensity of 80 mm/hr, allowing for 100% runoff. Drains adjacent to roads shall be in brick masonry (1:5) of appropriate thickness, topped with 75 mm thick M 15 pre-cast concrete covers and plastered internally in cement mortar (1:4), 20 mm thick.

The storm water drainage system shall be designed to cater for the run-off from the structures, if necessary.

1.15.2 Foul Drainage

The foul drainage system shall accept discharge from toilets, washrooms, offices and shall discharge to separate septic tank and further to a soak pit, both of appropriate volumes for individual buildings.

1.16 Cable and Pipe work Trenches

Cable and pipe work trenches shall generally be constructed in reinforced concrete. However, 500 mm x 500 mm size or smaller trenches, not on fill may be constructed in 350 mm thick brick masonry (1:4). The trenches will be plastered internally with cement mortar (1:4) and externally in cement mortar (1:3).

Trenches within the buildings or Plant areas shall be covered with M.S chequered plates, suitably painted and those outside the buildings shall be covered with M20 precast R.C.C covers. The trenches shall be suitably sloped to drain rainwater.

Layout of trenches outside the buildings shall allow space for construction of future trenches where necessary with due consideration for planning for future developments. This aspect shall be brought to the notice of City Engineer while planning the works.

1.17 Pipes and Ducts

R.C.C ducts for drainage shall have minimum 1 meter cover while laid under roads. Access shafts of size not less than 600 mm x 1000 mm shall be provided.
All drains (except storm water drains adjacent to roads) shall be covered and designed structurally for appropriate loads.

1.18 Valve Chambers

a) All valve chambers are to be of an adequate size to facilitate maintenance and operation. The base slab of valve chambers shall slope towards a sump pit from which water can be pumped to keep the chamber dry. All valve chambers shall be constructed in M15 grade reinforced concrete. Chambers shall have removable cast iron / reinforced concrete covers, as appropriate, approach ladders and valve supports.

1.19 Landscaping

The site shall be landscaped once the Works are substantially complete. The landscaping scheme shall be submitted and got approved from City Engineer prior to start of actual work.
Landscaping shall include planting of suitable trees and development of grassed areas. Landscaping in general shall meet ecological and environmental conditions of the site. Road widths shall determine the size of the tree height and spread to be selected for planting. Trees suitable for local conditions shall be selected. Medicinal and fruit trees shall be avoided.

1.19.1 Tree Planting

Pits dug a few days in advance of actual planting shall be allowed to weather and be filled with top soil mixed with manure. Size of the pit shall be as per standard requirement. Only one tree shall be planted in each pit. A guard made of bamboo with wire mesh shall be provided.

2.0 EARTHWORKS

2.1 Applicable Codes

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to.

a)	IS 783 - 1985	-	Code of practice for laying of concrete pipes.
b)	IS 3764 - 1992	-	Excavation work - Code of Safety .
c)	IS 2720	-	Methods of test for soils:
	(Part-1) - 1983	-	Part 1 Preparation of dry soil samples for various tests.
	(Part-2) - 1986	-	Part 2 Determination of Water Content.
	(Part-4) - 1985	-	Part 4 Grain size analysis.
	(Part-5) - 1985	-	Part 5 Determination of liquid and plastic limit.
	(Part-7) - 1980	-	Part 7 Determination of water content - dry density relation using light compaction.
	(Part-9) - 1971	-	Part 9 Determination of dry density - moisture content by constant weight of soil method.
	(Part-14) – 1983	-	Part 14 Determination of density index (relative density) of cohesion less soils.
	(Part-22) – 1978	-	Part 22 Determination of organic matter.
	(Part-26) – 1987	-	Part 26 Determination of pH Value.
	(Part-27) – 1987	-	Part 27 Determination of total soluble sulphates.
	(Part-28) – 1974	-	Part 28 Determination of dry density of soils in place, by the sand replacement method.
	(Part-33) – 1971	-	Part 33 Determination of the density in place by the ring and water replacement method.
	(Part-34) – 1972	-	Part 34 Determination of density of soil in place by rubber balloon method.
	(Part-38) – 1976	-	Part 38 Compaction control test (Hilf Method).

2.2 General

The Contractor shall furnish all tools, plant, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein for completion of the work in accordance with the Employer's Requirements.

The Contractor shall survey the site before excavation and set out all lines and establish levels for various works such as grading, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference/grid lines at 8m intervals or nearer, if necessary, based on ground profile and thereafter properly recorded.

The excavation shall be carried out to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of substantial barricades around excavated areas and warning lamps at night.

Excavated material shall be dumped in regular heaps, bunds, riprap with regular slopes within the lead specified and leveling the same so as to provide natural drainage. Rock/soil excavated shall be stacked properly as approved by the Employer's Representative. As a rule, all softer material shall be laid along the center of heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Rock shall be stacked separately.

Topsoil shall be stock piled separately for later re-use.

2.3 Clearing

The area to be excavated/filled shall be cleared of fences, trees, plants, logs, stumps, bush, vegetation, rubbish, slush, etc. and other objectionable matter. If any roots or

stumps of trees are encountered during excavation, they shall also be removed. The material so removed shall be disposed off as approved by the Employer's Representative. Where earth fill is intended, the area shall be stripped of all loose/ soft patches, top soil containing objectionable matter/ materials before fill commences.

2.4 Excavation

All excavation work shall be carried out by mechanical equipment unless, in the opinion of Employer's Representative, the work involved requires it to be carried out by manual methods.

Excavation for permanent work shall be taken out to such widths, lengths, depths and profiles as are shown on the drawings provided by the Contractor or such other lines and grades as may be agreed with the Employer's Representative. Rough excavation shall be carried out to a depth of 150mm above the final level. The balance shall be excavated with special care.

Soft pockets shall be removed below the final level and extra excavation filled up with lean concrete as approved by the Employer's Representative. The final excavation should be carried out just prior to laying the blinding course.

To facilitate the permanent works the Contractor may excavate, and also backfill later, outside the lines shown on the drawings provided by the Contractor as agreed with the Employer's Representative. Should any excavation be taken below the specified elevations, the Contractor shall fill it up with concrete of the same class as in the foundation resting thereon, up to the required elevation at no cost to the Employer.

All excavations shall be to the minimum dimensions required for safety and ease of working. Prior approval of the Employer's Representative shall be obtained by the Contractor in each individual case, for the method proposed for the excavation, including dimensions, side slopes, dewatering, disposal, etc. This approval, shall not in any way relieve the Contractor of his responsibility for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. Side slopes shall be as steep as will stand safely for the actual soil conditions encountered. Every precaution shall be taken to prevent slips. Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope.

2.5 Rock

2.5.1 General

'Rock' means a natural aggregate of mineral crystals which for its excavation would normally require the use of heavy pneumatic/hydraulic breaker and/or cutting equipment or explosives. the term shall exclude any material that can be removed by ordinary excavating machinery and which in any individual mass has a volume not exceeding $1m^3$ or $0.25m^3$ where the net width of excavation is less than 2 m. Ordinary excavating machinery means a hydraulic back hoe with rated output of 50 kW or less.
Before classification of material as rock the Contractor shall demonstrate to the satisfaction of the Employer's Representative his inability to excavate it without resort to heavy percussion tools complete with rock bits, hydraulic wedges or blasting. Excavation by the use of explosive will not normally be permitted except for pipeline.
Material shall not be classified as rock unless the Employer's Representative has agreed to such classification on the basis of such a demonstration before its excavation. Excavations where rock has been encountered and classified as such shall not be backfilled before examination of the excavated faces by the Employer's Representative to enable the extent of the rock excavation to be determined.

2.5.2 Excavation by the Use of Explosives

Unless otherwise stated herein, I.S. Specification " IS:4081: Safety Code for Blasting and related Drilling Operations" shall be followed. As far as possible all blasting shall be completed prior to commencement of construction. At all stages of excavation, precautions shall be taken to preserve the rock below and beyond the lines specified

for the excavation, in the soundest possible condition. The quantity and strength of explosives used, shall be such as will neither damage nor crack the rock outside the limits of excavation. All precautions, as directed by Employer's Representative, shall be taken during the blasting operations and care shall be taken that no damage is caused to adjoining buildings or structures as a result of blasting operations. In case of damage to permanent or temporary structures, Contractor shall repair the same to the satisfaction of Employer's Representative at his cost. As excavation approaches its final lines and levels, the depth of the charge holes and amount of explosives used shall be progressively and suitably reduced.

The contractor shall obtain a valid Blasting License from the authorities concerned. No explosive shall be brought near the work in excess of quantity required for a particular amount of firing to be done; and surplus left after filling the holes shall be removed to the magazine. The magazine shall be built as away as possible from the area to be blasted. Employer's Representative's prior approval shall be taken for the location proposed for the magazine.

In no case shall blasting be allowed closer than 30 meters to any structure or to locations where concrete has just been placed. In the latter case the concrete must be at least 7 days old.

For blasting operations, the following points shall be observed.

I) Contractor shall employ a competent and experienced supervisor and licensed blaster in-charge of each set of operation, who shall be held personally responsible to ensure that all safety regulations are carried out.

ii) Before any blasting is carried out, Contractor shall intimate Employer's Representative and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.

iii) Contractor shall ensure that all workmen and the personnel at site are excluded from an area within 200 m radius from the firing point, at least 15 minutes before firing time by sounding warning whistle. The area shall also be given a warning by sounding a distinguishing whistle.

iv) The blasting of rock near any existing buildings, equipments or any other property shall be done under cover and Contractor has to make all such necessary muffling arrangements. Covering may preferably be done by MS plates with adequate dead weight over them. Blasting shall be done with small charges only and where directed by Employer's Representative, a trench shall have to be cut by chiseling prior to the blasting operation, separating the area under blasting from the existing structures.

v) The firing shall be supervised by a Supervisor and not more than 6 (six) holes at a time shall be set off successively. If the blasts do not tally with the number fired, the misfired holes shall be carefully located after half an hour and when located, shall be exploded by drilling a fresh hole along the misfired hole (but not nearer than 600 mm from it) and by exploding a new charge.

vi) A wooden tamping rod with a flat end shall be used to push cartridges home and metal rod or hammer shall not be permitted. The charges shall be placed firmly into place and not rammed or pounded. After a hole is filled to the required depth, the balance of the hole shall be filled with stemming which may consist of sand or stone dust or similar inert material.

vii) Contractor shall preferably detonate the explosives electrically.

viii) The explosives shall be exploded by means of a primer which shall be fired by

detonating a fuse instantaneous detonator (F.I.D) or other approved cables. The detonators with F.I.D. shall be connected by special nippers.

ix) In dry weather and normal dry excavation, ordinary low explosive gunpowder may be used. In damp rock, high explosive like gelatin with detonator and fuse wire may be used. Underwater or for excavation in rock with substantial accumulated seepage electric detonation shall be used.

x) Holes for charging explosives shall be drilled with pneumatic drills, the drilling pattern being so planned that rock pieces after blasting will be suitable for handling without secondary blasting.

xi) When excavation has almost reached the desired level, hand trimming shall have to be done for dressing the surface to the desired level.

Any rock excavation beyond an over break limit of 75 mm shall be filled up as instructed by Employer's Representative, with concrete of strength not less than M10. Stopping in rock excavation shall be done by hand trimming.

xii) Contractor shall be responsible for any accident to workmen, public or Employer's property due to blasting operations. Contractor shall also be responsible for strict observance of rules, laid by Inspector of explosives, or any other Authority duly constituted under the State and / or Union Government as applicable at the place of excavation.

2.6 Stripping Loose Rock

All loose boulders, detached rocks partially and other loose material which might move therewith not directly in the excavation but so close to the area to be excavated as to be liable, in the opinion of Employer's Representative, to fall or otherwise endanger the workmen, equipment, or the work shall be stripped off and removed from the area of the excavation. The method used shall be such as not to render unstable or unsafe the portion which was originally sound and safe.

Any material not requiring removal in order to complete the permanent works, but which, in the opinion of Employer's Representative, is likely to become loose or unstable later, shall also be promptly and satisfactorily removed.

2.7 Fill, Backfilling and Site Grading

2.7.1 General

(a) All fill material shall be subject to the Employer's Representative's approval. If any material is rejected by Employer's Representative, the Contractor shall remove the same forthwith from the site. Surplus fill material shall be deposited/disposed off as directed by Employer's Representative after the fill work is completed.

No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with to the approval of the Employer's Representative.

2.7.2 Material

To the extent available, selected surplus spoil from excavations shall be used as backfill. Backfill material shall be free from lumps, organic or other foreign material. All lumps of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murmur or earth to fill the voids and the mixture used for filling.

If fill material is required to be imported, the Contractor shall make arrangements to bring such material from outside borrow pits. The material

and source shall be subject to the prior approval of the Employer's Representative. The approved borrow pit areas shall be cleared of all bushes, roots of trees, plants, rubbish, etc. Top soil containing foreign material shall be removed. The materials so removed shall be disposed of as directed by Employer's Representative. The Contractor shall provide the necessary access roads to borrow areas and maintain the same if such roads do not exist.

2.7.3 Filling in pits and trenches around foundations of structures, walls, etc.

As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches, etc., shall be cleared of all debris, and filled with earth in layers not exceeding 15 cm, each layer being watered, rammed and properly consolidated, before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of Employer's Representative. Earth shall be rammed with approved mechanical compaction machines. Usually no manual compaction shall be allowed unless the Employer's Representative is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and leveled to a proper profile to the approval of the Employer's Representative.

2.7.4 Plinth Filling

Plinth filling shall be carried out with approved material as described hereinbefore in layers not exceeding 15cm, watered and compacted with mechanical compaction machines. The Employer's Representative may, however, permit manual compaction by hand tampers where he is satisfied that mechanical compaction is not possible. The finished level of the filling shall be trimmed to the level/slope specified.

The thickness of each unconsolidated fill layer can in this case be up to a maximum of 300mm. The Contractor will determine the thickness of the layers in which fill has to be consolidated depending on the fill material and equipment used and the approval of the Employer's Representative obtained prior to commencing filling.

The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated, then filled and consolidated.

2.7.5 Sand Filling in Plinth and Other Places

Where backfilling is required to be carried out with local sand it shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Employer's Representative has inspected and approved the fill.

2.7.6 Filling in Trenches

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipe and drains have been tested and passed. The backfilling material shall be properly consolidated taking due care so that no damage is caused to the pipes.

Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the centre line of the pipe shall be done by hand compaction with selected approved earth in layers not exceeding 8 cm; backfilling above the level of the centre line of the pipes shall be done with selected earth by hand compaction, or other approved means in layers not exceeding 15 cm.

In case of excavation of trenches in rock, the filling up to a level 30 cm above the top of the pipe shall be done with fine materials such as earth, murmur, etc. The filling up to the level of the centre line of the pipe shall be done by

hand compaction in layers not exceeding 8 cm whereas the filling above the centre line of the pipe shall be done by hand compaction or approved means in layers not exceeding 15 cm. The filling from a level 30 cm above the top of the pipe to the top of the trench shall be done by hand or other approved mechanical methods with broken rock filling of size not exceeding 15 cm mixed with fine material as available to fill up the voids.

Filling of the trenches shall be carried out simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

2.8 General Site Grading

Site grading shall be carried out as indicated in the drawings and as approved by the Employer's Representative. Excavation shall be carried out as specified in the Employer's Requirements. Filling and compaction shall be carried out as specified under Clause 2.7 and elsewhere unless otherwise indicated below.

If no compaction is called for, the fill may be deposited to the full height in one operation and leveled. If the fill has to be compacted, it shall be placed in layers not exceeding 225 mm and leveled uniformly and compacted as indicated in Clause 2.7 before the next layer is deposited.
To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the Contractor.

Field compaction tests shall be carried out in each layer of filling until the fill to the entire height has been completed. This shall hold good for embankments as well. The fill will be considered as incomplete if the desired compaction has not been obtained.
The Contractor shall protect the earth fill from being washed away by rain or damaged in any other way. Should any slip occur, the Contractor shall remove the affected material and make good the slip.

If so specified, the rock as obtained from excavation may be used for filling and leveling to indicated grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cms approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone, etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12 ton roller. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken up.

2.9 Fill Density

The compaction, under the plant road area and building plinths shall comply with minimum 95% compaction by Standard Proctor at moisture content differing not more than 4% from the optimum moisture content. The Contractor shall demonstrate adequately by field and laboratory tests that the specified density has been obtained. In other areas the soil should be backfilled and compacted suitably as specified by the Engineer.

2.10 Timber Shoring

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'polling boards'. These shall be of minimum 25 cm x 4 cm sections or as approved by the Employer's Representative. The boards shall generally be placed in position vertically side by side without any gap on each side of the excavation and shall be secured by horizontal walling of strong wood at maximum 1.2 meter spacing, strutted with bellies or as approved by the Employer's Representative. The length of the belie struts shall depend on the width of the trench or pit. If the soil is very soft and loose, the boards shall be placed horizontally against each side of the excavation and supported by vertical walling,

which in turn shall be suitably strutted. The lowest boards supporting the sides shall be taken into the ground and no portion of the vertical side of the trench or pit shall remain exposed, so as to render the earth liable to slip out.

Timber shoring shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench. The type of timbering shall be as approved by the Employer's Representative. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of excavations, trenches, pits, etc. from collapsing.

Timber shoring may also be required to keep the sides of excavations vertical to ensure safety of adjoining structures or to limit the slope of excavations, or due to space restrictions or for other reasons. Such shoring shall be carried out, except in an emergency, only under instructions from the Employer's Representative.
The withdrawal of the timber shall be done carefully to prevent the collapse of the pit or trench. It shall be started at one end and proceeded with, systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber.

In the case of open timbering, the entire surface of the side of trench or pit is not required to be covered. The vertical boards of minimum 25 cm x 4 cm sections shall be spaced sufficiently apart to leave unsupported strips of maximum 50 cm average width. The detailed arrangement, sizes of the timber and the spacing shall be subject to the approval of the Employer's Representative. In all other respects, the Employer's Requirements for close timbering shall apply to open timbering.

In case of large pits and open excavations, where shoring is required for securing safety of adjoining structures or for any other reasons and where the planking across sides of excavations/pits cannot be strutted against, suitable inclined struts supported on the excavated bed shall be provided. The load from such struts shall be suitably distributed on the bed to ensure no yielding of the strut.

2.11 Dewatering

The Contractor shall ensure that the excavation and the structures are free from water during construction and shall take all necessary precautions and measures to exclude ground/rain water so as to enable the works to be carried out in reasonably dry conditions in accordance with the construction programme. Sumps made for dewatering must be kept clear of the excavations/trenches required for further work. The method of pumping shall be approved by Employer's Representative, but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction. The dewatering shall be continued for at least (7) seven days after the last pour of the concrete. The Contractor shall, however, ensure that no damage to the structure results on stopping of dewatering.

The Contractor shall study the sub-soil conditions carefully and shall conduct any tests necessary at the site with the approval of the Employer's Representative to test the permeability and drainage conditions of the sub-soil for excavation, concreting etc., below ground level.

The scheme for dewatering and disposal of water shall be approved by the Employer's Representative. The Contractor shall suitably divert the water obtained from dewatering from such areas of site where a build up of water in the opinion of the Employer's Representative obstructs the progress of the work, leads to insanitary conditions by stagnation, retards the speed of construction and is detrimental to the safety of men, materials, structures and equipment.

When there is a continuous inflow of water and the quantum of water to be handled is considered in the opinion of Employer's Representative, to be large, a well point system- single stage or multistage, shall be adopted. The Contractor shall submit to the Employer's Representative, details of his well point system including the stages, the spacing, number and diameter of well points, headers etc., and the number, capacity and location of pumps for approval.

2.12 Rain Water Drainage

Grading in the vicinity of excavation shall be such as to exclude rain/ surface water draining into excavated areas. Excavation shall be kept clean of rain and such water as the Contractor may be using for his work by suitably pumping out the same. The scheme for pumping and discharge of such water shall be approved by the Employer's Representative.

3.0 Applicable Codes

3.0.1 Materials

1)	IS.269	Specification for 33 grade ordinary Portland cement.
2)	IS.455	Specification for Portland slag cement.
3)	IS.1489	Specification for portland-pozzolana cement (Part 1&2).
4)	IS:8112	Specification for 43 grade ordinary Portland cement.
5)	IS:12269	Specification for 53 grade ordinary Portland cement.
6)	IS:12330	Specification for sulphate resisting Portland cement.
7)	IS:383	Specification for coarse and fine aggregates from natural sources for concrete.
8)	IS:432	Specification for mild steel and medium (tensile steel bars and hard-drawn steel) wires for concrete reinforcement. (Part 1 and 2)
9)	IS:1786	Specification for high strength deformed steel bars and wires for concrete reinforcement.
10)	IS:1566	Specification for hard-drawn steel wire fabric for concrete reinforcement.
11)	IS:9103	Specification for admixtures for concrete.
12)	IS:2645	Specification for integral cement water- proofing compounds.
13)	IS:4990	Specification for plywood for concrete shuttering work.

3.0.2 Material Testing

1)	IS.4031	Methods of physical tests for hydraulic cement (Parts 1 to 15)
2)	IS:4032	Method chemical analysis of hydraulic cement.
3)	IS:650	Specification for standard sand for testing of cement.
4)	IS:2430	Methods for sampling of aggregates for concrete.
5)	IS.2386	Methods of test for aggregates for concrete (Parts 1 to 8)
6)	IS:3025	Methods of sampling and test (physical and chemical) for water used in industry.
7)	IS:6925	Methods of test for determination of water soluble chlorides in concrete admixtures.

3.0.3 Material Storage

1)	IS:4082	Recommendations on stacking and storing of construction materials at site.

3.1.4 Concrete Mix Design

1)	IS:10262	Recommended guidelines for concrete mix design.
2)	SP:23 (S&T)	Handbook on Concrete Mixes

3.1.5 Concrete Testing

1)	IS.1199	Method of sampling and analysis of concrete.
2)	IS:516	Method of test for strength of concrete.
3)	IS:9013	Method of making, curing and determining compressive strength of accelerated cured concrete test specimens.
4)	IS:8142	Method of test for determining setting time of concrete by penetration resistance.
5)	IS:9284	Method of test for abrasion resistance of concrete.
6)	IS:2770	Methods of testing bond in reinforced concrete.

3.1.6 Equipments

1)	IS:1791	Specification for batch type concrete mixers.
2)	IS:2438	Specification for roller pan mixer.
3)	IS:4925	Specification for concrete batching and mixing plant.
4)	IS:5892	Specification for concrete transit mixer and agitator.
5)	IS:7242	Specification for concrete spreaders.

6) IS:2505 General Requirements for concrete vibrators: Immersion type.
7) IS:2506 General Requirements for screed board concrete vibrators.
8) IS:2514 Specification for concrete vibrating tables.
9) IS:3366 Specification for pan vibrators.
10) IS:4656 Specification for form vibrators for concrete.
11) IS:11993 Code of practice for use of screed board concrete vibrators.
12) IS:7251 Specification for concrete finishers.
13) IS:2722 Specification for portable swing weigh batchers for concrete (single and double bucket type).
14) IS:2750 Specification for steel scaffoldings.

3.1.7 Codes Of Practice

1) IS:456 Code of practice for plain and reinforced concrete.
2) IS:457 Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
3) IS:3370 Code of practice for concrete structures for storage of liquids (Parts 1 to 4)
4) IS:3935 Code of practice for composite construction.
5) IS:2204 Code of practice for construction of reinforced concrete shell roof.
6) IS:2210 Criteria for the design of reinforced concrete shell structures and folded plates.
7) IS:2502 Code of practice for bending and fixing of bars for concrete reinforcement.
8) IS:5525 Recommendation for detailing of reinforcement in reinforced concrete works.
9) IS:2751 Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction.
10) IS:9417 Specification for welding cold worked bars for reinforced concrete construction.
11) IS:3558 Code of practice for use of immersion vibrators for consolidating concrete.
12) IS:3414 Code of practice for design and installation of joints in buildings.
13) IS:4326 Code of practice for earthquake resistant design and construction of building.
14) IS:4014 Code of practice for steel tubular scaffolding (Parts 1 & 2)
15) IS:2571 Code of practice for laying insitu cement concrete flooring.
16) IS:7861 Code of practice for extreme weather concreting : Part 1 Recommended practice for hot weather concreting.

3.1.8 Construction Safety

1) IS.3696 Safety code for scaffolds and ladders. (Parts 1 &
2) IS:7969 Safety code for handling and storage of building materials.
3) IS:8989 Safety code for erection of concrete framed structures.

3.2 General

The City Engineer shall have the right at all times to inspect all operations including the sources of materials, procurement, layout and storage of materials, the concrete batching and mixing equipment and the quality control system. Such an inspection shall be arranged and the City Engineer's approval obtained, prior to starting of concrete work. This shall, however, not relieve the Contractor of any of his responsibilities. All materials which do not conform to the Specifications shall be rejected.

Materials should be selected so that they can satisfy the design requirements of strength, serviceability, safety, durability and finish with due regards to the functional requirements and the environmental conditions to which the structure will be subjected. Materials complying with codes/standards shall generally be used. Other materials may be used after approval of the City Engineer and after establishing their performance suitability based on previous data, experience or tests.

3.3 Materials

3.3.1 Cement

Unless otherwise called for by the City Engineer, cement shall be ordinary Portland cement conforming to IS:269, IS:8112 or IS:12269.

Where Portland pozzolana or slag cements are used, it shall be ensured that consistency of quality is maintained, there will be no adverse interactions between the materials and the finish specified is not marred.

Only one type of cement shall be used in any one mix. The source of supply, type or brand of cement within the same structure or portion thereof shall not be changed without approval from the City Engineer.

Cement which is not used within 90 days from its date of manufacture shall be tested at a laboratory approved by the City Engineer and until the results of such tests are found satisfactory, it shall not be used in any work.

3.3.2 Aggregates (General)

Aggregates shall consist of naturally occurring stones (crushed or uncrushed), gravel and sand. They shall be chemically inert, strong, hard, clean, durable against weathering, of limited porosity, free from dust/silt/ organic impurities/deleterious materials and conform to IS:383. Aggregates such as slag, crushed over burnt bricks, bloated clay ash, sintered fly ash and tiles shall not be used.

Aggregates shall be washed and screened before use where necessary or if directed by the City Engineer.

Aggregates containing reactive materials shall be used only after tests conclusively prove that there will be no adverse effect on strength, durability and finish, including long term effects, on the concrete.

The fineness modulus of sand shall neither be less than 2.2 nor more than 3.2.

The maximum size of coarse aggregate shall be as stated on the drawings but in no case greater than 1/4 of the minimum thickness of the member.

Plums 160 mm and above of a reasonable size may be used in mass concrete fill where directed. Plums shall not constitute more than 20% by volume of the concrete.

3.3.3 Water

Water used for both mixing and curing shall conform to IS:456. Potable waters are generally satisfactory. Water containing any excess of acid, alkali, sugar or salt shall not be used.

3.3.4 Reinforcement

All reinforcement steel shall be tore steel conforming to relevant I.S. for water retaining structure with CRS - Fe-500 confirming to IS - 1786.

All reinforcement shall be clean, free from pitting, oil, grease, paint, loose mill scales, rust, dirt, dust, or any other substance that will destroy or reduce bond.

3.3.5 Admixtures

Accelerating, retarding, water-reducing and air entraining admixtures shall conform to IS:9103 and integral water proofing admixtures to IS:2645.

Admixtures may be used in concrete as per manufacturer's instructions only with the approval of the City Engineer. An admixture's suitability and effectiveness shall be verified by trial mixes with the other materials used in the works. If two or more admixtures are to be used simultaneously in the

same concrete mix, their interaction shall be checked and trial mixes done to ensure their compatibility. There should also be no increase in risk of corrosion of the reinforcement or other embedments.
Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts. When calcium chloride is permitted such as in mass concrete works, it shall be dissolved in water and added to the mixing water by an amount not exceeding 1.5 percent of the weight of the cement in each batch of concrete. The designed concrete mix shall be corrected accordingly.

Wastage
Wastage allowance for cement and steel shall be considered in the item rate and no extra payment shall become payable to the Contractor on any account.

3.4 Samples and Tests

All materials used for the works shall be tested before use.

Manufacturer's test certificate shall be furnished for each batch of cement/steel and when directed by the City Engineer samples shall also be got tested by the Contractor in a laboratory approved by the City Engineer at no extra cost to Employer. City Engineer may appoint separate third party inspection for the material testing to ensure the quality of the work. The Contractor shall replace the defective material as an outcome of these tests.
Sampling and testing shall be as per IS:2386 under the supervision of the City Engineer.
Water to be used shall be tested to comply with requirements of IS:456.
The Contractor shall furnish manufacturer's test certificates and technical literature for the admixture proposed to be used. If directed, the admixture shall be got tested at an approved laboratory at no extra cost.

3.5 Storing of Materials

All materials shall be stored in a manner so as to prevent its deterioration and contamination which would preclude its use in the works. Requirements of IS:4082 shall be complied with.

The Contractor will have to make his own arrangements for the storage of adequate quantity of cement. If such cement is not stored properly and has deteriorated, the material shall be rejected. Cement bags shall be stored in dry weatherproof shed with a raised floor, well away from the outer walls and insulated from the floor to avoid moisture from ground. Not more than 15 bags shall be stacked in any tier. Storage arrangement shall be approved by the City Engineer. Storage under tarpaulins shall not be permitted. Each consignment of cement shall be stored separately and consumed in its order of receipt.

Each size of coarse and fine aggregates shall be stacked separately and shall be protected from leaves and contamination with foreign material. The stacks shall be on hard, clean, free draining bases, draining away from the concrete mixing area.
The Contractor shall make his own arrangements for storing water at site in tanks to prevent contamination.
The reinforcement shall be stacked on top of timber sleepers to avoid contact with ground/water. Each type and size shall be stacked separately.

3.6 Concrete

3.6.1 General

Concrete grade shall be as designated on drawings. In concrete grade M15, M20 etc. the number represents the specified characteristic compressive strength of 150 mm cube at 28 days, expressed in N/sq.mm as per IS:456. Concrete in the works shall be "DESIGN MIX CONCRETE" or "NOMINAL MIX CONCRETE". All concrete works of grade M5, M7.5 and M10 shall be NOMINAL

MIX CONCRETE whereas all other grades, M15 and above, shall be DESIGN MIX CONCRETE.

3.6.2 Design Mix Concrete

(a) Mix Design & Testing

For Design Mix Concrete, the mix shall be designed according to IS:10262 and SP:23 to provide the grade of concrete having the required workability and characteristic strength not less than appropriate values given in IS:456. The design mix shall be cohesive and does not segregate and should result in a dense and durable concrete and also capable of giving the finish as specified. For liquid retaining structures, the mix shall also result in water tight concrete. The Contractor shall exercise great care while designing the concrete mix and executing the works to achieve the desired result.

The minimum cement content for Design Mix Concrete shall be as per Appendix-A of IS:456 or as given below, whichever is higher.

Grade of Concrete	Minimum Cement Content in Kg/Cu.m of Concrete	Maximum water cement ratio
M15	260	0.55
M20	360	0.55
M25	380	0.50
M30	400	0.45

The minimum cement content stipulated above shall be adopted irrespective of whether the Contractor achieves the desired strength with less quantity of cement. The CONTRACTOR's quoted rates for concrete shall provide for the above eventuality and nothing extra shall become payable to the CONTRACTOR in this account. Even in the case where the quantity of cement required is higher than that specified above to achieve desired strength based on an approved mix design, nothing extra shall become payable to the CONTACTOR.

It shall be the Contractor's sole responsibility to carry out the mix designs at his own cost. He shall furnish to the City Engineer at least 30 days before concreting operations, a statement of proportions proposed to be used for the various concrete mixes and the strength results obtained. The strength requirements of the concrete mixes ascertained on 150 mm cubes as per IS:516 shall comply with the requirements of IS:456.

Grade of Concrete	Minimum Compressive Strength N/sq.mm at 7 days	Specified Characteristic Compressive Strength N/sq.mm at 28 days
M 15	10.0	15.0
M 20	13.5	20.0
M 25	17.0	25.0
M 30	20.0	30.0
M 35	23.5	35.0
M 40	27.0	40.0

A range of slumps which shall generally be used for various types of construction unless otherwise instructed by the City Engineer is given below :

Structure/Member	**Slump in millimeters**

	Maximum	Minimum
Reinforced foundation walls and footings		
Plain footings, caissons and substructure walls	75	25
Slabs, Beams and reinforced walls	100	25
Pump & miscellaneous Equipment Foundations	75	25
Building columns	100	25
Pavements	50	25
Heavy mass construction	50	25
	50	25

(b) Batching & Mixing of Concrete

Proportions of aggregates and cement, as decided by the concrete mix design, shall be by weight. These proportions shall be maintained during subsequent concrete batching by means of weigh batchers capable of controlling the weights within one percent of the desired value.

Amount of water added shall be such as to produce dense concrete of required consistency, specified strength and satisfactory workability and shall be so adjusted to account for moisture content in the aggregates. Water- cement ratio specified for use by the City Engineer shall be maintained. Each time the work stops, the mixer shall be cleaned out, and while recommencing, the first batch shall have 10% additional cement to allow for sticking in the drum.

Arrangement should be made by the Contractor to have the cubes tested in an approved laboratory or in field with prior consent of the City Engineer. Sampling and testing of strength and workability of concrete shall be as per IS:1199, IS:516 and IS:456, IS 3370.

3.6.3 Nominal Mix Concrete

(a) Mix Design & Testing

Mix design and preliminary tests are not necessary for Nominal Mix Concrete. However works tests shall be carried out as per IS:456. Proportions for Nominal Mix Concrete and w/c ratio may be adopted as per Table 3 of IS:456. However it will be the Contractor's sole responsibility to adopt appropriate nominal mix proportions to yield the specified strength.

(b) Batching & Mixing of Concrete

Based on the adopted nominal mixes, aggregates shall be measured by volume. However cement shall be by weight only.

Ready Mix Concrete

Minimum cement consumption shall be as specified in tender document. However, necessary computer print out for consumption of all materials an admixtures if permitted shall be made available as and when required in any frequencies as directed by Engineer – in-charge.

Necessary slump requirements at the pouring places shall be made available with ready mix concrete. Concrete mix shall be design for 33% higher strength than the grade of concrete specified. The proportions for ingredients chosen shall be such that concrete has adequate workability for condition prevailing on the work in question and can be properly compacted with the means available. Use of cementations material like Fly ash etc. shall not be permissible.

Except where it can be shown to the satisfaction of the Engineer-in-charge that a supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be strictly controlled. The different sizes shall be stocked in separate stock piles. Required quality of material shall be stock-piled several hours, preferably a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible, frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the design mix.

The quantity of both cement and aggregate shall be determined by weight. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean and serviceable condition. Their accuracy shall be periodically checked.

If is most important to keep the specified water – cement ration constants and its correct value. To this end, the moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates, IS: 2386 (Part-III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content.

The special Conditions / Specification regarding **Ready Mix Concrete** are as follows. The details like locations, capacity, experience, delivery schedule etc. of the **Ready Mix Concrete** agency shall be submitted by the successfully tenderer for prior approval of the under signed.

The Ready Mix Concrete shall be conforming to IS: 4926 with its latest amendments. All the responsibility of **Ready Mix Concrete** i.e. procurement for all materials, operation of plant and machinery, transit mixers, pumping machineries relevant piping etc. shall be on the account of the contractor.

The Rajkot Municipal Corporation shall not be held responsible for any delay / damage / loss due to deployment of **Ready Mix Concrete** for this project. The octroi for the **Ready Mix Concrete** shall have to be borne by the contractor as per prevailing rates. **Ready Mix Concrete** process shall be fully automatic and computerized.

When a transit mixer is used for transportation of concrete, no extra water should be added to the concrete from elsewhere after initial introduction of mixing water from the batch, except when on arrival at the site of the work, the slump of the concrete is less than that

specified: such additional water to bring the mixer under such pressure and direction of flow that requirements for uniformity are met.

Records and certificates: The contractor shall keep from the manufacture batch records of the quantities by mass of all mixing and of the results of all tests. If required by the Rajkot

Municipal Corporation, the contractor shall furnish certificates, at agreed intervals, giving this information.

The contractor shall supply the following information for guidance of the manufacturer:

- ☐ The type of cement to be used
- ☐ Details Specification of aggregates to be used.
- ☐ Type of admixture to be used. If specified.
- ☐ Min. acceptable strength
- ☐ Slump of concrete or compaction factor
- ☐ Ages at which the test cubes or beams are to be tested and the frequency and number of test to be made.
- ☐ Any other requirement.

Tolerance: Unless otherwise agreed to between the Rajkot Municipal Corporation RMC)and the contractor, the concrete shall be deemed to comply with the requirements of this, if these results of testes where applicable lie within the tolerance specified below.

Consistency of workability: The slump average of two tests shall not differ from thespecified value by + 10 mm for a specified slump of 75 mm. The compacting factor averageof two tests shall be within + 0.03 of the value specified. If any other method of determining consistency to be used a suitable tolerance shall be agreed to be between the purchaser and the manufacture. The tests for consistency or workability shall be complete within 15 minutes of the time of receipt of the ready mix concrete at the site.

Aggregate: When tested in accordance with IS 2386 (Part-I) 1963, the quantity ofaggregate larger than the max size specified by the purchaser shall not exceed 5% of the qty. of course aggregate and all such pass sieve of next higher size.

3.7 Formwork

Formwork shall be all inclusive and shall consist of but not be limited to shores, bracings, sides of footings, walls, beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts, false work, wedges etc.

The design and engineering of the formwork as well as its construction shall be the responsibility of the Contractor. However, if so desired by the City Engineer, the drawings and calculations for the design of the formwork shall be submitted to the City Engineer for approval.

Formwork shall be designed to fulfill the following requirements :

(a) Sufficiently rigid and tight to prevent loss of grout or mortar from the concrete at all stages and appropriate to the methods of placing and compacting.

(b) Made of suitable materials.

(c) Capable of providing concrete of the correct shape and surface finish within the specified tolerance limits.
(d) Capable of withstanding without deflection the worst combination of self weight, reinforcement and concrete weight, all loads and dynamic effects arising from construction and compacting activities, wind and weather forces.
(e) Capable of easy striking out without shock, disturbance or damage to the concrete.
(f) Soffit forms capable of imparting a camber if required.
(g) Soffit forms and supports capable of being left in position if required.
(h) Capable of being cleaned and/or coated if necessary immediately prior to casting the concrete; design temporary openings where necessary for these purposes and to facilitate the preparation of construction joints.

The formwork may be of timber, plywood, steel, plastic or concrete depending upon the type of finish specified. Sliding forms and slip form may be used with the approval of the City Engineer. Timber for formwork shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps and other surface defects. Joints between formwork and formwork and between formwork and structures shall be sufficiently tight to prevent loss of slurry from concrete, using seals if necessary.

The faces of formwork coming in contact with concrete shall be cleaned and two coats of approved mould oil applied before fixing reinforcement. All rubbish, particularly chippings, shavings, sawdust, wire pieces dust etc. shall be removed from the interior of the forms before the concrete is placed. Where directed, cleaning of forms shall be done by blasting with a jet of compressed air at no extra cost.

Forms intended for reuse shall be treated with care. Forms that have deteriorated shall not be used. Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes suitably plugged, joints repaired and warped lumber replaced to the satisfaction of the City Engineer. The Contractor shall equip himself with enough shuttering to allow for wastage so as to complete the job in time.

Permanent formwork shall be checked for its durability and compatibility with adjoining concrete before it is used in the structure. It shall be properly anchored to the concrete.

Wire ties passing through beams, columns and walls shall not be allowed. In their place bolts passing through sleeves shall be used. Formwork spacers left insitu shall not impair the desired appearance or durability of the structure by causing spelling, rust staining or allowing the passage of moisture.

For liquid retaining structures, sleeves shall not be provided for through bolts nor shall through bolts be removed if provided. The bolts, in the latter case, shall be cut at 25 mm depth from the surface and the hole made good by cement mortar of the same proportion as the concrete just after striking the formwork.
Where specified all corners and angles exposed in the finished structure shall have chamfers or fillets of 20 mm x 20 mm size.

Forms for substructure may be omitted when, in the opinion of the City Engineer, the open excavation is firm enough (in hard non-porous soils) to act as a form. Such excavations shall be larger, as approved by the City Engineer, than that required as per drawing to compensate for irregularities in excavation.

The Contractor shall provide adequate props carried down to a firm bearing without overloading any of the structures.

The shuttering for beams and slabs shall be so erected that the side shuttering of beams can be removed without disturbing the bottom shuttering. If the shuttering for a column is erected for the full height of the column, one side shall be built up in sections as placing of concrete proceeds or windows left for placing concrete from the side to limit the drop of concrete to 1.0m or as approved by the City Engineer. The Contractor shall temporarily and securely fix items to be cast (embedments/ inserts) in a manner that will not hinder the striking of forms or permit loss of grout.

Formwork showing excessive distortion, during any stage of construction, shall be repositioned and strengthened. Placed concrete affected by faulty formwork, shall be entirely removed and formwork corrected prior to placement of new concrete at Contractor's cost.

The striking time for formwork shall be determined based on the following requirements:

(a) Development of adequate concrete strength;
(b) Permissible deflection at time of striking form work;
(c) Curing procedure employed - its efficiency and effectiveness;
(d) Subsequent surface treatment to be done;
(e) Prevention of thermal cracking at re-entrant angles;
(f) Ambient temperatures; and
(g) Aggressiveness of the environment (unless immediate adequate steps are taken to prevent damage to the concrete).

Under normal circumstances (generally where temperatures are above 20°C) forms may be struck after expiry of the time period given in IS:456 unless approved otherwise by the City Engineer. For Portland Pozzolana/slag cement the stripping time shall be suitably modified as approved by the City Engineer. It is the Contractor's responsibility to ensure that forms are not struck until the concrete has developed sufficient strength to support itself, does not undergo excessive deformation and resist surface damage and any stresses arising during the construction period.

3.8 Reinforcement Workmanship

Reinforcing bars supplied bent or in coils shall be straightened cold without damage. No bending shall be done when ambient temperature is below 5°C. Local warming may be permitted if steel is kept below 10° C.

All bars shall be accurately bent gradually and according to the sizes and shapes shown on the drawings/ schedules or as directed by City Engineer.

Re-bending or straightening incorrectly bent bars shall not be done without the approval of the City Engineer.

Reinforcement shall be accurately fixed and maintained firmly in the correct position by the use of blocks, spacers, chairs, binding wire etc. to prevent displacement during placing and compaction of concrete. The tied in place reinforcement shall be approved by the City Engineer prior to concrete placement. Spacers shall be of such materials and designs as will be durable, not lead to corrosion of the reinforcement and not cause spelling of the concrete cover.

Binding wire shall be 16 gauge soft annealed wire. Ends of the binding wire shall be bent away from the concrete surface and in no case encroach into the concrete cover.

Substitution of reinforcement, laps/splices not shown on drawing shall be subject to City Engineer's approval.

3.9 Tolerances

Tolerance for formwork and concrete dimensions shall be as per IS:456 unless specified otherwise.

Tolerances specified for horizontal or vertical building lines or footings shall not be construed to permit encroachment beyond the legal boundaries.

The formwork shall be designed and constructed to the shapes, lines and dimensions shown on the drawings within the tolerances given below :

(a)	Deviation from specified dimensions of cross section of columns and beams	- 6 mm + 12 mm
(b)	Deviations from dimensions of footings (Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel or dowels	
1)	Dimension in plan	- 12 mm + 50 mm
2)	Eccentricity	0.02 times the width of the footing in the direction of deviation but not more than 50 mm
3)	Thickness	± 0.05 times the specified thickness

3.10 Preparation Prior to Concrete Placement

Before concrete is actually placed in position, the inside of the formwork shall be cleaned and mould oil applied, inserts and reinforcement shall be correctly positioned and securely held, necessary openings, pockets, etc. provided.

All arrangements-formwork, equipment and proposed procedure, shall be approved by the City Engineer. Contractor shall maintain separate Pour Card for each pour as per the format enclosed.

3.11 Transporting, Placing and Compacting Concrete

Concrete shall be transported from the mixing plant to the formwork with minimum time lapse by methods that shall maintain the required workability and will prevent segregation, loss of any ingredients or ingress of foreign matter or water.

In all cases concrete shall be deposited as nearly as practicable directly in its final position. To avoid segregation, concrete shall not be rehandled or caused to flow. For locations where direct placement is not possible and in narrow forms the Contractor shall provide suitable drops and "Elephant Trunks". Concrete shall not be dropped from a height of more than 1.0m.

Concrete shall not be placed in flowing water. Under water, concrete shall be placed in position by tremies or by pipeline from the mixer and shall never be allowed to fall freely through the water.

While placing concrete the Contractor shall proceed as specified below and also ensure the following:

(a) Continuously between construction joints and pre- determined abutments.

(b) Without disturbance to forms or reinforcement.

(c) Without disturbance to pipes, ducts, fixings and the like to be cast in; ensure that such items are securely fixed. Ensure that concrete cannot enter open ends of pipes and conduits etc.

(d) Without dropping in a manner that could cause segregation or shock.

(e) In deep pours only when the concrete and formwork designed for this purpose and by using suitable chutes or pipes.

(f) Do not place if the workability is such that full compaction cannot be

achieved.

(g) Without disturbing the unsupported sides of excavations; prevent contamination of concrete with earth. Provide sheeting if necessary. In supported excavations, withdraw the linings progressively as concrete is placed.

(h) If placed directly onto hardcore or any other porous material, dampen the surface to reduce loss of water from the concrete.

(i) Ensure that there is no damage or displacement to sheet membranes.

(j) Record the time and location of placing structural concrete.

Concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer. Concrete shall be compacted during placing with approved vibrating equipment without causing segregation until it forms a solid mass free from voids thoroughly worked around reinforcement and embedded fixtures and into all corners of the formwork. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn slowly till air bubbles cease to come to the surface, leaving no voids. When placing concrete in layers advancing horizontally, care shall be taken to ensure adequate vibration, blending and melding of the concrete between successive layers. Vibrators shall not be allowed to come in contact with reinforcement, formwork and finished surfaces after start of initial set. Over-vibration shall be avoided.

Concrete may be conveyed and placed by mechanically operated equipment after getting the complete procedure approved by the City Engineer. The slump shall be held to the minimum necessary for conveying concrete by this method. When concrete is to be pumped, the concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

Except when placing with slip forms, each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete before the start of subsequent placement. Placing shall stop when concrete reaches the top of the opening in walls or bottom surface of slab, in slab and beam construction, and it shall be resumed before concrete takes initial set but not until it has had time to settle as approved by the City Engineer. Concrete shall be protected against damage until final acceptance.

3.12 Mass Concrete Works

Sequence of pouring for mass concrete works shall be as approved by the City Engineer. The Contractor shall exercise great care to prevent shrinkage cracks and shall monitor the temperature of the placed concrete if directed.

3.13 Curing

Curing and protection shall start immediately after the compaction of the concrete to protect it from:

(a) Premature drying out, particularly by solar radiation and wind;

(b) leaching out by rain and flowing water;

(c) rapid cooling during the first few days after placing;

(d) high internal thermal gradients;

(e) low temperature or frost;

(f) vibration and impact which may disrupt the concrete and interfere with its bond to the reinforcement.

All concrete, unless approved otherwise by the City Engineer, shall be cured by use of continuous sprays or ponded water or continuously saturated coverings of sacking, canvas, hessain or other absorbent material for the period of complete hydration with a minimum of 7 days. The quality of curing water shall be the same as that used for mixing.

Where a curing membrane is approved to be used by the City Engineer, the same shall be of a non-wax base and shall not impair the concrete finish in any manner. The curing compound to be used shall be approved by the City Engineer before use and shall be applied with spraying equipment capable of a smooth, even textured coat.
Curing may also be done by covering the surface with an impermeable material such as polyethylene, which shall be well sealed and fastened.

3.14 Construction Joints and Keys

Construction joints will be as shown on the drawing or as approved by the City Engineer. Concrete shall be placed without interruption until completion of work between construction joints. If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made with the approval of the City Engineer.

Dowels for concrete work, not likely to be taken up in the near future, shall be coated with cement slurry and encased in lean concrete as indicated on the drawings or as approved by the City Engineer.

Before resuming concreting on a surface which has hardened all laitance and loose stone shall be thoroughly removed by wire brushing/hacking and surface washed with high pressure water jet and treated with thin layer of cement slurry for vertical joints and horizontal layers.

When concreting is to be resumed on a surface which has not fully hardened, all laitance shall be removed by wire brushing, the surface wetted, free water removed and a coat of cement slurry applied. On this, a layer of concrete not exceeding 150 mm thickness shall be placed and well rammed against the old work. Thereafter work shall proceed in the normal way.

3.15 Foundation Bedding

All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft or spongy areas shall be cleaned out and back filled with either soil-cement mixture, lean concrete or clean sand compacted as approved by the City Engineer. The surfaces of absorptive soils shall be moistened.

Concrete shall not be deposited on large sloping rock surfaces. The rock shall be cut to form rough steps or benches by picking, barring or wedging. The rock surface shall be kept wet for 2 to 4 hours before concreting.

3.16 Finishes

3.16.1 General

The formwork for concrete works shall be such as to give the finish as specified. The Contractor shall make good any unavoidable defects as approved consistent with the type of concrete and finish specified; defects due to bad workmanship (e.g. damaged or misaligned forms, defective or poorly compacted concrete) will not be accepted. The Contractor shall construct the formwork using the correct materials and to meet the requirements of the design and to produce finished concrete to required dimensions, plumbs, planes and finishes.

3.16.2 Surface Finish Type F1

The main requirement is that of dense, well compacted concrete. No treatment is required except repair of defective areas, filling all form tie holes and cleaning up of loose or adhering debris. For surfaces below grade which will receive waterproofing treatment the concrete shall be free of surface irregularities which would interfere with proper and

effective application of waterproofing material specified for use.

3.16.3 Surface Finish Type F2

The appearance shall be that of a smooth dense, well- compacted concrete showing the slight marks of well fitted shuttering joints. The Contractor shall make good any blemishes.

3.16.4 Surface Finish Type F3

This finish shall give an appearance of smooth, dense, well-compacted concrete with no shutter marks, stain free and with no discoloration, blemishes, arises, airholes etc. Only lined or coated plywood with very tight joints shall be used to achieve this finish. The panel size shall be uniform and as large as practicable. Any minor blemishes that might occur shall be made good by the Contractor.

3.16.5 Integral Cement Finish on Concrete Floor

In all cases where integral cement finish on a concrete floor has been specified, the top layer of concrete shall be screeded off to proper level and tamped with tamper having conical projections so that the aggregate shall be forced below the surface. The surface shall be finished with a wooden float and a trowel with pressure. The finish shall be continued till the concrete reaches its initial set. No cement or cement mortar finish shall be provided on the surface. Where specified, a floor hardener as approved by the City Engineer shall be supplied and used as recommended by the manufacturer.

3.17 Repair and Replacement of Unsatisfactory Concrete

Immediately after the shuttering is removed, all the defective areas such as honey-combed surfaces, rough patches, holes left by form bolts etc. shall be inspected by the City Engineer who may permit patching of the defective areas or reject the concrete work.

All through holes for shuttering shall be filled for full depth and neatly plugged flush with surface.

Rejected concrete shall be removed and replaced by the Contractor at no additional cost to the Employer.

For patching of defective areas all loose materials shall be removed and the surface shall be prepared as approved by the City Engineer.

Bonding between hardened and fresh concrete shall be done either by placing cement mortar or by applying epoxy. The decision of the City Engineer as to the method of repairs to be adopted shall be final and binding on the Contractor. The surface shall be saturated with water for 24 hours before patching is done with 1:5 cement sand mortar. The use of epoxy for bonding fresh concrete shall be carried out as approved by the City Engineer.

3.18 Vacuum Dewatering of Slabs

Where specified floor slabs, either grade or suspended, shall be finished by vacuum dewatering including all operations such as poker vibration, surface vibration, vacuum processing, floating and trowelling as per equipment manufacturers recommendation. The equipment to be used shall be subject to the City Engineer's approval.

3.19 Hot Weather Requirements

Concreting during hot weather shall be carried out as per IS:7861 (Part I).
Adequate provisions shall be made to lower concrete temperatures which shall

not exceed 40° C at the time of placement of fresh concrete.
Where directed by the City Engineer, the Contractor shall spray non-wax based curing compound on unformed concrete surfaces at no extra costs.

Cold Weather Requirements

Concreting during cold weather shall be carried out as per Is : 7861 (Part II).
The ambient temperature during placement and up to final set shall not fall below 5 Deg.C. Approved antifreeze/accelerating additives shall be used where directed.
For major and large scale concreting works the temperature of concrete at times of mixing and placing, the thermal conductivity of the formwork and its insulation and stripping period shall be closely monitored.

3.20 Liquid Retaining Structures

The Contractor shall take special care for concrete for liquid retaining structures, underground structures and those others specifically called for to guarantee the finish and water tightness.
The minimum level of surface finish for liquid retaining structures shall be Type F2. All such structures shall be hydro-tested.
The Contractor shall make all arrangements for hydro-testing of structure, all arrangements for testing such as temporary bulk heads, pressure gauges, pumps, pipe lines etc.
The Contractor shall also make all temporary arrangements that may have to be made to ensure stability of the structures during construction.
Any leakage that may occur during the hydro-test or subsequently during the defects liability period or the period for which the structure is guaranteed shall be effectively stopped either by cement/epoxy pressure grouting, guniting or such other methods as may be approved by the City Engineer. All such rectification shall be done by the CONTRACTOR to the entire satisfaction of the City Engineer at no extra cost to the EMPLOYER.

3.21 Testing Concrete Structures for Leakage

Hydro-static test for water tightness shall be done at full storage level or soffit of cover slab, as may be directed by the City Engineer, as described below :
In case of structures whose external faces are exposed, such as elevated tanks, the requirements of the test shall be deemed to be satisfied if the external faces show no sign of leakage or sweating and remain completely dry during the period of observation of seven days after allowing a seven day period for absorption after filling with water.
In the case of structures whose external faces are buried and are not accessible for inspection, such as underground tanks, the structures shall be filled with water and after the expiry of seven days after the filling, the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hrs. over a period of seven days. Backfilling shall be withheld till the tanks are tested. The total drop in surface level over a period for seven days shall be taken as an indication of the water tightness of the structure. The City Engineer shall decide on the actual permissible nature of this drop in the surface level, taking into account whether the structures are open or closed and the corresponding effect it has on evaporation losses. Unless specified otherwise, a structure whose top is covered shall be deemed to be water tight if the total drop in the surface level over a period of seven days does not exceed 40 mm.
Each compartment/segment of the structure shall be tested individually and then all together.
For structures such as pipes, tunnels etc. the hydrostatic test shall be carried out by filling with water, after curing as specified, and subjecting to the specified test pressure for specified period. If during this period the loss of water does not exceed the equivalent of the specified rate, the structure shall be

considered to have successfully passed the test.

3.22 Optional Tests

If the City Engineer feels that the materials i.e. cement, sand, coarse aggregates, reinforcement and water are not in accordance with the Specifications or if specified concrete strengths are not obtained, he may order tests to be carried out on these materials in laboratory, to be approved by the City Engineer, as per relevant IS Codes. Contractor shall have to pay for these tests.

In the event of any work being suspected of faulty material or workmanship requiring its removal or if the works cubes do not give the stipulated strengths, the City Engineer reserves the right to order the Contractor to take out cores and conduct tests on them or do ultrasonic testing or load testing of structure, etc. The City Engineer also reserves the right to ask the Contractor to dismantle and re-do such unacceptable work, at no cost to the Employer. Alternately City Engineer also reserves the right to ask the CONTRACTOR to dismantle and re-do such unacceptable work at the cost of CONTRACTOR.

3.23 Grouting

3.23.1 Standard Grout

Grout shall be provided as specified on the drawings.

The proportion of Standard Grout shall be such as to produce a flow able mixture consistent with minimum water content and shrinkage. Surfaces to be grouted shall be thoroughly roughened and cleaned. All structural steel elements to be grouted, shall be cleaned of oil, grease, dirt etc. The use of hot, strong caustic solution for this purpose will be permitted. Prior to grouting, the hardened concrete shall be saturated with water and just before grouting, water in all pockets shall be removed. Grouting once started shall be done quickly and continuously. Variation in grout mixes and procedures shall be permitted if approved by the City Engineer. The grout proportions shall be limited as follows :

Use	Grout Thickness	Mix Proportions	W/C Ratio (max)
a) Fluid mix	Under 25mm	One part Portland Cement to one part sand	0.44
b) General mix	25mm and over but less than 50mm	One part Portland Cement to 2 parts of sand	0.53
c) Stiff mix	50mm and over	One part Portland Cement to 3 parts of sand	0.53

3.23.2 Non-Shrink Grout

Non –shrink grout where required shall be provided in strict accordance with the manufacturer's instructions / specifications on the drawings

General

Inspection

All materials, workmanship and finished construction shall be subject to continuous inspection and approval of City Engineer. Materials rejected by City Engineer shall be expressly removed from site and shall be replaced by Contractor immediately.

Clean-Up

Upon the completion of concrete work, all forms, equipment, construction

tools, protective coverings and any debris, scraps of wood, etc. resulting from the work shall be removed and the premises left clean.

Acceptance Criteria

Any concrete work shall satisfy the requirements given below individually and collectively for it to be acceptable.

a) properties of constituent materials;
b) characteristic compressive strength;
c) specified mix proportions;
d) minimum cement content;
e) maximum free-water/cement ratio;
f) workability;
g) temperature of fresh concrete;
h) density of fully compacted concrete;
I) cover to embedded steel;
j) curing;
k) tolerances in dimensions;
l) tolerances in levels;
m) durability;
n) surface finishes;
o) special requirements such as;

I) water tightness
ii) resistance to aggressive chemicals
iii) resistance to freezing and thawing
iv) very high strength
v) improved fire resistance
vi) wear resistance
vii) resistance to early thermal cracking

The City Engineer's decision as to the acceptability or otherwise of any concrete work shall be final and binding on the Contractor.

For work not accepted, the City Engineer may review and decide whether remedial measures are feasible so as to render the work acceptable. The City Engineer shall in that case direct the Contractor to undertake and execute the remedial measures. These shall be expeditiously and effectively implemented by the Contractor. Nothing extra shall become payable to the Contractor by the Employer for executing the remedial measures.

3.24 Waterstops

3.24.1 Material

The material for the PVC water stops shall be a plastic compound with the basic resin of polyvinyl chloride and additional resins, plasticizers, inhibitors, which satisfies the performance characteristics specified below as per IS:12200. Testing shall be in accordance with IS:8543.

a) Tensile strength : 3.6 N/mm^2 minimum
b) Ultimate elongation : 300% minimum
c) Tear resistance : 4.9 N/mm^2 minimum
d) Stiffness in flexure : 2.46 N/mm^2 minimum
e) Accelerated extraction

I) Tensile strength : 10.50 N/mm^2 minimum
ii) Ultimate elongation : 250% minimum

(f) Effect of Alkali : 7 days
I) Weight increase : 0.10% maximum

	ii)	Weight decrease	:	0.10% maximum
	iii)	Hardness change	:	± 5 points
(g)	Effect of Alkali		:	28 days
	I)	Weight increase	:	0.40% maximum
	ii)	Weight decrease	:	0.30% maximum
	iii)	Dimension change	:	±1%

PVC water stops shall be either of the bar type, serrated with centre bulb and end grips for use within the concrete elements or of the surface (kicker) type for external use.

PVC water stops shall be of approved manufacture. Samples and the test certificate shall be got approved by the City Engineer before procurement for incorporation in the works. Alternatively G.I. sheet of 18 gage (1.3mm) thick and 200mm wide can be used by the contractor as construction joints.

Alternatively contractors can use G.I sheet 200mm wide and 18 gauage thick as constructions joints

3.24.2Workmanship

Water stops shall be cleaned before placing them in position. Oil or grease shall be removed thoroughly using water and suitable detergents.

Water stops shall be procured in long lengths as manufactured to avoid joints as far as possible. Standard L or T type of intersection pieces shall be procured for use depending on their requirement. Any non-standard junctions shall be made by cutting the pieces to profile for jointing. Lapping of water stops shall not be permitted. All jointing shall be of fusion welded type as per manufacturer's instructions.

Water stops shall be placed at the correct location/level and suitably supported at intervals with the reinforcement to ensure that it does not deviate from its intended position during concreting and vibrating. Care shall also be taken to ensure that no honey-combing occurs because of the serrations/end grips, by placing concrete with smaller size aggregates in this region. Projecting portions of the water stops embedded in concrete shall be thoroughly cleaned of all mortar/ concrete coating before resuming further concreting operations. The projecting water stop shall also be suitably supported at intervals with the reinforcement to maintain its intended position during concreting so as to ensure that it does not bend leading to formation of pockets. In addition, smaller size aggregates shall be used for concreting in this region also.

3.25 Preformed Fillers and Joint Sealing Compound

3.25.1Materials

Preformed filler for expansion/isolation joints shall be non-extruding and resilient type of bitumen impregnated fibers conforming to IS:1838 (Part I).

Bitumen coat to concrete/masonry surfaces for fixing the preformed bitumen filler strip shall conform to IS:702. Bitumen primer shall conform to IS:3384.

Sealing compound for filling the joints above the preformed bitumen filler shall conform to Grade 'A' as per IS:1834.

3.25.2Workmanship

The thickness of the preformed bitumen filler shall be 25mm for expansion joints and 50mm for isolation joints around foundation supporting rotator equipment's. Contractor shall procure the strips of the desired thickness and width in lengths as manufactured. Assembly of small pieces/thicknesses of strips to make up the specified size shall not be permitted.

The concrete/masonry surface shall be cleaned free from dust and any loose particles. When the surface is dry, one coat of industrial blown type bitumen of grade 85/25 conforming to IS:702 shall be applied hot by brushing at the rate of 1.20 kg/sq.m. When the bitumen is still hot the preformed bitumen filler shall be pressed and held in position till it completely adheres. The surface of the filler against which further concreting/masonry work is to be done shall similarly be applied with one coat of hot bitumen at the rate of 1.20 kg/sq.m.

Sealing compound shall be heated to a pouring consistency for enabling it to run molten in a uniform manner into the joint. Before pouring the sealing compound, the vertical faces of the concrete joint shall be applied hot with a coat of bitumen primer conforming to IS: 3384 in order to improve the adhesive quality of the sealing compound.

Expansion joints between beams/slabs shall be provided with 100mm wide x 4mm thick mild steel plate at the soffit of RCC beams/slabs to support and prevent the preformed joint filler from dislodging. This plate shall be welded to an edge angle of ISA 50 x 50 x 6mm provided at the bottom corner, adjacent to the expansion joint of one of the beams/slabs, by intermittent fillet welding. Steel surfaces shall be provided with 2 coats of red oxide zinc chrome primer and 3 coats of synthetic enamel paint finish.

CONCRETE POUR CARD

POUR NO. :
DATE :
DRG. NO. :
STRUCTURE :
CONCRETE GRADE/QUANTITY/ :
MAX. AGGREGATE SIZE /
START / COMPLETION TIME :
SLUMP :

SL. NO.	ITEM					Remarks If Any
1.	BEFORE CONCRETING	CENTRELINES CHECKED		YES/NO		
2.		FORMWORK AND STAGING CHECKED FOR ACCURACY, STRENGTH & FINISH		YES/NO		
3.		REINFORCEMENT CHECKED		YES/NO		
4.		COVER TO REINFORCEMENT CHECKED		YES/NO		
5.		VERIFIEDTEST CERTIFICATE FOR CEMENT/STEEL		YES / NO		
6.		ADEQUACY OF MATERIALS / EQUIPMENT FOR POUR		YES / NO		
7.		EMBEDDED PARTS (LOCATION & PLUMB) CHECKED	CIVIL	YES/NO		
			MECH.	YES/NO		
			ELEC.	YES/NO		
8.	SOFFIT(S) & POUR TOP(T) LEVELS CHECKED BEFORE (B) & AFTER (A) FORM REMOVAL (ONLY OF BEAMS OF OVER 10 M SPAN & IMPORTANT STRUCTURE LIKE T.G. ETC.)			S(B) T(B) S(A) T(A)		
9.	CONSTRUCTION JOINTS LOCATION & TIME (IF NOT AS PER DRAWING)					
10.	CEMENT CONSUMPTION IN KGS.					

11.	NUMBER OF CUBES AND IDENTIFICATION MARKS		
12.	TEST CUBE RESULTS (7 DAYS / 28 DAYS)		
13.	CONCRETE CONDITION ON FORM REMOVAL	V.GOOD/GOOD/FAIR/POOR	

Contractor's Representative **City Engineer's Representative**

NOTES: 1. EACH POUR TO HAVE SEPARATE CARDS, IN TRIPLICATE ONE EACH FOR CLIENT,CONTRACTOR & SITE OFFICE.

UNDER REMARKS INDICATE DEVIATIONS FROM DWGS. & SPECIFICATIONS, CONGESTION IN REINFORCEMENT IF ANY, UNUSUAL OCCURRENCES SUCH AS FAILURE OF EQUIPMENTS, SINKING OF SUPPORTS / PROPS. HEAVY RAINS AFFECTING CONCRETING, POOR COMPACTION, IMPROPER CURING, OTHER DEFICIENCIES, OBSERVATIONS ETC.

TECHNICAL SPECIFICATIONS FOR BUILDING WORKS

GENERAL

In the specifications, "as directed" / "Approved" shall be taken to mean 'as directed' / 'approved' by the Engineer-in-Charge.

Wherever a reference to any Indian Standard appears in the specifications, it shall be taken to mean as a reference to the latest edition of the same in force on the date of agreement.

Approval to the samples of various materials given by the Engineer-in-charge shall not absolve the contractor from the, responsibility of replacing defective material brought on site of materials used in the work found defective at a later date. The contractor shall have no claim to any payment of compensation whatsoever on account of any such materials being rejected by the Engineer-in-charge.

The contract rate of the item of work shall be for the work completed in all respects.

No collection of materials shall be made before it is got approved form the Engineer-in-charge.

Collection of approved materials shall be done at site of work in a systematic manner. Materials shall be stored in such a manner as to prevent damage, deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work.

Materials, if and when rejected by the Engineer-in-charge, shall be immediately removed form the site of work.

No materials shall be stored before, during and after execution of structures in such a way as to cause or lead to damage of overloading of the various components of the structure.

All tools, templates, machinery and equipment for correct execution of the work as well as for checking lines, levels, alignment of the works during execution shall be kept in sufficient numbers and in good working condition on the site of the work.

The mode, procedure and manner of execution shall be such that it does not cause damage or over loading of the various components of the structure during execution of after completion of the structure.

Special modes of construction not adopted in general Engineering practice, if proposed to be adopted by the Contractor shall be considered only if the contractor provides satisfactory evidence that such special mode of construction is safe, sound and helps in speedy construction and completion of work to the required strength and quality.

Acceptance of the same by the Engineer-in-charge shall not, however, absolve the contractor of the responsibility of any adverse effects and consequences of adopting the same in the course of execution of completion of the work.

All installations pertaining to water supply and fixtures thereof as well as drainage lines and sanitary fittings shall be deemed to be completed only after giving satisfactory tests by the Contractor.

The contractor shall be responsible for observing the rules and regulation imposed under "Minor Minerals Act", and such other laws and rules prescribed by Government from time to time.

All necessary safety measures and precaution (including those laid down in the various relevant India Standards) shall be taken to ensure the safety of men, materials and machinery on the works as also of the work itself.

The testing charges of all materials shall be borne by the Contractor.

Approval to any of the executed items for the work does not in any way relieve the contractor of his responsibility for the correctness, soundness and strength of the structure as per the drawings and specification.

MATERIALS

S-1 WATER

Water shall not be salty of brackish and shall be clean, reasonably clear and free from objectionable quantities of silt and trace of oil and injurious alkalis, salts, organic matter and other deleterious material which will either weaken the mortar of concrete of cause efflorescence of attack the steel in RCC Container for transport, storage and handling of water shall be clean, water shall conform to the standards specified in 1.S. 456-2000.

If required by Engineer-in-charge, it shall be tested by comparison with distilled water. Comparison shall be made by means of standard cement tests for soundness, time of setting and mortar strength as specified in 1.S. 269-1979. Any indication of unsoundness, change in time of setting be 30 minutes or more of decrease of more than 10 per cent in strength of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water under test.

Water for curing mortar, concrete of masonry should not be too alkaline. It shall be free of elements that significantly affect the hydration reaction of otherwise interfere with the hardening of concrete during curing of those which produce objectionable stains of other unsightly deposits on concrete of mortar surfaces.
Hard and bitter water shall not be used for curing.
Potable water will be generally found suitable for curing mortar of concrete.

S-2 LIME

Lime shall be hydraulic lime as per 1.S. 712-1973. Necessary test shall be carried out as per I.S. 6932 (Parts to X), 1973.
The following field tests for lime are to be carried out:

(A) A very rough idea can be formed about the type of lime by its visual examination i.e. at lime bears pure white color lime in form of porous lumps of dirty while color indicates quick lime, and solid lumps are the un-burnt lime stone.

(B) Acid tests for determining the carbonate content in lime, excessive amount of impurities and rough determination of class of lime.

Storage shall comply with 1.S. 721-1973. The slaked lime, if stored, shall be kept in a weather proof and damp-proof shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All time that has been damaged in any way shall be rejected materials shall be removed from site of work.

Field-testing shall be done according to I.S. 1624-1974 to show the acceptability of materials.

S-3 CEMENT

Cement shall be 53 Grade Ordinary Portland Cement as per I.S. 12269-1976 and 43 Grade Ordinary Portland Cement as per I.S. 8112-1976.

S-4 WHITE CEMENT

The white cement shall conform to I.S. 80412-E 1978.

S-5 COLORED CEMENT

Colored cement shall be with white of gray Portland cement as specified in the item of the work.
The pigments used for colored cement shall be of approved quality and shall not exceed 10 % of cement used in the Mix. The mixture of pigment shall be properly

grounded to have a uniform color and shade. The pigments shall have such properties to provide for durability under exposure to sunlight and weather.
The pigment shall have the property such that it is neither affected by the cement nor detrimental to it.

S-6 SAND
Sand shall be natural sand, clean, well graded, hard strong durable and gritty particle free from injurious amounts of dust clay, kankar nodules, soft of flaky particles, shale, alkali, salts organic matter, loam, mica of other deleterious substances and shall be got approved from the Engineer-in-charge. The sand shall not contain more than 8 percent of silt as determined by field test. If necessary the sand shall be washed to make it clean.

COARSE SAND
The fineness modules of coarse sand shall not be less than 2.5 and shall not exceed 3.0.
The sieve analysis of coarse shall be as under:

I.S. Sieve Designation	Percentage by weight passing sieve	I.S. Sieve Designation	Percentage by weight passing sieve
4.75 mm	100	600 micron	30-100
2.36 mm	90-100	300 micron	5-70
1.18 mm	70-100	150 micron	0-50

FINE SAND
The fineness modulus shall not exceed 1.0. The sieve analysis of fine sand shall be as under:

I.S. Sieve Designation	Percentage by weight passing sieve	I.S. Sieve Designation	Percentage by weight passing sieve
4.75 mm	100	600 micron	40-85
2.36 mm	100	300 micron	5-50
1.18 mm	70-100	150 micron	0-10

S-7 STONE DUST
This shall be obtained from crushing hard black trap of equivalent. It shall not contain more than 8 % of silt as determined by field test with measuring cylinder. The method of determining silt contents by field test is given as given as under.

A sample of stone dust to be tested shall be placed without drying in 200 mm measuring cylinder. The quantity of the sample shall be such that it fills the cylinder up to 100 mm mark. The clean water shall be added up to 150 mm mark. The mixture shall be stirred vigorously and the content allowed settling for 3 hours.

The height of silt visible as settled layer above the stone dust should be expressed as percentage of the height of the stone dust below. The stone dust containing more than 8 % silt shall be washed so as to bring the silt content within the allowable limit.
The fineness modules of stone dust shall not be less than 1.80.

S-8 STONE GRIT
Grit shall consist of crushed, of broken stone and be hard strong, dense, durable, clean, of proper graduation and free from skin of coating likely to prevent adhesion of mortar Grit shall generally by cubical in shape and as far as possible flaky elongated pieces shall be avoided. It shall generally comply with the provisions of I.S. 383-1970. Unless special stone of particular quarries is mentioned, grit shall be obtained form the best black trap or equivalent hard stone as approved by the Engineer-in-charge. The grit shall have no deleterious reaction with cement.

I.S. Sieve	Percentage by	I.S. Sieve	Percentage by

Designation	weight passing Sieve	Designation	weight passing sieve
12.50 mm	100	4.75 micron	0-20
10.00 mm	85-100	2.36 micron	0-25

The crushing strength of grit will be such as to allow the concrete in which it is used to built up the specified strength of concrete.
The necessary test for grit shall carried out as per the requirement of I.S. 2386 (Parts I to VII) 1963 as per instructions of the Engineer-in-charge. The necessity of test will be decided by the engineer-in-charge.

S-9 CINDER
Cinder is well burnt furnace residue, which has been fused of sintered into lumps of varying sizes.

I.S. Sieve Designation	Percentage by weight passing Sieve	I.S. Sieve Designation	Percentage by weight passing sieve
20.00 mm	100	4.75 micron	70
10.00 mm	86	2.36 micron	52

Cinder aggregates shall be well burnt furnace residue obtained form furnace using call fuel only. It shall be sound clean free form clay, dirt, ash of other deleterious matter.
The average grading for cinder aggregates shall be mentioned below.

S-10 LIME MORTAR
Lime shall conform to specification S-2. Water shall conform to specifications S-1.
Sand: Sand shall conform to specifications S-6.
Proportion of Mix: Mortar shall consist of such proportion of slaked lime and sand as may be specified in the item. The asked lime and sand be measured by volume.

Proportion of Mortar: Lime mortar shall be prepared by wet process as per I.S. 16251971 power driven the 180 revolutions with sufficient water. Water shall be added as required during grinding (care being taken not to add more water) that will bring the mixed material to a consistency of stiff paste. Thoroughly wetted sand shall then be added evenly and the mixture ground for another 180 revolutions.
Storage: Mortar shall always be kept damp, protected from sun and rain till used up, covering it by tarpaulin of open sheds.
Use: All mortar shall be used as soon as possible after grinding. It should be used on the day on which it is prepared. In no case mortar made earlier then 36 hours shall be permitted for use.

S-11 CEMENT MORTAR
Water: Water shall conform to specification S-1.
Cement: Cement shall conform to specification S-3.
Sand: Sand shall conform to M-6.

Proportion of Mix: Cement and sand shall be mixed to specified proportion, sand being measured by measuring boxes. The proportion of cement will be by volume on the basis of 50 kg/Bag of cement being equal to 0.0342 m^3. The mortar may be hand mixed of machine mixed as directed.

Preparation of Mortar: In hand mixed mortar cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times of more till a homogenous mixture of uniform color is obtained. Mixing platform shall be so arranged that no deleterious extraneous material shall get mixed with mortar of mortar shall flow out., While mixing, the water shall be gradually added and thoroughly mixed to form a stiff plastic mass of uniform color so that each

particle of sand shall be completely covered with a film of wet cement ratio shall be adopted as directed.

The mortar so 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.

S-12 STONE COARSE AGGREGATE FOR NOMINAL MIX CONCRETE

Coarse aggregate shall be machine-crushed stone of black trap of equivalent and be hard, strong, dense, durable, clean and free from skin and coating likely to prevent proper, adhesion of mortar.

The aggregate shall generally be cubical in shape. Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best black trap of equivalent hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement concrete and ordinary reinforced cement concrete shall generally be as per the table given below. However in case of reinforced cement concrete the maximum limit may be restricted to 6 mm less than the minimum lateral clear distance between bars of 6 mm less than the cover, whichever is smaller.

I.S. sieve Designation	Percentage passing from single sized aggregates of nominal size		
40 mm	20 mm	16 mm	
80 mm	-	-	-
63 mm	100	-	-
40 mm	85-1 00	100	-
20 mm	0-20	-	85-100
12.5 mm	-	-	-
10 mm	0.5	0.02	0.30
4.75 mm	-	0.5	0.5
2.35	-	-	-

Note:
This percentage may be varied some what by Engineer-in-charge when considered necessary for obtaining better density and strength of concrete.
The grading test shall be taken in the beginning and at the change of source of materials. The necessary test indicated in 1.5.: 383-1970 and J.5. 456-2000 shall have to be carried out to ensure the acceptability. The aggregates shall be stored separately and handled in such a manner as to prevent the intermixing of different aggregates. If the aggregates are covered with dust, they shall be washed with water to make them clean.

S-13 BLACK TRAP OF EQUIVALENT HARD STONE COARSE

Aggregate for Design Mix Concrete: Coarse aggregate shall be of machine crushed stone of black trap of equivalent hard stone and be hard strong dense, durable clean and free from skin and coating likely to prevent proper adhesion of mortar.
The aggregates shall generally be cubical in shape. Unless special stones of particular quarries are mentioned, aggregates shall be machine crushed from the best, back trap or equivalent hard stones as approved. Aggregate shall have no deleterious reaction I with cement. .
The necessary tests indicate in I.S. 383-1970 and I.S. 456-2000 shall have to be carried out to ensure the acceptability of the material.
If aggregate is covered with dust it shall be washed with water to make it clean.

S-14 BRICK BATS AGGREGATE

Brickbat aggregate shall be broken from well burnt of slightly over burnt and dense brick. It shall be homogeneous in texture roughly cubical in shape, clean and free from dirt of any other foreign material. The brickbats shall be of 40 mm to 50 mm size

unless otherwise specified in the item. The under-burnt of over-burnt brick bats shall not be allowed.
The brickbats shall be measured by volume by suitable boxes of as directed.

S-15 BRICKS

The bricks shall be hand of machine molded and made from suitable soils and kiln burnt. They shall be free form crack and nodules of free lime. They shall have smooth rectangular faces with sharp corners and shall be of uniform color. The bricks shall be molded with a frog of 100 mm x 40 mm and 10 mm to 20 mm deep on one of its flat sides. The bricks shall not break when thrown on the ground from a height of 600 mm.
The size of modular bricks shall be 190 mm x 90 mm x 90 mm
The size of the conventional bricks shall be as under:
(9" x 4 $^3/_8$" x 2 $^3/_4$") 225 x 110 x 75 mm

Only bricks of one standard size shall be used on one work. The following tolerances shall be permitted in the conventional size adopted in a particular work.

Length	1/8" (3.0 mm)
Width	1/16" (1.50 mm)
Height	1/16" (1.50 mm)

The crushing strength of the bricks shall not be less than 35 kg/cm^2. The average water absorption shall not be more than 20 percent by weight. Necessary tests fro crushing strength and water absorption etc. shall be carried out as per I.S. 3495 (Part I to IV) 1976.

S-16 STONE

The stone shall be of the specified variety such as Granite / Trap stone / Quartzite of any other type of god hard stones.

The stones shall be obtained only from the approved quarry and shall be hard, sound, durable and free from defects like cavities, cracks, sand holes, flaws, injurious, veins, patches of loose of soft materials etc. and weathered portions and other structural defects of imperfections tending to affect their soundness and strength. The stone with round surface shall not be used. The percentage of water absorption shall not be more than 5 % of dry weight, when tested in accordance with I.S. 1134-1974. The minimum crushing strength of the stone shall be 200 kg/c^2 unless otherwise specified.

The samples of the stone to be used shall be got approved before the work is started.

The Khanki facing stone shall be dressed by chisel as specified in the item for khanki facing in required shape and size. The face of stone shall be so dressed that the bushing on the exposed face shall not project by more than 40 mm from the general well surface and on face to be plastered it shall not project by more than 19 mm nor shall it have depressions more than 10 mm from the average wall surface.

S-17 LATERITE STONE

Laterite stone shall be obtained from the approved quarry. It shall be compacted in texture, sound, durable and free form soft patches. It shall have a minimum crushing strength of 100 kg/cm^2 in its dry condition. It shall not absorb water more than 20 % of its own weight, when immersed for 24 hours in water. After quarrying the stone shall be allowed to weather for some time before using in work.
The stone shall be dressed into regular rectangular blocks so that all faces are free from waviness and unevenness, edges true and square.
Those types of stone in which white clay occur, should not be used.
Special corner stones shall be provided where so directed.

S-18 ALL STEEL MUST BE TMT BARS

TMT bars reinforcement for RCC work shall conform to I.S. 432 (part-II) 1966 and shall be of tested quality. It shall also comply with relevant part of I.S. 456-2000.
All the reinforcement shall be clean and free from-dirt, paint, grease, mill scale of loose or thick rust at the time of placing.

S-19 HIGH YIELD STRENGTH STEEL DEFORMED BARS

High Yield strength deformed bars be either cold twisted of hot roiled, shall conform to I.S. 1786-1966 respectively.

S-20 HIGH TENSILE STEEL WIRE

The high tensile wires for the use in pre-stressed concrete work shall conform to I.S. 2090-1962.
The tensile strength, of the high tensile steel bars shall be as specified in the item. In absence of the given strength, the minimum strength shall be taken as per Para 6.1 of I.S. 1985-1962. Testing shall be done as per I.S. requirements.
The high tensile steel shall be free from loose mill scale, rust oil, grease, or any other harmful matter. Cleaning of steel bars may be carried out by immersion in solvent solution, wire brushing of passing through a pressure box containing carborundum.
The high tensile wire shall be obtained from manufactures in coil having diameter not less than 350 times the diameter of wire itself so that wire springs back straight on being uncoiled.

S-21 MILD STEEL BINDING WIRE

The mild steel wire shall be of 1.63 mm of 1.22 mm (16 of 18 gauge) diameter and shall conform to I.S. 280-1972.
The use of black wire will be permitted for binding reinforcement bars. It shall be free from rust, oil paint, grease, loose mill scale or any other undesirable coating that may prevent adhesion of cement mortar.

S-22 STRUCTURAL STEEL

All structural steel shall conform to I.S. 2062-1965 or its latest edition. The steel shall be free from the defects mentioned in I.S. 226-1975 and shall have a smooth finish. The material shall be Rivet bars shall conform to I.S. 1148-1973 or its latest edition.
When the Contractor supplies the steel, test certificates of the manufactures shall be obtained according to I.S. 226-1975 and other relevant Indian Standards.

S-23 GALVANIZED IRON SHEETS

The galvanized iron sheets shall be plain of corrugated sheets of specified in item. The G.I. Sheets shall conform to I.S. 277-1977. The sheets shall be undamaged in carriage and handling either by rubbing off of zinc coating of otherwise they shall have clean and bright surface and shall be free form dents, holes, rust of white powder deposit.
The length and width of G.I. sheet be as directed as per site condition.

S-23(A) G.I. VALLEYS GUTTER RIDGES

The G.I. ridges and hips shall be of plain galvanized sheets class-3 of the thickness as specified in item. These shall be 600 mm in width and properly bent up to shape without damage to the sheets in process of bending.
Valley gutters and flashing shall also be galvanized sheet of thickness as specified in item. Valleys shall be 900 mm wide overall and flashing shall be 380 mm wide overall. They shall be bent to the required shape without damage to the sheet in the process of bending.

S-24 ASBESTOS CEMENT SHEETS

Asbestos cement sheets plain, corrugated of semi-corrugated shall conform to I.S. 4591970.

RIDGES & HIPS

(A) Ridges & hips shall be of same thickness at that of A.C. Sheets. The types of ridges used shall be suitable for the type of sheets and locations.

(B) Other accessories to be used in roof such as flashing pieces, cave-filler pieces, valley gutters, north light and ventilator curves, barge boards etc. shall be standard manufacture and shall be suitable for the type of sheets and location.

S-25 MANGALORE PATTERN ROOF TILES

The Mangalore pattern tiles shall conform to I.S. 654-1972 for Class 'AA' or Class 'A' type as specified in item. Samples of the tiles to be provided shall be got approved from the Engineer-in-charge. Necessary tests shall be carried out as directed.

S-26 SHUTTERING

The shuttering shall be either of wooden planking of 30 mm minimum thickness with of without steel lining or of steel plates stiffened by steel angles. The shuttering shall be supported on battens and beams and props of vertical bellies properly cross-braced together so as to make the centering rigid. In place of belie props, brick pillar of adequate section built in mud mortar may be used.

The form work shall be sufficiently strong and shall have camber, so that it assumes correct shape after deposition of the concrete and shall be able to resist force caused by vibration of live load of men working over it and other incidental loads associated with it. The shuttering shall have smooth and eve surface and its joints shall not permit leakage of cement grout.

If at any stage of work during of after placing concrete in the structure, the form work sags of bulges out beyond the required shape of the structure, the concrete shall be removed and work redone with fresh concrete and adequately rigid from work. The complete formwork shall be got inspected by and got approved from the Engineer-in-charge, before the reinforcement bars are placed in position.

The props shall consist of bullies having 100 mm minimum diameter measures at max length and 80 mm at thin end and shall be placed as per design requirement. These shall rest squarely on wooden sole plates 40 mm thick and minimum bearing area if 0-10 m^2 laid on sufficiently hard base.

Double wedges shall further be provided between the sole plate and the wooden props so as to facilitate tightening and easing of shuttering without jerking the concrete.

The timber used in shuttering shall not be so dry as to absorb water from concrete and swell of bulge nor so green of wet as to shrink after creation. The timber shall be property sawn and planed on the sides and surface coming in contact with concrete / wooden form work with metal sheet timing of steel plates stiffened by steel angles shall be permitted.

As far as practicable, clamps shall be used to hold the forms together and use of nails and spikes avoided.

The surface of timber shuttering that would come in contact with concrete shall be well wetted and coated with soap solution before the concreting is done. Alternatively coat of raw linseed oil of approved manufacturer may be applied in place of soap solution. In case of steel shuttering either soap solutions of raw linseed oil shall be applied after thoroughly cleaning the surface. Under no circumstances black .of burnt oil shall be permitted.

The shuttering for beams and slabs shall have camber of 4 mm per meter (1 in 250) of as directed by the Engineer-n-charge so as to offset the subsequent deflection. For cantilevers, the camber at free end shall be 1750 of the projected length of as directed by the Engineer-in-change.

S-27 EXPANSION JOINTS - PRE MOLDED FILTER

The item provides for expansion joints in RCC frame structures for internal joints, as well as exposed joints, with the use of pre-molded bituminous joint filter.

Pre-molded bituminous joint filter, i.e. performed strip of expansion joint filler shall not get deformed of broken by twisting, bending of other handling when exposed to atmosphere condition. Pieces of joint filter that have been damaged shall be rejected.
Thickness of the pre-molded joint filter shall be 25 mm unless otherwise specified.
Pre-molded bituminous join filler shall conform to I.S. 1838 - 1961.

S-28 EXPANSION JOINTS - COPPER STRIPS & HOLD FASTS

The item provide for expansion joints in RCC frame structure for internal joint as well as for exposed joints with the use of necessary copper strip and hold-fasts.

Copper sheet shall be of 1.25 mm thick and of 1.25 mm width with the 'U' Shape in the middle. Copper strip shall have hold-fast of 3 mm diameter copper rod fixed to the plate soldered on strip at intervals of about 30 cm. of as shown in the drawing of as directed. The width of each flange (horizontal side) of the copper plate to be embedded in the concrete work shall be 25 mm Depth of 'U' to be provided in the expansion joint, in the copper plate shall be of 25 mm.

S-29 TEAK WOOD

The teak wood shall be of good quality as required for the item to be executed. When the kind of wood is not specifically mentioned, good Indian teak wood as approved shall be used.
Teak wood shall generally be free from large, loose, dead or cluster knots, flaws, shakes, warps, twists, bends, of any other defects. It shall generally be uniform in substance and of straight fibers as far as possible. It shall be free from rot, decay, harmful fungi and other defects of harmful nature, which will affect the strength durability of its usefulness for the purpose for which it is required. The color shall be uniform as far as possible. Any effort like painting, using any adhesive of resins materials made to hide the defects shall render the pieces liable to rejection by the engineer-in-charge.
All scantlings, plank etc. shall be sawn in straight lines and planes in the direction of grains and have uniform thickness.

The tolerances in the dimensions shall be allowed at the rate of 1.5 mm per face to be planed.
FIRST CLASS TEAK WOOD: First class teak wood shall have no individual hard and sound knots, more than 6 cm^2 size and the aggregate area of such knots shall not be more than 1 % of area of piece. The timber shall be closed grained.
SECOND CLASS TEAK WOOD: No individual hard and sound knots shall be more than 15 cm^2 in size and aggregate area of such knots shall not exceed 2 % of the area of piece.

S-29 (A) NON TEAK WOOD

The non-teakwood shall be chemically treated, seasoned as per I.S. Specifications and of good quality. The type of wood shall be got approved before collecting the same on site. Fabrication of wooden members shall be started only after approved.

For this purpose wood of Bio, Kalali, Siras, Behda, Jamun, Sisoo will be used for doorframes where as only Kalali, Siras, Halda, Kalam etc. will be permitted for shutters after proper seasoning and chemical treatment.

The non-teak wood shall be free from large, loose dead of cluster knots, flows, shakes, warps, and bends of any other defect. It shall be uniform in substance and of straight fibers as far as possible; it shall be free from rots, decay harmful fungi and other defects of nature which affect the strength, durability of its usefulness for the purpose for which it is required. The color of wood shall be uniform as far as possible. The scantlings planks etc. shall be sawn in straight lines and planes in the direction of grain and uniform thickness.

The department will use the Agency to produce certificate from Forest Department in event of Dispute and the decision of the Department shall be final and binding to the contractor.
The tolerance in the dimension shall be allowed as 1.5 mm per face to be planed.

S-30 WOODEN FLUSH DOOR SHUTTERS (SOLID CORE)

The solid core type flush door shutters shall be decorative of non-decorative type as specified in the drawing. The size and thickness of the shutter shall be as specified in drawings of as directed. The timber species for core shall be used as per I.S. 2202 (Part-I) 1980. The timber shall be free from decay and insect attack. Knots and knot holes less than half the width of cross section of the members in which they occur may be permitted. Pitch pockets, pitch streaks and harmless pinholes shall be permissible except in the exposed edges of the core members. The commercial plywood, cross bands stall conform to I.S. 303-1275.
The face panel of the shutters shall be formed by gluing by the hot press process on both face of the core with either plywood of cross bands and face veneers. The hopping rebating opening of glazing, Venetian etc. shall be provided if specified in the drawing.
All edges of the door shutters shall be square. The shutters shall be free from twist of warp in its plane. Both faces of the shutters shall be sand papered to smooth even texture.

THE SHUTTERS SHALL BE TESTED FOR

(A) End Immersion Test: The test shall be carried out as per I.S. 2202 (Part-I) 1980. There shall be no de-lamination at the end of the test. .

(B) Knife Test: the face panel when tested in accordance with I.S. 1659-1979 shall pass the test.

(C) Glue adhesion test: the flush door shall be tested for glue adhesive test in accordance with I.S. 2202 (Part-I) 1980. The shutters shall be considered to have passed the test if no de-lamination occurs in the glue lines in the plywood and if no single de-lamination more than 80 mm in length and more than 3 mm in depth has occurred in the assembly glue lines between the plywood face and the style and rail, De-lamination at the corner shall be measured continuously around the corner De-lamination at the knots holes and other permissible wood defects shall not be considered in assessing the sample.

The tolerance in size of solid core type flush door shall be as under:
In Normal thickness + 1.2 mm
In normal height + 3 mm
The thick of the shutters shall be uniform throughout with a permissible variation of not more than 0.8 mm when measure at any two points.

S-31 ALUMINIUM DOORS, WINDOWS, VENTILATORS

Aluminium alloy used in the manufacture of extruded window sections shall conform to I.S. designation HEA-WP of I.S.: 733-1975 and also to I.S. Designation WVG-WP of I.S.

1285-1975. The section shall be as specified in the drawing and design. The fabrication shall be done as directed.
The hinges shall be cast of extruded hinge of same type as in window but of large size.
The hinges shall normally be of 50 mm projecting type of hinges may also be used if directed. The handles of doors shall be of specified design. A suitable lock for the door operable either from outside of inside shall be provided.
In double shutter door, the first closing shutter shall have concealed aluminium alloy bolt at top and bottom.

S-32 ROLLING SHUTTERS

The rolling shutters shall conform to I.S. 6248-1979. Rolling shutters shall be supplied of specified type with accessories. The size of the rolling shutters shall be specified in the drawings. The shutters shall be constructed with interlocking lath sections formed from cold rolled steel strips not less than 0.9 mm thick and 80 mm wide for shutters up to 3.5 mm width not less than 1.25 mm thick and 80 mm wide for shutters 3.5 mm in width and above unless otherwise specified.
Guide channels shall be of mild steel deep channel section and of rolled pressed of built up (fabricated) joint-less construction. The thickness of sheet used shall not be less than 3.15 mm.

Hood covers shall be made of MS Sheets not less than 0.92 mm thickness. For shutters having width 3.5 Meter and above, the thickness of MS sheet for the hood cover shall be not less than 1.25 mm.

The spring shall be of best quality and shall be manufactured from tested high tensile spring steel wire of strip of adequate strength to balance the shutters in all position. The spring pipe shaft etc. shall be supported on strong MS or malleable C.I. brackets. The brackets shall be fixed on of under the lintel as specified with raw plugs and screws bolts etc.

The rolling shutters shall be of self-rolling type up to 6 m^2 clear area with ball bearing. If the rolling shutters are larger, then gear operated type shutters shall be used.
The locking arrangement shall be provided at the bottom of shutter at both ends. The shutters shall be opened from outside.
The shutter shall be completed with door suspension shafts, locking arrangements, pulling hooks, handles and other accessories.

S-33 COLLAPSIBLE STEEL GATE

The Collapsible Steel Gate shall be in one of two leaves and size as per approved drawings of as specified. The gate shall be fabricated from best quality mild steel channels, flats etc. Either steel pulley of hall bearings shall be provided in every double channel. Unless otherwise specified the particulars of collapsible gate shall be as under:

(A) Pickets: These shall be of 20 mm MS channels of heavy sections unless otherwise shown of drawings. The distance center to center of pickets shall be 12 cm with an opening of 10 cm.
(B) Pivoted MS flats shall be 20 mm x 6 mm
(C) Top and bottom guides shall be from tee of flat iron of approved size.
(D) The fitting like stoppers, fixing holdfasts, locking cleats, brass handles and cast iron rollers shall be of approved design and size.

S-34 WELDED STEEL WIRE FABRIC

Welded steel wire fabric for general purpose shall be manufactured from cold drawn steel wire "as drawn" of galvanized steel conforming to I.S. 226-1975 with longitudinal and transverse wire securely connected at every intersection by a process of electric resistance welding and conforming to I.S. 4948-1974. It shall be fabricated and finished in workman like manner and shall be along of square as directed. The mesh sizes and size of wire for square as well as oblong welded steel wire fabric shall be as

directed. The steel wire fabric in panels shall be in one whole piece in each panel as far as stock size permit.

S-35 EXPANDED METAL SHEETS

The expanded metal sheets shall be free from flaws, joints, broken strands, laminations and other harmful surface. Expanded metal steel sheet shall conform to I.S. 412-1975, except that blank sheets need not be with guaranteed mechanical properties. The size of the diamond mesh of expended metal and dimensions of strands (width and thickness) shall be as specified. The tolerance in nominal weight of expanded metal sheets shall be of 10 percent.

Expanded metal in panels shall be in on whole piece panel each as far as stock size permit. The expanded metal sheets shall be coated with suitable protective coating to prevent corrosion.

S-36 MILD STEEL WIRE (WIRE GAUZE JALI)

Mild steel wire may be galvanized, as indicated. AII finished steel wire shall be well cleanly drawn to the dimensions and size of wire as specified in item. The wire shall be sound, free from splits, surface flaws, rough jagged and imperfect edges and other harmful surface defects and shall conform to I.S. 280-1979.

S-37 PLYWOOD

The plywood for general purpose shall conform I.S. 303-1975. Plywood is made by, cementing thin boards of sheets of wood into panels. There are always an odd number of layers 3,5,7,9 piles etc. the plies are placed so that grain of each layer is right angle to the grain in the adjacent layer.

The main advantage of plywood over a single board of the same thickness is the more uniform strength of the plywood along the length and width of the plywood and greater resistance to cracking and splitting with change in moisture content.

Usually synthetics resins are used for gluing, phenolic resins are usually cured in a hot press which compressed and simultaneously heirs the plies between hot plates which maintaining a temperature of 90 degree C. to 140 degree C. and a pressure of 11 to 14 kg/cm^2 of the wood. The times of heating may be anything from 2 to 60 minutes depending given thickness.

When water glue are used, the wood absorbs so much water that the finished plywood must be dried carefully. When synthetic resins are used as adhesive finished plywood must be exposed to an atmosphere of controlled humidity until the proper amount of moisture has been absorbed.

According to I.S. 303-1975 the plywood for general purpose shall be of three grades namely BWR, WWR and CWR depending upon the adhesives used for bonding and veneers, and it will be further classified into six types namely AA, AB, AC, BB, BC and CC based on the quality of the two faces, each face being of three kinds namely. A, B and C. After pressing, the finished plywood should be reconditioned to a moisture-content not less than 8 percent and not more than 16 percent.

Board	Thickness Thickness	Board	Thickness	Board	
3 ply	3 mm	5 ply	5 mm	9 ply	16 mm
	4 mm		6 mm		19 mm
	5 mm		8 mm	11 ply	19 mm
	6 mm		9 mm		22 mm
					25 mm

S-38 GLASS

All glass shall be of the best quality, free from specks, bubbles, smokes, veins, air holes blisters and other defects. The king of glass to be used shall be mentioned in the item of specification of in to special provisions of as shown in detailed drawings. Thickness of glass panels shall be uniform the specifications of different kinds of glass shall be as under:

(A) In absence of any specified thickness of weight in the item of detailed specifications of the item of work, sheet glass shall be weighing 7.5 kg $1m^2$ for panes up to 600 mm x 600 mm.

(B) For panes larger than 600 mm x 600 mm and up to 800 mm x the glass weighing not less than 8.75 kg/m^2 shall be used. For biggest panes up to 900 mm x 900 mm glass weighing not less than 11.25 kg/m^2 shall be used.

(C) Sheet glass shall be patent flattened glass of best quality and for glazing and framing purpose shall conform to I.S. 1761-1960. Sheet glass of the specified colors shall be used, if so shown on detailed drawings of so specified. For important buildings and for panes with any dimension over 900 mm plate glass of specified thickness shall be used.

PLATE GLASS : When plate glass is specified, it shall be 'Polished patent plate glass' of best quality. It shall have both the surface ground flat and parallel and polished to obtain clear undisturbed vision and reflection. The plate glass shall be of the thickness mentioned in the item of as shown in the detailed drawing of as specified. In absence if any specified thickness of plate glass to be supplied shall be 6 mm and a tolerance of 0.20 mm shall be admissible.

OBSCURED GLASS : This type of glass transmits light so that vision is partially of almost completely obscured. Glass shall be plain rolled, figured; ribbed of fluted or frosted glass as may be specified as required. The thickness and type of glass shall be as per details on drawings of as specified or as directed.

WIRED GLASS : Glass shall be with wire setting embedded in a sheet of plate glass electrically welded 13 mm Georgian square mesh may be used. Thickness of glass shall not be less than 6 mm wired glass shall be of type and thickness as specified.

S-39 ACRYLIC SHEETS

Acrylic sheet shall be of thickness as specified in the item and of a specified shape and size as the case may be. Panels may be flat of curved. It should be light in weight. It shall be colorless of colored of opaque as specified in the item. Colorless sheet shall be as transparent as the finest optical glass. Its light transmission rate shall be about 95 %. Transparency shall not be affected for the sheets of larger thickness. It shall be extremely resistant to sunlight, weather and low temperatures. It shall not show any significant yellowing or change in physical properties of loss of light transmission over a longer period of use. The sheet shall be impact resistant also. Sheets should be available in complete range of standard transparent, translucent and opaque colors. Sheets shall be of such quality that they can be cat, bent and jointed as desired; Solution for the joints shall be used as per the requirement of manufacturer.

S-40 PARTICLE BOARD

The particle boards used for face panels shall be of best quality free from any defects. The particle boards shall be made with phenol formaldehyde adhesive. The particle boards shall conform to I.S. 380-1965. "Specification for wood particle board for general purpose". The size and the thickness shall be as indicated.

S-41 EXPANDED POLYSTYRENE OF FRAMED STYOPER SLABS

The expanded to polystyrene ceiling boards and tiles shall be of approved make and shall be of size, thickness, finish and color as indicated. It shall be of high density and suitable for use as insulating material. The insulating material shall be like slab of Thermo Cole etc.

S-42 RESIN BONDED FIBERGLASS

The resin bonded fiberglass tiles, of rolls shall be of approved make and shall be of sizes, thickness and finish as indicated.
For test of Mineral wool thermal insulation Blanket I.S.: 3144/1965 shall be followed.
Insulation wool blanket shall be with following coverings on one or both sides as indicated.

A. Bituminized Hessian Craft paper suitable for use in position where moisture has to be excluded.

B. Hessian cloth of Craft paper for keeping out dust.

C. G.I. wire netting, suitable for surfaces to be plastered over.

S-43 FIXTURES AND FASTENINGS

GENERAL

A. The fixtures and fastenings, that is, butt, hinges, tee and strap hinges, sliding door bolts, tower bolts, door, latch, bath room latch, handles, door stoppers, casement window fasteners, casement stays and ventilators catch shall be made of the metal as specified in the item of its specifications.
B. They shall be of iron, brass, aluminium, chromium-plated iron, chromium-plated brass, copper oxidized iron, copper oxidized brass of anodized aluminium as specified.
C. The fixtures shall be heavy, medium of light type. The fixtures and fastenings shall be smooth finished and shall be such as will ensure case of operation.
D. The samples of fixtures and fastenings shall be got approved as regards quality and shape before providing them in position.
E. Brass and anodized aluminium fixtures and fastenings shall be bright finished.

HOLDFASTS

Holdfasts shall be made from mild steel flat 30 cm length and one of the holdfasts shall be bent at right angle and two nos. of 6 mm diameter holes shall be made in it for fixing it to the frame with screws. At the other end, the holdfast shall be forked and bent at right angles in opposite directions.

BUTT HINGES

Railway standard heavy type butt hinges shall be used when so specified.
Tee and strap hinges shall be manufactured from MS Sheet.

SLIDING DOOR BOLTS (ALDROPS)

The aldrops as specified in the item shall be used and shall be got approved.

DOOR LATCH

The size of door latch shall be taken as the length of latch.

BATHROOM LATCH

Bathroom latch shall be similar to tower bolt.

HANDLE

The size of the handles shall be determined by the inside grip of the handles. Handles shall have a base plate of length 50 mm more than the size of the handle.

DOOR STOPPERS

Door catch shall be fixed at a height of about 900 mm from the floor level so that one part of the catch is fitted on the inside of the shutter and the other part is fixed in the wall with necessary wooden plug arrangements for appropriate fixing. The catch shall be fixed 20 mm inside his face of the door for easy operation of catch.

WOODEN DOORS STOP WITH HINGES
Wooden doorstop of size 100 mm x 60 mm x 40 mm shall be fixed on the doorframe with a hinge of 75 mm size and at a height of 900 mm form the floor level. The wooden doorstop shall be provided with 3 coats of approved oil paint.

CASEMENT WINDOW FASTENER
Casement window fastener for single leaf window shutter shall be left or right handled as directed.

CASEMENT STAYS (STRAIGHT PEG STAY)
The stays shall be made from a channel section having three holes at appropriate position so that the window can be opened either fully of partially as directed. Size of the sty shall be 250 mm to 300 mm as directed.

VENTILATOR CATCH
The pattern and shape of the catch shall be as approved.

PIVOT
The base and socket plate shall be made from minimum 3 mm thick plate and projected; pivot shall not be less than 12 mm diameter and 12 mm length and shall be firmly riveted to the base plate in case of iron pivot and in single piece base plate in the case of brass pivot.

S-44 PAINTS OIL PAINTS

A. Oil paints shall be of the specified color and shade, and as approved. The ready mixed paints shall only be used. However, if ready mixed paint or specific shade or tint is not available, white ready mixed paint with approved stainer will be allowed, in such a case, the contractor shall ensure that the shade of the paint so allowed shall be uniform.

B. All the paints shall meet with following general requirements:
   - I. Paint shall not show excessive setting in a freshly opened full can and shall easily be re-dispersed with a paddle to a smooth homogeneous state. The paint shall show no curdling, livering, caking or color separation and shall be free from lumps and skins.
   - ii. The paints as received shall brush easily, possess good leveling properties and show no running of sagging tendencies.
   - iii. The paint shall not skin within 48 hours in a three quarters filed closed container.
   - iv. The paint shall dry to a smooth uniform finish free from roughness, grit, unevenness and other imperfections.

C. Ready mixed paint shall be used exactly as received from the manufacturers and generally according to their instructions and without any admixtures whatsoever.

ENAMEL PAINTS
The French-polish of required tint and shape shall be prepared with the below mentioned ingredients and other necessary materials.

(a) Denatured spirit of approved quality, (b) Chandras, (c) Shellac, (d) Pigment
The French polish so prepared shall conform to I.S.: 348 - 1968.

S-46 MARBLE CHIPS FOR MARBLE MOSAIC TERRAZZO

The marble chips shall be of approved quality and shades. It shall be hard, sound, dense and homogeneous in texture with crystalline and coarse grains. It shall be uniform in color and free from stains, cracks decay and weathering.

The size of various colors of marble chips ranging from the smallest up to 20 mm shall be used where the thickness of top wearing layer is 6 mm size. The marble chips of approved quality and colors only as per grading as decided by the Engineer-in-Charge shall be used for marble mosaic tiles of works.

The marble chips shall be machine crushed. They shall be free from foreign matter, dust etc. Except as above, the chips shall conform to I.S.: 2114 - 1962.

S-47 FLOORING TILES

PLAIN CEMENT TILES

A. The plain cement tiles shall be general-purpose type. These are the tiles in the manufacturer of which no pigments are used. Cement used in the manufacture of tiles shall be as per Indian Standard.

B. The tiles shall be manufactured from a mixture of cement and natural aggregates by pressure process. During manufacture, the tiles shall be subjected to a pressure of not less than 140 kg/cm^2. The proportion of cement to aggregate in the backing of the tiles shall be not less than 1:3 by weight. The wearing face through the tiles are of plain cement, shall be provided with stone chips of 1 to 2 mm size. The proportions of cement to the marble chops aggregate in the wearing layer of the tiles shall be three parts of cement to one part chips by weight.

   The minimum thickness of wearing layer shall be 3 mm. The color and texture of wearing layer shall be uniform throughout its face and thickness. On removal from mould, the tiles shall be kept in moist conditions continuously at least for seven days and subsequently, if necessary, for such long period as would ensure their conformity to requirements of I.S. 1237 - 1980 regarding strength resistance to wear and water absorption.

C. The wearing face of the tiles shall be plain, free from projections, depressions and cracks and shall be reasonably parallel to the back face of the tile. All angles shall be right and all edges shall be sharp and true.

D. The size of tiles shall generally be square shape 24.85 cm x 24.85 cm x 25 cm. The thickness of tiles shall be 20 mm.

E. Tolerance of length and breadth shall be plus or minus one millimeter. Tolerance on thickness shall be plus 5 mm.

F. The tiles shall satisfy the tests as regards transverse strength, resistance to wear and water absorption as per I.S.: 1237 - 1980.

PLAIN COLORED TILES

A. These tiles shall have the same specification as per plain cement tiles as per (A) above except that they shall have a plain wearing surface wherein pigments are used. They shall conform to I.S. 1237 – 1980.

B. The pigment used for coloring cement shall not exceed 10 percent by weight of cement used in the mix. The pigments, synthetic of otherwise, used for coloring tiles shall have permanent color and shall not contain materials detrimental to concrete.

C. The color of the tiles shall be specified in the item of as directed.

MARBLE MOSAIC TILES

A. These tiles have the same specifications as per plain cement tiles except the requirements as stated below.

B. The marble mosaic tiles shall conform to I.S. 1237-1980. The wearing face of the tiles shall be mechanically ground and filled. The wearing face of tiles shall be free from projections, depressions and cracks and shall be reasonably parallel to the back face of the tiles. All angles shall be right angles and all edges shall be sharp and true.

C. Chips used in the tiles be from smallest up to 20 mm size. The minimum thickness of wearing layer of tiles shall of 6 mm. For pattern of chips to be used on the wearing face, a few samples with of without their full size photographs as directed shall be presented to the Engineer-in-Charge for approval.

D. Any particular samples, if found stable shall be approved by the Engineer-in-Charge, or he may ask for a few more samples to be prepared indicating roughly the particular sized chips to be more of less in the samples presented. The samples have to be made by the contractor till a suitable sample is finally approved for use in the work.

The contractor shall ensure that the tiles supplied for the work shall be in conformity with the approved sample only, in terms of its dimensions, thickness of backing layer and wearing surface, materials, ingredients, color shade, chips, distribution etc. required.

E. The tiles shall be prepared from cement conforming to Indian Standards of colored Portland cement generally depending upon the color of tiles to be used of as directed.

CHECKERED TILES

A. Checkered tiles shall be plain cement tiles or marble mosaic tiles. The former shall have the same specifications as per (A) above and the latter as per marble mosaic tiles as per (C) except as mentioned below:

B. The tiles shall be nominal size of 250 mm x 250 mm of as specified. The center-to-center distance of checker shall not be of nominal size 250 mm x 250 mm of as specified. The center-to-center distance of checker shall not be less than 25 mm and not more than 50 mm. The overall thickness of his tile shall be 22 mm.

C. The grooves in the checkers shall be uniform and straight. The depth of the grooves shall not be less than 3 mm the checkered shall be plain, colored of mosaic as specified. The thickness of the upper layer measured from the top of the checkers shall not be less than 6 mm. The tiles shall be given in the first grinding with machine before delivery to site.

D. Tiles shall conform to relevant I.S. 1237-1980.

CHECKERED TILES FOR STAIR CASES

A. The requirements of these tiles shall be the same as checkered as per (D) above except in following respects;

1. The length of a tile including nose shall be 330 mm.
2. The minimum thickness shall be 28 mm.
3. The nosing shall have also the same wearing layer as at the top.
4. The nosing edge shall be rounded.
5. The front portion of the tile for a minimum length of 75 mm from and including the nosing shall have grooves running parallel to nosing and at center not exceeding 25 mm. Beyond that the tiles shall have normal checker pattern.

S-48 ROUGH KOTAH STONE

The kotah stones shall be hard, even, sound and regular in shape and generally uniform in color. The color of the stone shall generally be green. Brown color stones shall not be allowed for use. They shall be without any soft veins, cracks of flaws.

The size of the stones to be used for flooring shall be of size 600 mm x 600 mm and / or size 600 mm x 450 mm as directed. However smaller sizes will be allowed to be used to the extent of maintaining required pattern. Thickness shall be as specified.

Tolerance of minus 30 mm on account of chisel dressing of edges shall be permitted for length as well as breadth. Tolerance in thickness shall be + 3 mm.

The edges of stones shall be truly chiseled and table rubbed with coarse sand before paving. All angles and edges of the stone shall be true, square and free from chipping and the surface shall be true and plain.

When machine cut edges are specified, the exposed edges and the edges at joints shall be machine cut. The thickness of the exposed machine cut edges shall be uniform.

S-49 POLISHED KOTAH STONES

Polished kotah stone shall have the same specification as per rough kotah stone except as mentioned below:

The stones shall have machine polished smooth surface. When brought on sit, the stones shall be single polished of double polished depending upon its use. The stones for paving shall generally be single polished. The stones to be used for dado, skirting, platforms, sink, veneering, sills, steps, etc. where machine polishing after the stones are fixed in-situ is not possible, shall be double polished.

S-50 DHOLPUR STONE SLAB

Dholpur stone slab shall be of best quality as approved by the Engineer-in-Charge. The stone slab shall be even, sound and durable, regular in shape and of uniform color.

The size of the stone shall be specified in the item of detailed drawings of as approved by the Engineer-in-Charge. The thickness of the stone shall be as specified in the item of work with the permissible tolerance of plus of minus 2 mm. The provisions in respect of polishing as for polished kotah stone shall apply to polish Dholpur stone also. All angles and edges of the face of the stone slab shall be fine chiseled of polished as specified in the item of work and all the four edges shall be machine cut.

All angle and edges of the stone slab shall be true and plane.

The sample of stone shall be got approved from the Engineer-in-Charge for shade and tint for a particular work. It shall be ensured that the stones to be used in a particular work shall not differ much in shade of tint from the approved sample.

S-51 MARBLE SLAB

Marble slab shall be white or of other colored and of best quality as approved by the Engineer-in-charge.

Slabs shall be hard, uniform and homogeneous in texture. They shall have even crystalline grain and free from defects and cracks. The surface shall be machine polished to an even and perfectly plant surface and edges machine cut true and square. The rear face shall be rough to provide key for the mortar.

The slab shall not be thinner than the specified thickness at its thinnest part. A few specimen of finished slab to be used shall be deposited by the Contractor in the office for reference.

Except as above, the marble slabs shall conform to I.S. 1130-1969.

S-52 GRANITE STONE SLAB

Granite shall be of approved color and quality. The stone shall be hard, even, sound regular in shape and generally uniform in color. It shall be without any soft veins, cracks of flows.

The thickness of the stone shall be as specified in the items.

All exposed face shall be double polished to tender truly smooth and the even reflecting surface. The exposed edges and corners shall be rounded off as directed. The exposed edges shall be machine cut and shall have uniform thickness.

S-53 PVC FLOORING

PVC sheets for PVC floor covering shall be of homogeneous flexible type, conforming to I.S. 3452-1966. The PVC covering shall neither develop any toxic effect while put to use nor shall give off any disagreeable odor.
Thickness of flexible type covering tiles shall be as specified in the description of the item.
The flexible type shall be backed with Hessian of other woven fabric. The following tolerances shall be applicable of the nominal dimension of the sheet rolls of tiles:

Thickness		± 0.15 mm
Length or Width		
1	300 mm square tiles	± 0.20 mm
2	600 mm square tiles	± 0.40 mm
3	390 mm square tiles	± 0.30 mm
4	Sheet and rolls	± 0.10 %

ADHESIVE
The adhesive for PVC flooring shall be of the type and make recommended by the Manufacturers of PVC sheets / tiles.

S-54 WHITE GLAZED TILES
The tiles shall be of best quality as approved by the Engineer-in-Charge. They shall be flat and true to shape. They shall be free from cracks, crazing, spots, chopped edges and corners. The glazing shall be of uniform shade.
The tiles shall be nominal size of 150 mm x 150 mm unless otherwise specified. The maximum variation from the stated sizes, other than the thickness of tiles, shall be plus of minus 1.5 mm. The thickness of tile shall be 6 mm except as above the tiles shall conform to I.S. 777-1970.

S-55 GALVANIZED IRON PIPES AND FITTINGS
Galvanized iron pipe shall be of the medium type and of required diameter and shall comply with I.S. 1239-1979. The specified diameter of the pipes shall refer to the inside diameter of the bore. Clamps, screw and all galvanized iron fittings shall be of the standard "R" or equivalent make.

S-56 BIB COCK AND STOP COCK
A bibcock is a draw off tap with a horizontal inlet and free outlet. A stopcock is a valve with a suitable means of connection for insertion in a pipeline for controlling of stopping the flow.
They shall be of screw down type and of brass chromium plated and of diameter as specified in the description of the item. They shall conform to I.S. 781-1977 and they shall be of best Indian Make. They shall be polished bright.
The Minimum finished weight of bib cock and stop cock shall be as given below:

Diameter	Bib cock	Stop Cock	Diameter	Bib cock	Stop cock
8 mm	0.25 kg	0.25 kg	15 mm	0.40 kg	0.40 kg
10 mm	0.30 kg	0.35 kg	20 mm	0.75 kg	0.75 kg

S-57 GUN METAL WHEEL VALVE
The gun-metal wheel valve is of approved quality. These shall be gun metal fitted with wheel and shall be of gate valve opening full way and of the size as specified. These shall conform to I.S. 778-1971.

S-58 WHITE GLAZED PORCELAIN WASHBASIN
Washbasin shall be of white porcelain first quality best Indian-make and it shall conform to I.S. 2556 (Part-IV) and I.S. 771-1979.

The size of the washbasin shall be as specified in the item. Washbasin shall be of one piece construction with continued overflow arrangements. All internal angles shall be designed so as to facilitate cleaning. Washbasin shall have single tap hole or two holes as specified. Each basin shall have a circular waster hole, which is either rebated of bevelled internally with 65 mm diameter at top and 10 mm depth to suit the waste fitting. The necessary stud slot to receive the bracket on the under side of he basin shall be provided. Basin shall have an internal soap holder recess which shall fully drain into the bowl.

White glazed pedestal of the quality and color as that of the basin shall be provided where specified in the item. It shall be completely recessed at the back for reception of supply and wash pipe. It shall be It shall be capable of supporting the basin rigidly and adequately and shall be so designed as to make the height from floor to top of the rim of basin 750 mm to 800 mm as directed.

S-59 EUROPEAN TYPE WATER CLOSET WITH LOW LEVEL FLUSHING

The European type water closet shall be white glazed porcelain first quality and shall be of wash down type conforming to I.S. 771-1979.

'S' trap shall be provided as required with water seal not less than 50 mm the solid plastic seat and cover shall be off the best Indian make conforming to I.S. 2548-1980. They shall be made of molded synthetic materials which shall be tough and band with high resistance to solvents and shall be free from blisters and other surface defects and shall have chromium plated brass hinges and rubber buffer of suitable size.

S-60 ORISSA TYPE WATER CLOSET

The specification of ORISSA type white glazed water closet of first quality shall confirm to I.S. 2556 (Part-III) 1981 and relevant specification of Indian type water closet except that pan will be with the integral squatting pan of size 580 mm x 440 mm with raised footrest.

S-61 INDIAN TYPE WATER CLOSET

The Indian type white glazed water closet of first quality shall be of size as specified in the item and conforming to I.S. 771-1979 and I.S. 2556 (Part-II) 1981. Each pan shall have integral flushing ring of suitable type with adequate number of holes all-round as directed to have satisfactory flushing. It shall also have an inlet at back or front for connecting flush pipe as directed. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and surface shall be uniform and smooth.

Pan shall be provided with 100 mm diameter 'P' of 'S' trap with approximately 50 mm water seal and 50 mm diameter vent horn.

A pair of white glazed earthenware rectangular foot rests of minimum size 250 mm x 130 mm 20 mm shall be provided with water closet.

S-62 GLAZED EARTHENWARE SINK

The glazed earthenware sink shall be specified size, color and quality. The sink shall conform to I.S. 771 Part-II-1979. The brackets for sinks shall conform to I.S. 1970.

The piper shall conform to I.S. 1239-Part-1 1973 and I.S. 404-1962 for steel and lead pipes respectively 32 mm brassware coupling of standard pattern with brass chain and rubber plug shall be provided with sink.

S-63 GLAZED EARTHENWARE LIPPED TYPE FLAT BACK CORNER TYPE URINAL

The lipped type urinal shall be flat back of corner type as specified in the item and shall conform to I.S. 771-1979. It shall be of best Indian make and size as specified and

approved by the Engineer-in-charge. The flat back of corner type urinal must be of 1st quality free from any defects, cracks, etc.

S-64 LOW LEVEL ENAMEL FLUSHING TALK

The low level enamel-flushing tank shall be of 15 liters capacity. It shall conform to I.S. 774-1971. the flushing cistern shall be of best quality and free from any defects. The flushing tank shall have outlet 32 mm diameters. The outlet shall be connected with WC Pan by lead pipe or PVC Pipe as specified. The flushing Tank shall be provided with inlet and outlet for fixing G.I. Inlet Pipe and overflow pipes. The flushing cistern shall be provided with chromium-plated handle for flushing. The flushing tank shall be provided with bracket of cast iron so that it can be fixed on wall at specified height. The brackets shall conform to I.S. 775-1970.

S-65 CAST IRON FLUSHING CISTERN

The cast iron flushing cistern shall be of 15 liters capacity. It shall conform to I.S. 7741971. The flushing cistern shall be of best quality-free from any defects. The flushing cistern shall have outlet of 32 mm diameter. The outlet shall be connected to lead pipe of 32 mm diameter. The lead pipe shall conform to I.S. 404 (part-I) 1962. For fixing G.I. inlet pipes and overflow pipe 20 mm dia. Inlet and outlet shall be provided. The flushing cistern shall be provided with galvanized iron chain and pull of sufficient length and shall be got approved from the engineer-in-charge. The cast iron flushing cistern shall be painted with one coat of anticorrosive paint and two coats of paints. The flushing cistern shall be fixed on two G.I. brackets. The C.I. brackets shall conform to I.S. 775-1970.

S-66 FLUSH COCK

Half turn cock (heavy weight) shall be of gun metal chromium plated of diameter as specified in the description of the item the flush cock shall conform to relevant Indian Standard.

S-67 CAST IRON PIPES AND FITTINGS

All soil, waster, vent and anti-syphonage pipes and fitting shall confirm to I.S. 17201964. The pipe shall have spigot and socket ends with head on spigot end. The pipes and fittings shall be true to shape, smooth, cylindrical, their inner and outlet surfaces being as nearly as practicable concentric. They shall be sound and nicely cast and shall be free from cracks. Laps, pinholes or other imperfection and shall be neatly dressed and carefully fettled.

The end of pipes and fitting shall be reasonable square to their axis.

The sand cast iron pipes shall be of the diameter as specified in the description and shall be in lengths of 1.5 M, and 2 M. including socket ends of the pipe unless shorter lengths are either specified or required at junctions etc. The Pipes and fittings shall be supplied without ears unless specified of directed otherwise.

TOLERANCES

The Standard weights and thickness of pipes shall be as shown in him following table: A tolerance up to minus 10 percent may however be allowed against these standard weights.

Sr.	Nominal	Thickness	Overall Weight of Pipe excluding ears		
No.	Dia. of bore		1.5 m long	1.8 m long	2 m long
1	75 mm	50 mm	12.83 kg	16.52 kg	18.37 kg
2	100 mm	5.0 mm	18.14 kg	21.67 kg	24.15 kg

A tolerance up to minus 15 percent in thickness and 20 mm in length will be allowed. For fittings tolerance in lengths shall be plus 15 mm and minus 10 mm.
The thickness of fittings and their socket and spigot dimensions shall conform to the thickness and dimensions specified for the corresponding sizes of straight pipes. The tolerance in weights and thickness shall be the some as for straight pipes.

S-68 NAHNI TRAP

Nahni Trap shall be of cast iron and shall be sound and free from porosity of other defects that affect serviceability. The thickness of the base metal shall not be less than 6.5 mm. The surface shall be smooth and free from craze, ships and shall be of self cleansing design.
The Nahni Trap shall be of quality approved by the Engineer-in-charge and shall generally conform to the relevant Indian Standards.
The Nahni Trap provided shall be with deep seal, minimum 50 mm, except at places where trap with deep seal can not be accommodated. The cover shall be cast Iron. Perforated cover shall be provided on the trap of appropriate size.

S-69 GULLY TRAP

Gully Trap shall conform to I.S. 651-1980. It shall be sound. Free from defects such as fire cracks. The glaze of the traps shall be free from crazing. They shall give a sharp clear note when struck with light hammer. There shall be no broken blisters.

The size of the Gully Trap shall be as specified in the item.

Each Gully Trap shall have one C.I. grating of square size corresponding to the dimensions of inlet of Gully Trap. It will also have a watertight C.I. cover with frame inside dimensions 300 mm x 300 mm, the cover with frames inside dimension, 300 mm x 300 mm the cover weighing not less than 4.53 kg the grating cover and frame shall be of sound and good casting and shall have truly square machined seating faces.

S-70 GLAZE STONE WARE PIPE AND FITTING

The pipes and fitting shall be of best quality as approved by the Engineer-in-charge. The pipe shall be of best quality manufactured from stoneware of fire clay, salt glazed thoroughly burnt through the whole thickness, of a close even texture, free from air blows, fire blisters, crack and other imperfections, which effect the serviceability. The inner and outer surfaces shall be smooth and perfectly glazed. The pipe shall be capable to withstand pressure of 1.5 m. lead without showing sign of leakage. The thickness of the wall shall not be less than 1/12th of the internal dia. The depth of socket shall not be less than 38 mm. The socket shall be sufficiently large to allow a joint of 1 mm around the pipe.
The pipes shall generally conform to relevant I.S. 651-1980.

S-71 WALL PEG RAIL

The aluminium wall peg rail shall have three aluminium pegs of approved quality and size. It shall be fixed on teakwood plank of size 450 mm x 75 mm x 20 mm The teakwood shall be French polished of oil painted as specified.

S-72 G.I. WATERSPOUT

The G.I. pipes of 40 mm dia. shall be of medium quality and specials shall be of 'R' brand or equivalent brand of best-approved quality.

The pipe shall have length as required for the thickness of wall in which it is fixed and at the outside and tee and bend cut at half the length shall be provided and at other end coupling shall be provided to have better fixing. The waterspout shall be provided as per detailed drawing or as directed.

S-73 ASBESTOS CEMENT PIPE (A.C. PIPE)

The asbestos cement pipe of diameters as specified in the description of the item shall conform to I.S. 1626-1980. Specials like bends, shoes cowls, etc. shall conform to relevant Indian Standards. The interior of pipe shall have a smooth finish, regular surface and regular, internal diameter. The tolerance in all dimensions shall be as per I.S. 1626 Part-I 1980.

S-74 CRYDON BALL VALVE

Ball valve of screwed type including polyethylene float and necessary lever etc. shall be of the size as mentioned in the description of item and shall conform to I.S. 1730-1977.

S-75 BITUMEN FELT FOR WATER PROOFING AND DAMP PROOFING

Bitumen felt shall be on the fiber based and shall be type 2, self finished grade-2 and shall conform to I.S. 1322 -1970.

S-76 SELECTED EARTH

The selected earth shall be that obtained from excavated materials or shall have to brought from outside as indicated in the item. It item does not indicate anything; the selected earth shall have to be brought form outside.

The selected earth shall be good yellow soil and shall be got approved from the Engineer-in-charge. In no case black cotton soil or similar expansive and shrinkable soil shall be used. It shall be clean and free from all rubbish and perishable materials, stones or brickbats. The clods shall be broken to a size of 50 mm or less, contractor shall make his own arrangement at his own cost for land for borrowing selected earth. The stacking of material shall be done as directed by the Engineer-in-charge in such a way as not to interfere with any constructional activities and in proper stacks.

When excavated materials is to be used, only selected stuff got approved from the Engineer-in-charge shall be used. It shall be stacked separately and shall comply with all the requirements of selected earth mentioned above.

S-77 BARBED WIRE

The barbed wire shall be of galvanized steel and it shall generally conform to I.S. 278-1978. The barbed wire shall be of type-1 whose nominal diameter for line wire shall be 2.5 mm and point wire 2.24 mm the nominal distance between two bars shall be 75 mm unless otherwise specified in the item. Twisting together two lines wires, one containing the barbs, shall be used to make the barbed wire. The size of the line and point wires and barb spacing shall be as specified above. The permissible deviation from the nominal diameter of the line wire and point wire shall not exceed ± 0.08 mm.

The barbs shall carry four points shall be formed by twisting two point wires, each two turns, lightly round one line wire, making altogether four complete runs. The barbs shall be so finished that the four points are set and locked at right angles to each other. The barbs shall have a length of not less than 13 mm and not more than 18 mm the point shall be sharp and cut at an angle not greater than 35 degree of the axis of the wire forming the barbs.

The line and point wire shall be circular section free from scale and other defects and shall be uniformly galvanized. The line wire shall be in continuous length and shall not contain any weld other than those in the rod before it is drawn. The distance between two successive splices shall have to be less than 15 meters.

The lengths per 100 kg of barbed wire I.S. Type-I shall be as under:

Nominal	1000 meter	Minimum	834 meter	Maximum	1066 meter.

EARTH WORK

1. EXTENT AND INTENT

The work under this section covers all operations listed below concerning the civil work and the site development work.

a. Clearing and grubbing
b. Grading
c. Excavation including removal of top soil
d. Filling and back filling
e. Removal and disposal of surplus material
f. Bringing sweet earth from outside where required
g. Hard stone soling to floors and paving

The Construction Manager / Contractor shall provide all materials, labour, equipment, operations and incidental necessary and required for the completion of all aspects of work listed above as called for in the drawings and specifications.

2. GENERAL

The Contractor shall visit the site, and decide for himself the nature of the ground and the subsoil to be excavated. No claim of extras will be entertained in consequence of any misunderstanding or incorrect information or ignorance of existing conditions.

3. ANTIQUITIES

Any ancient carvings, relics, coins or other curiosition discovered during the excavation or other work shall remain the property of the Owner and shall be handed over to the OOW.

4. EXCAVATED MATERIALS

Any sand, gravel of similar useful materials obtained from excavation site shall be the property of the Owner and shall not disposed of or used in the construction of the works without prior written consent of the OOW. It is the intention of this contract that all benefits accruing from materials within the site shall pass to the Owner and the fair market rice of any such material disposed of or used shall be alleged to the Owner by the Contractor and the contract sum adjusted accordingly.
Borrow pits shall not be dug on the site without the prior written consent of the OOW.

5. CLEARING

The Contractor shall clear the site of all rubbish and unwanted civil work. All disused foundation drains of other obstructions met with during excavation shall be dug out and cleared at Contractor's own expense.

6. BENCHMARKS

The construction Manager / Contractor shall erect sufficient permanent benchmarks in suitable locations for all the works before starting work, from which all the important levels shall be laid out. A qualified surveyor shall be engaged by the Contractor to locate all buildings, paths, roads, utility lines, etc. Contractor shall provide all pegs, flags, pillars and labour required for setting out.

7. EXCAVATION

Excavation fro foundations, footings, trenches, paving, walkways, etc., as called for on the drawings shall be generally made to net widths required by the drawings. "Battering" or "Benching" to the sides of excavation shall have prior

approval of the OOW of Structural Designer. Extra excavations (i.e. excavations beyond the limits required by the drawings), "battering" and "benching" carried out without the prior approval of the OOW will not be measured, and such unauthorized excavations shall be filled up to the proper level with concrete of the same type and mix as for foundations or as ordered by the Architect or Structural Designer at Contractor's own expense.

8. EXCAVATION IN ROCK

All rock excavation shall be carried out with the help of crowbars, chiselling of burning. Blasting shall not be carried out without the written permission of the OOW, roughly level or shelf bottom, as required and avoid shattering or removing rock beyond authorized lines and grades.

9. STACKING OF SOIL

Excavated materials shall be placed at a distance of more than 1.5 meters from the edge of the trench, of half the depth of the trench, whichever is more.

10. WATER IN EXCAVATION

All water, which may accumulate in excavation from all causes, is to be baled, pumped out or otherwise removed. Adequate pumping or other facilities shall be employed to keep all excavation clear of water constantly. Care shall be taken to see that the water is not discharged where it will cause damage to the work or other property or cause inconvenience in the legitimate use of the property. During excavation, the Construction Manager / Contractor shall take particular care to avoid damage to drains, water mains, underground work and services. Should any damage be done, the OOW and Structural Designer are to be notified immediately and the damage made good at the Contractor's expense. Pipes, cables, etc. met with during the excavation are to be properly slung or otherwise supported.

11. NOTIFICATION TO ARCHITECT & STRUCTURAL DESIGNER

The Construction Manager / Contractor shall notify the Architect and the Structural Designer when excavation is ready for inspection and no foundation shall be put in before they have approved the excavation. He shall give the Architect and the Structural Designer at least three working day's notice.

12. PROTECTION

The Construction Manager / Contractor shall protect the excavation from the effect of harmful weather or other damage or make good such damages to the satisfaction of the Architect and Structural Designer.

13. DRESSING

Pit and trench bottoms shall be smoothed and tightly rammed to a uniform surface.

14. FILL MATERIAL

Fill materials required for fill and back fill shall be subject to the approval of the OOW and Structural Designer. Fill materials shall be hard and free from all soft or spongy material. Clods or rocks over 20 cm in greatest dimension shall not be placed within 30 cm of grade. No material over 8 cm in size shall be placed in the upper 15 cm of fill. Fill under floors, terraces and concrete beds shall be free of saltpeter, white ants etc.

15. FILL COMPACTION

The fill shall be spread in layers not exceeding 15 cm thick and each layer shall be watered and thoroughly consolidated with a ten (10) ton roller. At locations where rolling is not possible, the filling shall be carried out in layers not

exceeding 15 cm thick and each layer rammed with heavy hammers till the required level is reached. The fill shall then be flooded with water for at least 24 hours, allowed to dry and then rammed and consolidated again. The finished surfaces shall be formed to correct lines, levels, slopes, shapes etc. as required. Fills at building structures, walk paths etc. shall not be executed until all foundations, footings etc. have been inspected and approved by the Architect & Structural Designer.
Return and fill in around foundations, walls etc. as described above and bring grades up to either original round levels or as required by the drawings when different from original grades.

16. FINISH GRADING

Finish grading shall be done with fertile topsoil over those area notes as 'planting' on the plans. Depths of topsoil shall be 15 cm minimum. The Architect and the Structural designer shall approve the topsoil before placement.

17. REMOVAL

Removal of excavated materials includes the separation of the useful from the useless portion (what is useful and what is useless is left to the sole discretion of the OOW) and depositing the former in regular heaps and removal of the latter. Surplus earth, if any, and useless spoil shall be carted away from the site and disposed as directed at Contractor's cost. Disposal shall be at authorized dumping grounds only.

18. PLANKING, STRUTTING AND SHORING

The Construction Manager / Contractor shall be responsible to adopt such measures as may be needed to uphold the sides of excavation and protect excavation against the sides of public utilities and services and other structures. The rates for excavation shall include use and waste of timber or steelwork, as planking and strutting including walls, struts and open or close poling boards as directed by the OOW or Structural Designer.

19. HARD-CORE

Hard-core (stone soling) under floors and other locations where called for, shall be approved hard broken stones 50 mm and down. The stones shall be hand packed in position, interstices between stones packed with smaller chips and the surface thoroughly, rolled with a 10-ton roller, with frequent watering. The surface shall then be blinded with morrum, watered thoroughly and consolidated with a 10-ton roller to required grade and profiles. Earth shall on no account to be used for making god or blinding purposes. Where rolling as described above is not possible, the consolidation shall be carried out using heavy hand rammers and light manually operated rollers. The consolidated thickness shall be as shown on the drawings.

CONCRETE WORK

1. EXTENT AND INTENT

The Contractor shall provide all labour, materials, operations, equipment and incidentals necessary and required for the completion of all concrete work called for.

2. GENERAL

It is the intent of this specification to ensure that all concrete placed at various locations on the job should be durable and strong. It should wear well and be practically impervious to water. It should be free from such defects as shrinkage, cracking, honeycombing, all plain and reinforced concrete shall conform in all respects to Indian standard 456-2000.

3. MATERIALS

Cement: Ordinary / rapid hardening Ordinary Portland Cement of 43 Grade as per conforming to IS: 8112-1976 or Ordinary Portland Cement of 53 Grade conforming to IS: 12269-1976 shall be used. Cement shall have uniform color. Cement shall be fresh when delivered at site. Consignment shall be used in order or delivery. Admixtures (such as accelerators, retarders, waterproofing compounds, etc.,) shall be as far as possible avoided, where its use is considered unavoidable it may be used only if approved by the Architect and Structural Designer and subject to IS: 456-2000.

Water: Water used for mixing concrete shall be in accordance with clause 4/3 of IS: 456-2000. The Construction Manager / Contractor shall produce Test Results for the mixing of water used on the job, when requested by the OOW or Structural Designer.

Aggregates: Aggregates (fine and coarse) should be had and should not contain materials that are likely to decompose or change in volume when exposed to water or to affect the reinforcement. All aggregates shall be clean and free from organic impurities. The aggregates shall be free from coatings or dust and clay. Coarse aggregate shall be machine crushed hard stone and fine aggregate shall be coarse rover are pit sand, and both obtained from approved source. Aggregates shall be screened and washed by mechanically operated equipment, if the deleterious materials content exceeds 5 percent by volume. All aggregates used shall conform to IS: 383-1979. If the aggregates are wet, due allowance shall be made for bulking in accordance with IS: 2386-1963 (Part III) Unless otherwise specified, the size of coarse aggregates shall conform to clause 4.2 of IS: 456-2000.

All aggregates shall be suitably rated from the maximum certified gauge to the minimum. The construction Manager / Contractor shall submit a sieve analysis of the aggregates to be used on the works and maintain a regular record of sieve analysis during the currency to the work. The grading of the aggregates will be determined from these sieve analyses to produce maximum density of concrete. All expenses of sieve analysis, mix design and trial mixes shall be borne by the Contractor.

4. STORAGE

Cement shall be stored in accordance with clause 5.1 of IS: 269V1967. Any cement, which has become wet, show any sign of caking, or deterioration, of contamination of any kind shall not be used, and shall be immediately removed from the site. Fine and coarse aggregates shall be stored in separate open bins scoring to sizes. The bins shall have brick wall of adequate thickness and floor paved with flat bricks.

5. BATCHING

In the case of ordinary concrete, aggregates shall be measured by volume, cement by weight (density of cement assumed to be 1.44 kg/liter. (A. 50-kg

bag of cement contains 35 liters). Mixing water shall be measured in graduated liter cans.

6. MIX PROPORTIONS

All concrete not specifically designated as controlled concrete shall be treated as ordinary concrete of nominal mix as specified. Where nominal concrete mixes are described as 1:11 / 2:3, 1:2:4, 1:3:6, 1:4:8, etc., the figures denote the relative properties of cement, dry sand and graded stone aggregate respectively. For example, concrete of nominal mix 1:2:4 shall mean a mix of 1 part cement, 2 part of washed dry coarse sand and 4 parts crushed graded stone aggregate, the proportion being volumetric.

The cement shall be measured by weight, and aggregates shall be measured in properly constructed gauge boxes. If sand is wet, necessary allowance shall be made for bulking. The size of aggregates shall be 20 mm and down graded suitably to achieve dense concrete.

All aggregates and cement shall be measured by weights in approved high-batching equipment and water shall be measured in graduated, liter cans.

Grade of Concrete	Minimum Compressive Strength of 15 cm Cubes at 28 days	
	Preliminary (Trial) Cubes	Test Work Test Cubes
M 150	200 kg/cm^2	150 kg/cm^2
M 200	260 kg/cm^2	200 kg/cm^2
M 250	320 kg/cm^2	250 kg/cm^2
M 300	380 kg/cm^2	300 kg/cm^2
M 350	440 kg/cm^2	350 kg/cm^2

7. WATER-CEMENT RATIO

The water-cement ration shall be carefully controlled throughout the work. This calls for a regular check on the equipment used for measuring water. Only guaranteed liter-cans shall be used for this purpose.

In the case of 'ordinary' concrete, the maximum value of water-cement ration shall be 0.50 and in the case of 'controlled' the water-cement ration as determined by the mix design shall be strictly adhered to. While determining the amount of mixing water, moisture content of aggregates shall be taken into account. Additional water if water, moisture content of aggregates shall be taken into account. Additional water if used to improve to workability shall be accompanied by an equal volume of cement. In any case, such additional use of water shall be subject to approval of the Architect and Structural Designer.

8. MIXING

All concrete, whether plain or reinforced, ordinary of controlled, shall be mixed in a standard type box mixer, having minimum drum speed of 60 peripheral meters per minute. The cement and aggregates shall be first mixed dry until all articles of aggregate are coated with cement. Mixing water shall be added and mixing continued for at least two to twelve minutes to from concrete of a uniform color and consistency.

9. TRANSPORTATION

Concrete shall be placed In its final position within 20 minutes of mixing. The Construction Manager shall arrange his mixer position and a method of transportation to ensure that this period is not exceeded under any circumstance. Transportation should be smooth and free from jolting, so that there is no segregation or loss of any of the ingredients.

10. PLACING CONCRETE

The forms shall be well wetted before placing concrete. Concrete should not be dropped from a height greater than 1 meter. Properly constructed chute shall be used in such cases where it is necessary to exceed this height. Concrete must be thoroughly worked into the forms so that they are entirely filled; reinforcing bars adequately and tightly surrounded and entrained air released from the mass of concrete. Placing shall be carried out by hand punning as well as vibrators in the manner directed by Architect or Structural Designer. Concrete should not be moved any considerable distance in the moulds, being consolidated as nearly as possible in the place where it is dumped. The full depth of any lift shall be replaced at one pouring. In casting beams or other deep sections, concrete shall not be placed in layers.

11. CONSOLIDATION

All plain and reinforced concrete shall be consolidated by means of mechanical vibration. Adequate number of vibrators shall be used to ensure full compaction of concrete in about 10 minutes of placing. If immersion vibrators are used, these shall be inserted at places not exceeding half meter apart until it is immersed to the full depth of concrete. Wherever possible shutter vibrators shall be used and the construction Manager shall design his shuttering so that this can withstand form vibration. Care shall be taken to ensure that concrete is not over-vibrated to avoid segregation. In addition to mechanical vibration, sufficient hand tools must be used to ensure full consolidation around reinforcement and at all edges and corners.

12. TESTING

Testing of Cube: Specimens of the concrete used in the work shall be taken at intervals for crushing strength and density measurements. Test cubes shall be made and tested strictly in accordance with IS: 456-2000 and IS: 516-1964. Three to six cubes should be made for each sampling, subject to minimum requirements specified in Table V of IS: 456-2000. However, cubes shall be taken for all important structural members as directed by the OOW of Structural Designer regardless of the quantity of concrete involved in such members of volume of concrete laid on any particular day. They should be taken out of the moulds 24 hours after casting and stored in a most condition until the time of test. The Construction Manager shall carry out the tests as described above under the direction of Architect / Structural Designer and all expenses of cubes, testing and other incidentals shall be borne by the Contractor.

All concrete the test results of which fall below the "Acceptance Criteria for Concrete" listed under table V of IS: 456-2000 shall be classified as substandard concrete. All such substandard concrete shall be removed and replaced with concrete of specified strength at the Contractor's own cost and risk.

13. INSERTS

The Construction Manager shall fix all necessary inserts such as steel plates, pipe sleeves, bolts, etc., and make provision for holes, pockets, dowels, etc., in the shuttering of concrete work, to enable subsequent fixing of supports, brackets, ceilings, pro-cast members, etc., as indicated on the drawing or as required by the Architect of Structural Designer.

14. CURING OF CONCRETE

All exposed faces of concrete shall be covered with Hessian, sand or similar material, which shall be kept continuously, wet for a period of at least 15 days after costing. Horizontal surfaces shall be cured with the help of cement mortar bunds filled with water. After removal of Hessian or sand all concrete surface shall be kept well wetted by applying water at intervals for a further period of at least three weeks.

15. REINFORCEMENT

Steel Reinforcement shall be either mild steel quality conforming to Grade I of IS: 432-1966 or High yield Strength Deformed Bars with a guaranteed minimum yield strength of 4250 kg or 5000 kg per m^2 as called for on the drawings, conforming to IS: 1786-1966 or IS: 1139-1966. Fabric reinforcement where called for in topping slab or precise concrete units shall be of hard drawn mild steel mesh conforming to IS: 1566-1967. The make of the reinforcement will be from the. Manufacturers listed herewith (1) Malhotra, (2) TATA, (3) Sirhind, (4) SAIL, (5) Vizag. Bars shall be free from mill scale, loose rust, oil or paint. The reinforcement bar-ending schedule shall be prepared by the Construction Manager and submitted to the Structural Designer for his scrutiny and his concurrence obtained before commencing minimum cover as shown on structural drawings. Steel shall be rigidly held in place with the help of 18 gauge annealed steel wire. Cement mortar (1:2) cover blocks of required shape, MS chairs and spacers bars shall be used in order to ensure accurate positioning of reinforcement. All joints in mild steel reinforcement unto and including 16-mm diameter shall be overlapped. The lengths of overlap for tension and compression joints shall be as indicated on structural drawings. Joints in mild steel reinforcement above 16-mm diameter may be welded if permitted by the Architect or Structural Designer in writing.

16. COVER TO REINFORCEMENT

Care shall be taken to maintain the correct cover to reinforcement. Unless otherwise specified on the drawings, the following minimum cover (exclusive of rendering or other decorative finish) shall be provided in all reinforce concrete work.

a. At each end of a reinforcing bar not less than 25 mm nor less than twice the diameter of bar.
b. For longitudinal reinforcing bar in a beam neither less than 25 mm nor less than the diameter of bar.
c. For longitudinal reinforcing bar in a column not less than 40 mm in the case of columns less than 250 mm thick, minimum cover shall be 25 mm.
d. For tensile, compressive shear reinforcement in a slab not less than 13 mm nor less than the diameter of bar.
e. For Vertical or horizontal reinforcement in concrete walls not less than 25 mm nor less than diameters of bar.
f. For main or subsidiary reinforcement in concrete footings and pile caps not less than 50 mm.
g. The minimum cover for any reinforcement steel including stirrups and ties wires shall not be less than 13 mm under any circumstances.

For concrete members exposed to the atmospheric action or harmful chemicals (as in the case of concrete in contact with earth faces with such chemicals), acid vapor, saline atmosphere, sulfurous smoke, etc., covers given above shall be increased by 15 mm to 40 mm as directed by the Architect of Structural Designer. For concrete members of water retaining structures, covers for reinforcement hall be as stipulated in IS: 3370-(part II) - 1965.

17. FORMWORK

Formwork shall be rightly constructed of minimum 40 mm thick wrought, timer planking or steel plates or plywood. Timber used for shuttering shall be free from loose knots. Shuttering faces in contact with concrete shall be free from adhering grout, Projecting nails, splits or other defects that may mar the concrete surface. The shuttering shall be erected on battens, beams and steel props properly cross braced so as to make the form work rigid. Formwork shall be erected to line and levels and to the shapes required in the work and shall carry, without deformation, the full weight of wet concrete and other live loads. It should also withstand the effect of vibration without deflection, bulging,

distortion or loosening of its component parts. The Construction Manager shall be responsible for sufficiency and adequacy of all formwork, centering and moulds.

Details of centering and formwork shall be subject to approval of the Architect or Structural Designer. The completed formwork shall also be subject to approval by the Architect or Structural Designer before placement of reinforcement. The formwork shall be designed so that the soffits of slabs and the sides of beams may be removed first leaving the formwork to the soffits of beams and their supports in position. Wedges shall be, so provided as to allow accurate adjustment of form works and its easy removal.

All joints shall be sufficiently tight to prevent leakage of grout. Chamfer fillets shall be provided at all corners wherever called for on the drawings. Clean-out holes shall be provided at the bottom of all column and pier formwork and care shall be taken to remove any rubbish, wood shavings or any other foreign materials before concreting. Temporary supports shall be provided as required and / or ordered by Architect of Structural Designer.
Form work for water tanks, basements and other locations and facias, parapets and other similar vertical members shall be held tightly by means of firm ties of suitable length. The ties shall be approved design and type and have a minimum strength of 1500 kg. The ties shall be free of lugs, cones, washes, etc., which level a hole larger than 20 mm diameter or depressions back of exposed surface of concrete.

18. SPECIAL CONCRETE FORMWORK

Special Formwork for concrete work wherever called for shall be as per the detail design, made of hard wood timer planks, free from loose knots, of suitable thickness, and carved to the necessary shape. The planks shall be 40 mm thick, 100 mm to 125 mm wide with tongue and groove joints, assembled to pattern approved by the Architect of Structural Designer. The formwork shall be so constructed, braced and stayed as a to remain absolutely rigid and true during and after pouring. The boards shall be planned of suitable thickness in order that the surface against the concrete shall not be broken at joints between boards, and the boards shall not deform. Chamfers grooves, drips, moldings, beveled edges, etc., shall be made in the form itself to the size, profiles and details called for on the drawings.
The Construction Manager shall provided shuttering quality plywood of approved make (Anchor shuttering plywood or equivalent approved by the Architect or Structural Designer) of suitable thickness in place of timer plank shuttering mentioned above for such locations as called for by the Architect / Structural Designer. The joints in the plywood shuttering shall be located as directed by the Architect / Structural Designer. The plywood shall be properly cut and adequately framed with timber to produce true surfaces and approved pattern.

19. SURFACE TREATMENT OF SHUTTERING

The Surface of shuttering exposed to concrete shall be coated with shuttering oil of approved manufacture. Shuttering oil shall be applied before placing reinforcement. The shuttering shall be thoroughly cleaned and oiled before each use.

20. REMOVAL OF FORMWORK

All form shall be kept in position until expiry of a minimum
Period after concreting as specified below:-

I.	Forms supporting sides of beams, walls and columns	2 days
ii.	Bottom of slab up to 4.50m span	7 days

iii.	Bottom of slabs above 4.50m span	14 days
iv.	Bottom of beam up to 6.00m span	14 days
v.	Bottom of beam above 6.00m span	21 days

21. SURFACE FINISH OF CONCRETE

All formwork, centering and shuttering used for unexposed concrete work shall be rigid and straight, so as to produce all concrete members true to line level and plumb within a tolerance of + 3 mm. Only cement mortar rendering of maximum thickness 6 mm may be permitted as finishing to concrete surfaces except where terrazzo., ceramic tile or other finish are specified. All concrete surfaces scheduled to receive either plaster or similar finish shall be chipped as required if so directed by the Architect / Structural Designer. Shuttering, centering and formwork to be used for all exposed concrete work (like exposed columns, beams, ribs, slabs chhajjas, facias, etc.) shall be of such finish and rigidity as to produce all faces fair and smooth true to line, level and plumb. No. rendering or touching up shall be permitted on these faces.

22. DEFECTS IN CONCRETE

Immediately on removal of formwork, the Construction Manager shall examine the surface of concrete, and any honeycombs or other defects shall be brought to the notice of the Architect and Structural Designer. The acceptability or otherwise of such defective concrete shall be at the sole discretion of the OOW who may direct the Construction Manager / Contractor to repair the defective work of ask for demolition and replacement of such defective work at the risk, and cost of the Contractor.

23. PROTECTION OF CONCRETE

All concrete shall be protected from damage by workers, equipment, overload or any other cause for a minimum period of 20 days from the date of casting.
All edges corners and projections of concrete members likely to be damaged shall be protected by means of wooden cover fillets.

24. ENGINEER

It is essential that the engineer who is in charge of the construction of all concrete work, whether plain or reinforced shall be well experienced in this class of work and shall work in relation to the permanent bench marks established at the site.

BRICK WORK

1. EXTENT AND INTENT

The Contractor shall provide all labour, materials, operations, equipment and incidentals necessary and required for the completion of all brickwork called for.

2. GENERAL

Bricks and tiles shall be of selected quality, thoroughly burnt without being vitrified, of uniform deep red or copper color, regular in shape and size and shall have sharp and square sides and edges and parallel faces to ensure uniformity in the thickness of the courses of brickwork. They shall be free from cracks, chips, flaws, stones or lumps of any kind.

3. BRICKS

Bricks shall be locally available first class bricks. Bricks shall be of size 9" x 41/2" X 23/4" (22.9 cm x 11.1 cm x 7.0 cm) unless otherwise specified. In all masonry work bricks of class designation 35 are to be used.

4. SAMPLES

Samples of each type of brick and tiles taken at random from the load shall be deposited with the Architect / Structural Designer for his approval before being used in the work. All subsequent deliveries shall be up to the standard of the sample approved.

5. SOAKING OF BRICKS AND TILES

All bricks and tiles shall be thoroughly soaked before use, in specially prepared vats, tubs or tanks for not less than two hours and until air bubbles stop being given off. After soaking, bricks and tiles shall be kept on wooden planks or brick platforms to avoid earth being smeared on them.

6. MORTAR

Mortar for all brickwork shall consist of cement and clean, sharp coarse sand.

7. CEMENT

Portland cement conforming to IS: 269-1967 shall be used, unless otherwise specified. Cement shall be fresh when delivered at site.

8. SAND

Sand shall be clean, not too fine nor too coarse and shall fall within the grading zone I to IV given in table III of IS: 383-1963.

9. WATER

Water used for mixing mortar shall be in accordance with clause 4.3 of IS: 456-2000.

10. MIX PROPORTION

The mortar shall consist of one part cement and 6 parts sand for brickwork and tile work 240 mm thick and above. For brick piers, half brick walls and honey combed brickwork the mortar mix shall consist of one part cement and four parts sand.

11. MORTAR MIXING

Mixing of mortar shall be done in mechanical mixer. Hand mixing shall be resorted to only when specifically permitted by the Architect / Structural Designer. Cement and sand shall be mixed dry thoroughly and then water shall be added gradually. Wet mixing shall be continued till mortar of the consistency of a stiff paste and uniform color is obtained. Only the quantity of mortar which can be used up within 30 minutes of its mixing shall be prepared at a time.

12. LAYING BRICKWORK

All brickwork shall be built in English bond with frog upwards. Each brick shall be set with bed and vertical joints filled thoroughly with mortar. Selected bricks shall be used for the face work. The walls shall be taken up to truly plump. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. Vertical joints in alternate course shall come directly over the other. The thickness of brick courses shall be kept uniform and for this purpose wooden straight edge with graduation giving thickness of each brick course including joint shall be used. Necessary tools comprising of wooden straight edge, mason's spirit level, square, foot rule, plumb line and pins etc. shall be frequently and fully used by he masons to ensure that the walls are taken up true to plumb, line and levels.

Both the faces of walls of thickness greater than 23 cm shall be kept in proper plane. All the connected brickwork shall be carried up nearly at one level and no portion of the work shall be raised more than one meter above the rest of the work. Any dislodged brick shall be removed and reset in fresh mortar. Before commencing the brickwork, the Construction Manager shall confer with other tradesmen / agencies to ensure that all pipes, conduit, drains, sleeves, bolts hanger, or any other materials necessary to be installed in the brickwork at the time it is built, have been fixed or provided for.

13. JOINTS

Bricks shall be so laid that all joints are full of mortar. The thickness of joints shall not be more than 10 mm. The face joints shall be raked to a minimum depth of 12 mm by a raking tool during the progress of the work when the mortar is still green, so as to provide proper key for the plaster or pointing to be done. Where plastering or pointing is not to be done, the face of brickwork shall be cleaned duly and mortar droppings removed.

14. REINFORCED BRICKWORK

All brickwork under 23 cm thick shall be reinforced with hoop iron (16 gauge, 25 mm wide) at every fourth course. The hoop iron cleaned of rust and loose flakes with brush shall be embedded thoroughly in cement mortar at every fourth course. It shall be cast in or securely fixed to adjoining columns or walls.

15. CURING

All fresh brickwork shall be protected from the effects of sun, rain, etc., by suitable covering. All brickwork shall be kept constantly mist on all the face for at least ten days.

16. SCAFFOLDING

Unless otherwise instructed by the Architect / Structural Designer, double scaffolding having two sets of vertical supports shall be provided for all building work. The supports shall be sound, strong and tied together with horizontal pieces over which the scaffolding planks shall be fixed.

The Construction manager shall be responsible for providing and maintaining sufficiently strong scaffolding so as to withstand all loads likely to come upon it.

17. OPENINGS

Openings in brickwork for air-conditioning ducts, grills, pipes etc. shall be provided at the time of laying brickwork.

18. CAULKING

After installation of piping, conduits, grilles etc. all openings left around pipes, conduits, grilles etc. shall be checked and caulked with cement mortar to render the whole work vermin proof and tidily finished.

19. TESTING

comprehensive strength, water absorption test an dimension test has to be carried out as per the relevant I.S. specifications for purchase of every one lakh bricks or part thereof, at the cost of Contractor from the Government approved laboratory as directed by the Architect / Structural Designer.

PAVING & FLOOR FINISHING

1. GENERAL

The Contractor shall furnish all labour, materials, operations including fixing devices, equipment and incidentals necessary and required for the completion of all flooring and paving work. The Contractor shall pave the areas indicated on the plans and Schedule of finishes with materials therein called for. All flooring shall be laid to the best practice known to the trade. The flooring shall be laid to the level except where slopes are called for on the drawings, in which case the slopes shall be uniform and arranged to drain into the indicated outlets. Particular care shall be exercised to ensure that all flooring, skirting and dados are perfectly matched for color and finish.

2. SAMPLES

The Construction manager / Contractor shall furnish for approval by Architect samples of each type of floor and dodo finish.

3. DRESSING OF SLABS

Every slab to be cut to the required size and shape and fine chisel dressed on the sides to the full depth. The sides shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the tiles shall be true, square and free from chipping and the surface shall be true and plane.

4. LAYING

Cement mortar 1:6 (1 Cement : 6 Coarse sand) shall be spread under the area of each slab to 20 mm depth. Washed clean slab shall be laid on top, pressed, tapped with wooden mallets and brought to level with adjoining slabs. It shall then be lifted and laid aside. The top surface of the mortar shall then be corrected be adding fresh mortar at hollows. The mortar is allowed to harden a bit and a coat of cement slurry shall be spread over at the rate of 1 bag of cement per $10m^2$ of area, the slab shall then be with as fine a joint as possible. Subsequent slabs are laid in similar manner. After each slab is laid, surplus cement on the surface shall be cleaned off. The flooring shall be cured for a minimum period of seven days.

5. POLISHING AND FINISHING

Slight unevenness at the meeting edges of slabs shall then be removed by fine chiseling in a slant. The surface shall then be polished and fished in the same manner as specified for "Terrazzo-in-situ floor".

6. JOINTS

The joints shall be uniform and as thin as possible and run in straight lines or to suit the required pattern.

Tiles that are fixed in the floor adjoining the wall shall enter not less than 13 rnm under the plaster skirting or dado. The junction between wall plaster and tile work shall be finished neatly and without weavings. After the tiles have been laid surplus' cement grout that may have come out of the joints shall be cleaned off.

7. CURING, POLISHING AND FINISHING

33. The day after the tiles are laid all joints shall be cleaned with wire brush to the depth of 5 mm and all dust and loose mortar removed. Joints shall then be grouted with gray or white cement, mixed with or without pigment to match the shade of the topping of the wearing layer of the tiles. Pigment shall conform to IS 459.

The floor shall then be Kept wet of minimum period of 7 days. The surface shall thereafter be ground evenly to he satisfaction of OOW with machine grinders in 3 phase with grade stones from coarse to fine grade. The surface shall receive wash of neat cement mixed with or without pigment and cured before very grinding operation.

8. STONE SLAB FLOORING

Stone slabs for flooring, paving treads and risers or steps etc. shall be of selected quality, hard, sound, dense and homogeneous in texture, free from cracks, decay, weathering and flaws. They shall be from an approved quarry and shall be of the finish and color as approved by the Architect. The intent is to use local stone, Kotah stone, Katni stone, Jaisalmer stone, Mandana stone, Marble, Dholpur stone. Granite stone etc. individual and / or in combination.

SPECIAL FLOORING SPECIFICATIONS

A-1 40 mm thick marble chips flooring rubbed and polished (i.e. Terrazzo) to granolithic finishing with under layer 30 mm thick cement concrete (1:2:4) (1 Cement: 2 Coarse sand: 4 Graded Stone aggregate 10 mm and down gauge) and top layer, 10 mm thick with white, black and black marble chips of required sized from 1 mm to 4 mm nominal size laid In cement marble power mix 3:1 (3 Cement : 1 Marble Powder by weight in proportion 4:7 (4 Cement marble powder mix, 7 Marble Chips by Volume) : Dark shade pigment with ordinary cement (in top layer only).

MATERIALS

Water shall conform to S-1. Cement shall conform to S-3. Sand shall conform to S-6. Stone grit shall conform to S-8.
The pigment incorporated in terrazzo shall be of permanent color and shall conform to requirement mentioned in Appendix - A in I.S. 2114-1962. Marble chips shall conform to S-46. The marble powder shall pass through I.S. Sieve Terrazzo-30.

WORKMANSHIP

Terrazzo finish shall be laid over a layer of base concrete in case of ground floor. When the terrazzo floor is laid over R.C.C. slabs a Cushing layer consisting of 75 mm thick lime concrete shall be provided below the terrazzo floor. The terrazzo flooring shall consist of and under layer of cement concrete and layer of terrazzo which shall be laid monolithically.

UNDERLAYER

The under layer shall be of cement concrete mix 1:2:4 The Maximum size of aggregate used shall not exceed 10 mm Specification for cement concrete shall be followed as per item no. 5.4.1.

TERRAZZO TOPPING

The topping shall have mix of ordinary cement and marble powder in proportion (3:1) (3 Cement: 1 marble powder: 7 Marble powder by weight) and marble aggregate shall be and cushioning layer shall not be less than 10 cm and 7.5 cm respectively. The minimum thickness of under layer and topping shall be 40 mm.

PANELS

The floor, both while laying the under layer and topping shall be divided into panels not exceeding 2 m^2 in area so as to reduce the risk of cracking due to differential shrinkage or expansion of terrazzo and sub-floor. The joints shall be so located that the layer dimensions of any panel do not exceed 2 M. The panels shall preferable be separated by means of dividing strips. However where the butt joints are provided, the bays shall be laid alternatively allowing for an interval of at least 24 hours between the laying of adjacent bays.

MIXING MATERIALS

With a view to avoid variation in color, mixing shall be done in through or tub, and the completed quantities of cement and pigment required for one unit shall be mixed at the beginning of the work. Color cement and pigment mix shall be dry mixed with marble

powder. The mix thus obtained shall be mixed with aggregate. Care shall be taken not to get the materials into a head and this would result in coarser aggregates moving on the sides and cement to the center. To the dry mix thus prepared, water shall be added in small quantities while materials are being worked to get a mix of proper consistency. The mixture shall be plastic but not so wet to flow. The mix shall be used within half an hour of mix of addition of water during preparation laying.

LAYING

The base shall be divided in to panels with the help of dividing strips including the strips required for decorative design up to the finished surface level of the floor. Screed strips shall be used where the dividing strips are not used. The base shall be cleaned of all dust, dirt maintenance and any loose materials. It shall be then wetted with water mopped and smeared with cement slurry at 2.75 kg/m^2 Under layer shall be then spread and leveled with a screeding board. The top surface shall be left rough to provide a good bound to the terrazzo.

The terrazzo topping shall be laid while the under layer is still plastic but has hardened enough to prevent cement from rising to the surface. This is normally achieved between 18 to 24 hours after laying of under layer. Cement slurry preferably of the same color as the topping shall be brushed on the surface immediately before laying the topping. The terrazzo mix shall be laid to a uniform thickness on the screed bed and be completed thoroughly b taping or rolling and trowelled smooth. Excessive trowlling or rolling in early stages shall be avoided as it results in working up cement to the surface which will produce a surface liable to cracking and will require more grinding to exposed marble chip. The terrazzo surface shall be lamped trowelled, and brought one to required level by a straight edge and steel floats in such a manner that the maximum amount of marble chips come up and are spread uniform over the surface and no part of the surface is left without chips.

CURING

The surface shall be left dry for air curing for a period of 12 to 18 hours. Thereafter, water shall be allowed to stand overnight in pools for a period of a minimum of four days. The floor shall be prevented from being subjected to extreme temperature.

GRINDING AND FINISHING

Grinding and finishing shall be done either by hand or by machine. In case of manual grinding, the process of grinding shall being after two days, while in case of machine grinding, the process shall be started after seven days after completion of laying.

First grinding shall be done by carborundum stones of 60 grit size. The surface shall then be washed clean and grouted with a grout of cement and / of coloring matter in the same mix and proportion as the topping in order to fill any pin holes that appear. It shall be allowed to dry for 24 hours and wet cured for four days in the same manner as mentioned in curing para above.

The second grinding shall be done with carborundum stone of 80 grit size. The surface shall then be prepared as after first grinding. The third grinding shall be done with carborundum stone of 120 to 150 grit size. The surface shall then be washed again and allowed to dry for 12 hours, and wet cured four days as before. The fourth grinding shall be done with carborundum stone of 320 to 400 grit size. The surface shall again be washed clean rubbed hard with relt and slightly moistened Oxalic Acid Power @ 5 gm per sq. m. floor surface. After the finishing work is over, the surface shall be washed with dilute oxalic acid solution and dried for floor polishing, machine fitted with felt or Hessian bobs shall then be run over it until floor shines. In case wax polished surface is required, was-polished shall be applied on the surface with the help of soft linen over a lean and dry surface. The polishing machine fined with bobs shall be run over it, clean saw dust shall be spread over the floor surface and polishing machine

again operated which will removed excess wax and leave glossy surface. Floor shall not be left slippery.

A-2 40 mm thick marble chips, flooring rubbed and polished (i.e. Terrazzo) to, granolithic finish will under layer 30 mm thick cement concrete 1:2:4 (1 Cement: 2 Coarse Sand: 4 Graded Stone aggregate 10 man and down gauge) and top layer 10 mm thick with white, black or white and black marble chips of required sized from 1 mm to 4 mm nominal size laid In cement marble powder mix 3:1 (3 Cement: 1 Marble chips by volume): light shade pigment with white cement (in top layer only.)

MATERIALS & WORKMANSHIP
The relevant specification of item (A) shall be followed, except light shade pigment with white cement shall be used in top layer.

A-3 40 mm thick marble chips, flooring rubbed and polished (i.e. Terrozzo) to granolithic finish with under layer 30 mm thick cement concrete 1:2:4 (1 Cement: 2 Coarse sand: 4 Graded Stone aggregate 10 mm and down gauge) and top layer 10 mm thick with, black or white and black marble chips of required size from 1 mm to 4 mm nominal size laid In cement marble powder mix 3:1 (3 Cement: 1 Marble powder mix by weight) in proportion 4:7 (4 Cement: Marble powder: 7 Marble chips by volume). Medium shade pigment with approx. 50 % white cement and 50 % ordinary cement (in top layer only).

MATERIALS & WORKMANSHIP
The relevant specifications of item A-1 shall be followed, except that medium shade pigment with approximately 50 % ordinary cement in top layer only shall be used.

A-4 40 mm, thick marble chips, flooring rubbed and polished (I.e. Terrazzo) to granolithic finish with under layer 30 mm thick cement concrete 1:2:4 (1 Cement: 2 Coarse Sand: 4 Graded Stone aggregate 10 mm and down gauge) required size from 1 mm to 4 mm nominal size laid In cement marble powder mix 3:1 (3 Cement: 1 Marble powder mix by weight) In proportion 4:7 (4 Cement: Marble powder: 7 Marble chips by volume). Medium shade pigment with approx. 50 % white cement and 50 % ordinary cement (in top layer only).

MATERIALS & WORKMANSHIP
The relevant specifications of item No. 14.2 (2) shall be followed, except that white cement without any pigment in top layer shall be used.

A-4 40 mm, thick marble chips, flooring rubbed and polished (i.e. Terrazzo) to granolithic finish with under layer 30 mm thick cement concrete 1:2:4 (1 Cement: 2 Coarse Sand: 4 Graded Stone aggregate 10 mm and down gauge) required size from 1 mm to 4 mm .nominal size laid In cement marble powder mix 3:1 (3 Cement: 1 Marble powder mix by weight) in proportion 4:7 (4 Cement: Marble powder: 7 Marble chips by volume). Medium shade pigment with approx. 50 % white cement and 50 % ordinary cement (In top layer only).

MATERIALS & WORKMANSHIP
The relevant specification of item A-1 shall be followed, except that the light shade pigment with white cement (in top layer only) shall be used.

B-1 Marble chips skirting (terrazzo) of dado rubbed and polished to granolithic finish top layer 6 mm thick with white and black or white and black marble chips of sizes from smallest to 4 mm nominal size laid in cement marble powder mix 3:1 (3 cement: 1 marble powder by weight) In proportion of 4:7 (4 cement: 7 marble chips by volume) 20 mm thick with under layer 14 mm thick In cement plaster 1:3 (1 cement: 3 coarse sand) : Dark shade pigment with ordinary cement (in top layer only)

MATERIAL
The relevant specification of Item No. A-1 shall be followed.

WORKMANSHIP
The under layer for terrazzo on vertical surfaces like skirting and dados shall be of stiff cement mortar 1:3 (1 cement: 3 coarse sand) finished rough so as to give a good bond to the topping.

Terrazzo topping shall not be less than 6 mm thick and the combined thickness of under layer and topping shall be not less than 20 mm the other details shall be followed same as per specification of Item No. C24 except that light shade pigment with white cement in top layers shall be used.

B-2 Marble chips skirting (terrazzo) of dado rubbed and polished to granolithic finish top layer 6 mm thick with white and black or white and black marble chips of sizes from smallest to 4 mm nominal size laid in cement marble powder mix 3:1 (3 cement: 1 marble powder by weight) in proportion of 4:7 (4 cement: 7 marble chips by volume) 20 mm thick with under layer 14 mm thick in cement plaster 1:3 (1 cement: 3 coarse sand) : medium shade pigment with approximate 50 % white cement and 50 % ordinary cement (in top layer only)

MATERIALS & WORKMANSHIP
The relevant specification of Item No. 14.4 (a) shall be followed, except that the light shade pigment with white cement in top layer only shall be used.

B-3 Marble chips skirting (terrazzo) of dado rubbed and polished to granolithic finish top layer 6 mm thick with white and black or white and black marble chips of sizes from smallest to 4 mm nominal size laid in cement marble powder mix 3:1 (3 cement: 1 marble powder by weight) in proportion of 4:7 (4 cement: 7 marble chips by volume) 20 mm thick with under layer 14 mm thick In cement plaster 1:3 (1 cement: 3 coarse sand) : medium shade pigment with approximate 50 % cement plaster 1:3 (1 cement: 3 coarse sand) : Medium shade pigment with approximate 50 % white cement and 50 % ordinary cement (In top layer only)

B-4 Marble chips skirting (terrazzo) of dado rubbed and polished to granolithic finish top layer 6 mm thick with white and black or white and black marble chips of sizes from smallest to 4 mm nominal size laid In cement marble powder mix 3:1 (3 cement: 1 marble powder by weight) in proportion of 4:7 (4 cement: 7 marble chips by volume) 20 mm thick with under layer 14 mm thick in cement plaster 1:3 (1 cement: 3 coarse sand) : medium shade pigment with approximate 50 % white cement and 50 % ordinary cement (In top layer only)

MATERIALS & WORKMANSHIP
The relevant specification of Items No. B-1 shall be followed, except that the light shade pigment with white cement in top layer only shall be used.

B-5 Marble chips skirting (terrazzo) of dado rubbed and polished to granolithic finish top layer 6 mm thick with white and black or white and black marble

chips of sizes from smallest to 4 mm nominal size laid in cement marble powder mix 3:1 (3 cement: 1 marble powder by weight) in proportion of 4:7 (4 cement: 7 marble chips by volume} 20 mm thick with under layer 14 mm thick in cement plaster 1:3 (1 cement: 3 coarse sand): light shade pigment with ordinary cement (in top layer only)

MATERIALS & WORKMANSHIP

The relevant specification of Items No. B-1 shall be followed, except that the light shade pigment with ordinary cement in top layer only shall be used.

C-1 Providing and lying cushioning layer on R.C.C. slab consisting of 75 mm thick lime concrete using brick aggregate of 20 mm nominal size 50 % mortar comprising of 1 lime: 2 fine sand.

MATERIALS

Water shall conform to S-1 lime mortar of proportion 1:2 shall conform to S-10 Brick aggregate 20 mm nominal size shall conform to S-14.

WORKMANSHIP

The relevant specifications of item No. 4.18 shall be followed except that the proportion of mix shall be 50 % mortar comprising of 1 lime: 2 coarse sand and the size of brick aggregate shall be 20 mm nominal size. The lime concrete work shall be carried out in 7.5 cm average thickness as a cushioning layer on R.C.C. slab.

D-1 Precast terrazzo (Mosaic) tiles 20 mm thick with white, black or white and black marble chips of sizes up to 6 mm laid in floors of steps and landings on a bed of 25 mm average thickness of lime mortar 1:1.5 (1 lime putty: 1.5 fine sand) or C.M. 1:6 jointed with neat cement slurry mixed with pigment to match the shade of the tiles Including rubbing and polishing complete with precast tiles of: Light shade, using white cement.

MATERIALS

Water shall conform to S-1. Cement shall conform to S-3. Lime Mortar shall conform to S-10. Cement Mortar shall conform to S-11. The precast terrazzo tiles of 20 mm thick shall be of light shade using white cement, and conform to S-47.

WORKMANSHIP

The work shall be carried out as per I.S. 1443-1972.

BEDDING

Before spreading the mortar, the sub-base of the floor shall be cleaned of all dit, scum and loose materials and then well wetted without forming any pools of water on the surface.

In case of R.C.C. floors, the top shall be left a little rough, all points of level for the finished surface shall be marked out. The lime mortar of proportion 1: 1.5 (lime putty: 1.5 fine sand) or cement mortar of proportion C.M. 1:6 as directed shall be then evenly and smoothly spread over the base. Bedding layer of mortar shall be not less than 10 mm and average thickness of bedding shall be 25 mm.

LAYING

Before laying the terrazzo (Marble/Mosaic) tiles, the tiles shall be thoroughly wetted with water. Neat cement group of required consistency at 4.4 kg cement/m^2 shall be spread on the mortar bed. The tiles shall be laid on the neat cement float and shall be evenly and family bedded to required level and slope. There shall be no hollows left. The joints shall be of uniform thickness and in straight line as per the pattern.

The surface of flooring shall be checked frequently with straight edge at-least two meters long so as to obtain a true surface with required slope.

The tiles that are fixed in the floor adjoining the wall shall go about 10 mm under plaster. Skirting or dado shall be left unfinished for about 50 mm above finished floor level and unfinished strip them left earlier shall be finished.
In place where full tiles cannot be fixed, the tiles shall be cut to the size and smoothened at edges to give straight and true joints.
After the tiles have been laid, the surplus cement slurry and the joints shall be cleaned and washed fairly deep before cement hardens.
The day after tiles have been laid, the joints shall be cleaned of gray cement grout with a wire brush to a depth of about 5 mm and then grouted with white cement with or without pigment to match the shade of the topping of tiles. The same cement slurry shall than be soread over the whole surface in a thin coat to protect the surface from abrasive damage and to fill pinholes that may exist on the surface.

CURING
The flooring shall be kept wet with damp sand or water for seven days. It shall be kept undisturbed at least for 14 days. The grinding shall normally be commenced after 14 days.

POLISHING
After the tiles are properly cured, first grinding shall be done with carborundum stone of 48 to 60 grade grit fitted in machine, Water shall be properly used during grinding. When the chips show up and the floor has been uniformly rubbed, it shall be cleaned with water, baring all pinholes. It shall be covered with a thin coat of white cement mixed with or without pigments to match the color of the topping of the tiles. Pinholes if any shall thus be filled. This grout shall be kept moist for a week. Thereafter second grinding shall be started with corborandum of 120 grit. Grouting and curing shall follow again. Final grinding shall be done when other works are finished. The machine shall be fitted with coroundum of grit 220 to 350 using water in abundance. The floor shall then be washed clean with water. Oxalic acid powder shall than be dusted at 33 grams per square meter on the surface and the surface rubbed with machine fitted with Hessian bobs or rubbed with pad of woolen rags. The floor shall then be washed clean and dried with a soft cloth or linen. The finished floor shall not sound hollow when tapped with a mallet. .
If any tile is disturbed for damaged it shall be refitted or replaced properly jointed and polished.
Testing of the tiles shall be carried out by the contractor at his worn cost as per L.S. requirement for required tests.

D-2 Precast Terrazzo (Marble / Mosaic) tiles 20 mm thick with white black or white and black marble chips of sizes up to 6 mm laid In floors, treads of steps and landings on a bed of 25 mm average thickness of lime mortar 1 :1.5 (1 lime putty: 1.5 fine sand) or C.M. 1:6 jointed with neat cement slurry mixed with pigment to match the shade of the tiles, Including rubbing and polishing complete with precast tiles of medium shades using approximately 50 % white cement and 50 % ordinary cement.

MATERIALS & WORKMANSHIP
The relevant specification of item No. D-1 shall be followed except that the precast terrazzo (Marble/Mosaic) tiles shall be medium shade using approximately 50 % white cement and 50 % ordinary cement.
D-3 Precast Terrazzo Marble Mosaic tiles 20 mm thick with white black or white and black marble chips of sizes up to 6 mm laid In floors, treads of steps and landings on a bed of 25 mm average thickness of lime mortar 1:1.5 (1 lime putty: 1.5 fine sand) Of C.M. 1:6 jointed with neat cement slurry mixed with pigment to match the shade of the tiles, Including rubbing and polishing complete with precast tiles of dark shades using ordinary cement.

MATERIALS & WORKMANSHIP
The relevant specifications of Item No. D-1 shall be followed except that precast tiles shall be of Dark shade using ordinary Portland cement.

E-1 Precast terrazzo (Marble / Mosaic) tiles 20mm thick with marble chips of size up to 6mm in skirting and rises of steps not exceeding 30cm in height on 10mm thick plaster 1:8 (1 cement: 8 coarse sand) jointed with neat cement slurry including rubbing and polishing complete with tiles of light shades using white cement.

MATERIALS
Water shall conform to S-1 Cement Mortar shall conform to S-11. The precast terrazzo (Marble / Mosaic) tiles of light shades using white cement tiles 20mm thick shall conform to S-47.

WORKMANSHIP
The work shall be carried out for skirting as dedo. Before fixing precast terrazzo (Mosaic marble) tiles of shade and size as specified, the surface shall be prepared by heavy scraping, making joints etc. to the required line, level and plumb. The surface shall be thoroughly wetted before commencing the laying work. Thereafter about 10mm thick backing of cement mortar in specified proportion shall be applied on the surface in true like and level generally as per specifications of plaster item.

FIXING
The black of each tile to be fixed shall be smeared with cement paste of matching color and the mosaic tiles shall be gently lapped against the surface, with a wooden mallert. The skirting shall be done only after the flooring is completed. Any pipes coming out of the wall through the dedo or skirting shall only be at the intersections of the horizontal and vertical joints. The tiles shall not have staggered joints. The joints shall be true to entire line both ways and vertical joints shall be in line with joints of flooring. Tiles shall be fixed as close as possible to the adjoining tiles and any difference in the thickness of the mosaic tiles shall be evened out in the cement paste so that all the tiles faces are set in conformity with one another. The skirting shall project uniformly and not more than 6mm thickness beyond the finished surface above. Top of skirting of dedo shall be truly horizontal. The risers of steps, skirting or dedo shall rest on top of treads of flooring wherever required. The tiles shall be cut (sawn) and thin edges smoothened before use.

CURING
Curing shall be done for 7 days continuously.

FINISHING
Skirting and dedo shall be hand polished to have an even smooth and shining surface. In case of skirting only 10mm x 10mm grove shall be provided at the junction of cement plaster and cement tile.

E-2 Precast terrazzo tiles 20mm thick with marble chips of size up to 6mm in skirting and risers of steps not exceeding rubbing and polishing complete with tiles of medium shades using approximately 50% white cement and 50% ordinary cement.

MATERIALS & WORKMANSHIP
The relevant specifications of Item E-1 shall be followed except that the work is for using tiles of medium shades using approximately 50% white cement and 50% ordinary cement.

E-3 Precast terrazzo tiles 20mm. thick with marble chips of sizes up to 6mm in skirting and risers of steps not exceeding 30cms. in height on 10mm thick cement plaster In C.M. 1:3 (1 cement: 3 sand) joining with neat cement slurry

including rubbing and polishing complete, with tiles of Dark shade using ordinary cement.

MATERIALS & WORKMANSHIP
The relevant specifications of item No. 14.21 (A) shall be followed except that the tiles of dark shade using Portland cement shall be used.

F-1 Chequered terrazzo tiles 2mm thick with marble chips of size up to 6mm in floor on 25mm thick bed of like mortar 1:1.5 (1 Lime putty: 1.5 Coarse sand) or C.M. 1:5 jointed with neat cement slurry mixed with pigment to match the shade of the tiles Including rubbing and polishing etc. complete, light shade using white cement.

MATERIALS
Water shall conform to S-1. White cement shall conform to S-4. Lime mortar of proportion 1:1.5 shall conform to S-10. Cement mortar shall conform to S-11. Chequered tiles shall conform to S-47 D.

WORKMANSHIP
The relevant specifications of item No. F-1 shall be followed except that Chequered tiles of light shade using white cement, shall be used.

F-2 Chequered terrazzo tiles 25mm thick with marble chips of sizes up to 6mm in floors on 25mm thick bed of like mortar 1:1.5 (1 Lime putty: 1.5 coarse sand) or C.M. 1:6 jointed with neat cement slurry mixed with pigment to match the shade of the tiles Including rubbing and polishing etc. complete medium shade using approximate 50% white cement and 50% ordinary cement.

MATERIALS & WORKMANSHIP
The relevant specifications of item No. F-1 shall be followed except that the chequered tiles of medium shade using approximate 50% white cement and 50% ordinary cement shall be used.

F-3 Chequered terrazzo tiles 25mm thick with marble chips of sizes up to 6mm in floors on 25mm thick bed of like mortar 1:1.5 (Lime putty: 1.5 Coarse sand) or C.M. 1:6 jointed with neat cement slurry mixed with pigment to match the shade of the tiles including rubbing and polishing etc. complete dark shade using ordinary cement.

MATERIALS & WORKMANSHIP
The relevant specifications of item No F-1 shall be followed except that chequered tiles or dark shade using ordinary cement shall be used.

G-1 Chequered terrazzo tiles 28mm thick with marble chips of sizes up to 6mm in treads of stairs and staircases in 12mm thick bed of like mortar 1:1.5 (1 Lime putty: 1.5 coarse sand) or C.M. 1.6 jointed with neat cement slurry mixed with pigments to match the shade of tiles including rubbing and polishing complete, light shade using white cement.

MATERIALS & WORKMANSHIP
The relevant specifications of items F-1 shall be followed except that the chequered tiles 28mm thick of light shade using white cement shall be used in treads, stair cases etc.

G-2 Chequered terrazzo tiles 28mm thick with marble chips of sizes up to 6mm in treads of stairs and staircases in 12mm thick bed of like mortar 1:1.5 (1 Lime putty: 1.5 coarse sand) or C.M. 1.6 jointed with neat cement slurry mixed with pigments to match the shade of tiles including rubbing and polishing complete, medium shade using approximately 50% white cement and 50% ordinary cement.

MATERIALS & WORKMANSHIP
The relevant specifications of item F-1 shall be followed except that the chequered tiles 28mm thick of medium shade using approximately 50% white and 50% ordinary cement shall be used in treads of stair, staircases etc.

G-3 Chequered terrazzo tiles 28mm thick with marble chips of sizes up to 6mm in treads of stairs and staircases in 12mm thick bed of like mortar 1:1.5 (1 Lime putty: 1.5 coarse sand) or C.M. 1.6 jointed with neat cement slurry mixed with pigments to match the shade of tiles including rubbing and polishing complete, dark shade using ordinary cement.

MATERIALS & WORKMANSHIP
The relevant specifications of item F-1 shall be followed except that the chequered tiles 28mm thick of medium shade using approximately 50% white and 50% ordinary cement shall be used in treads of stair, staircases etc.

MATERIALS
Water shall conform to S-1. Cement mortar shall conform to S-11. White glazed tiles shall conform to S-55.

BEDDING
The sub-grade shall be cleaned, wetted and mopped. The bedding shall then be laid evenly over the surface tamped and corrected to desired level and allowed to harden enough to offer a rifid cushion to tiles and to enable the mason to place wooden planks across and equal on it.

The while glazed tiles shall be laid on cement mortar bedding of 12mm thick in C.M. 1:3. The mortar shall have sufficient plasticity for laying and there shall be no hard lumps that would interfere with the evenness of bedding. The base shall be cleared and well wetted. The mortar shall then be spread in thickness not less than 10mm at any place and average 12mm thickness. The proportion of the cement mortar shall be as specified in the item.

FIXING TILES
The tiles before laying shall be soaked in water for at least two hours. Neat grey cement grout at 3.3 Kg. / Cement / Sq. Mt. of honey like consistency shall be spread over the mortar bedding as directed. The edges of the tiles be smeared with neat cement slurry. The tiles shall be well pressed and gently tapped with a wooden mallet till they are properly bedded and in level with the adjoining tiles. There shall be no hollows in bed or joints. The joints between the tiles shall be as thin as possible in straight line or as per pattern.
The tiles shall not have staggered joints. The joints shall be true to centre line both ways. The Nahni trap coming in the flooring shall be so positioned that its grating shall replace only one tile as far as possible. Where full size tiles cannot be fixed, they shall be cut (Swan) to the required size and the edges rubbed smooth to ensure straight and true joints. The joints shall bee filled with grey cement grout with wire brush of trowel to a depth of 5mm and loose material removed. White cement shall be used for pointing the joints. After fixing the tile finally in an even plane the flooring shall be kept wet and allowed to nature undisturbed for 7 days.

CLEANING
The surplus cement grout that may have come out of the joints shall be cleared off before it sets. Once the floor has set, it shall be carefully washed, cleared by dilute acid and dried. Proper precaution and measures shall be taken to ensure that the tiles are not damaged many way till the completion of the construction.

H-1 White glazed tiles 5mm thick in skirting, risers of steps and dedo on 10mm thick cement plaster 1:3 (1 cement: 3 Coarse sand) and jointed with white cement slurry.

MATERIALS
Water shall conform to S-1. Cement mortar shall conform to S-11. White glazed tiles shall conform to S-55.

WORKMANSHIP
PREPARATION OF SURFACE: Incase of brick masonry wall, the joints shall be raked out to a depth of at least 15mm. while the masonry is being laid. In case of concrete wall, the surface shall be chiselled and roughened with wire brushes. The surface shall be, cleaned and wetted thoroughly before commencing the laying work.

LAYING
The wall surface shall be covered 10mm thick plaster of cement mortar 1:3 mix and allowed to hard. The plaster shall be roughened with wire brushes both way. The back of tiles shall be floated with grey cement slurry and edges with white cement slurry set in hedding mortar. The tiles shall be gently tapped in position one after the other keeping the joints as thin as possible. Top of skirting or dedo shall be truly horizontal and joints verticals or as per required pattern.
Rises of steps, skirting and dedo shall rest on top of treads of flooring. Where full size tiles cannot be fixed, hey shall be cut to the required size and the edges be smoothen.
The joints shall be cleaned and flush pointed with white cement. The surface shall be kept wet for seven days. After curing the surface shall be washed clean.

MATERIALS
Water shall conform to S-1. Cement shall conform to S-11. Glazed tiles shall conform to S-55.

WORKMANSHIP
The relevant specifications of item No. 14.32 shall be followed except that the internal or external angles of glazed tiles shall be of thickness not less than the tiles with which they are used. The fixing shall be done as per directions.

J-1 Providing and laying marble stone slab flooring over 20mm (Average) base of cement mortar 1:6 (1 Cement: 6 Coarse Sand) or L.M. 1 :1.5 laid and jointed with grey cement slurry including rubbing and polishing complete, Marble slab 25mm thick.

MATERIALS
Water shall conform to S-1. Lime mortar shall conform to S-10. Cement mortar shall conform to S-11. Marble stone slab 25mm thick shall conform S-51.

MATERIALS DRESSING OF SLABS
Every stone shall be cut to required size and fine chisel dressed to give a smooth and even surface on all sides to the full depth. A straight edge laid along the sides of the stone shall be fully in contact with it. Chisel dressing shall also be done on top surface to remove any waviness. The sides and top surface of marble slabs shall be machine rubbed or table rubbed with coarse sand before using. All angles and edges of slabs shall be true, square and free from chippings.
The thickness of stone shall be 25mm. The allowable tolerance shall be 2mm allowable., The tolerance shall be 15mm in length and breadth.

BEDDING
Bedding of marble slabs shall either be lime mortar 1:1.5 (1 Lime putty: 1.5 Coarse sand) or cement mortar 1:6 (1 cement: 6 coarse sand) of average thickness 20mm

thick saw given in description of item. Minimum thickness at any place not be less than 10mm.

LAYING

The surface of sub grade shall be cleared wetted and mopped. Mortar of specified mix and thickness shall then be spread on an area sufficient to receive one marble slab. The slab shall be washed clean before laying. It shall be laid on top pressed and tapped gently to bring it in level with other slabs. It shall then be lifted and laid a side. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows, or depressions. The mortar shall then be allowed to harden it over this surface cement slurry of honey like consistency at 4.4 Kg. of cement per Sq. Mt. The edges of slabs already paved shall be buttered with grey cement. The slab shall then be gently placed in position and tapped with wooden mallet till it is properly bedded in level with and closet to the adjoining slab. The joints shall be as fine as possible: surplus cement on the surface of the slabs shall be removed. The slab fixed in the floor adjoining the walls shall enter not less than 10mm under the plaster skirting or dedo. The junction between the walls and floors shall be finished neatly. The finished surface shall be the plaster skirting or dedo. The junction between the walls and floors shall be finished neatly. The finished surface shall be true to level and slopes as directed.

CURING

The floor shall be cured for a minimum period of seven days.

Polishing and finishing: Unevenness at the meeting edges of slab shall be removed by fine chiselling. Finishing etc. shall be done as per relevant specifications of item E-1 of terrazzo tiles flooring except that cement slurry with / or without pigments shall not be applied on the surface before each polishing.

K-1 Kotah stone slab (Polished, green color) flooring over 20mm (average) thick base of cement mortar 1:6 (1 cement: 6 coarse sand) or lime mortar 1:15 laid over and jointed with grey cement slurry including rubbing and polishing complete 25mm thick.

MATERIALS

Water shall conform S-1. Lime mortar shall conform to S-10. Cement mortar shall conform to S-11. Polished kotah stone shall conform to S-49.

WORKMANSHIP

Each slab shall be cut to the required size and shape and fine chisel dressed at all the edges. The sides thus dressed shall have a full contact if a straight edge is laid along. The sides shall be table rubbed with coarse sand before paving. All angles and edges of the slabs shall be true square and free from chippings and giving a plane surface. The thickness shall be 25mm (Average) as specified in the item but not less than 20mm at any place of the slab.

Bedding for the kotah stone slabs shall be cement mortar 1:6 (1 Cement: 6 Coarse sand) or L.M. 1:1.5 of average thickness 20mm as given in the description of the item. Sub grade shall be cleaned, wetted and mopped. Mortar of the specified mix and thickness shall be then be spread on an area sufficient to receive one kotah stone slab. The slab shall be washed clean before laying. It shall be laid on top pressed, tapped gently to bring it in level with the other slabs. It shall then be lifted and laid aside. Top surface of the mortar shall then be corrected by adding fresh mortar at hollows or depressions. The mortar shall then be allowed to harden bit. Over this surface, cement slurry of honey like consistency shall be applied. The slab shall then be gently placed in position and tapped with wooden mallet till it is properly padded in level with and closed to the adjoining slab. The joint shall be as fine as possible. The slabs fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dedo. The junction between the wall floor shall be finished neatly. The finished surface shall be true to levels and slopes as directed.

The floor shall be kept wet for minimum period of 7 days. So that bedding and joints set properly.

Polishing shall be normally commenced after 14 days of laying the stone slab. First polishing shall be done with carborundum stones of 120 grade grit fitted in the heavy machine and then second polishing shall be done with carborundum stone of 220 to 350 grade grit fitted in heavy machine. Water shall be properly used during polishing. The stone shall then be washed clean with water. When directed by the O.O.W. wax polish of approved quality shall be applied on the surface with the help of soft cloth over a clean and dry surface. Then the polish machine fitted with bobs shall be run over it.
The holes requirement for Nahni traps, pipes any other fittings shall be made without any extra cost.

K-2 Kotah stone slab flooring over 20mm (average) thick base of cement mortar 1:6 (1 cement: 6 coarse sand) or lime mortar 1:15 laid over and jointed with grey cement slurry including and polishing complete 30mm thick.

MATERIALS & WORKMANSHIP
The relevant specifications of item K-1 shall be followed except that the thickness of stone shall be 30mm.
L-1 Kotah stone slab 25mm thick in riser of steps, dedo and pillars laid on 10mm thick cement mortar 1:3 (1 cement: 3 coarse sand) jointed with grey cement slurry Including and polishing etc. complete.

MATERIALS
Water shall conform to S-1. Cement mortar shall conform to S-11. Kotah stone slab 25mm thick slab 25mm thick shall conform to S-19.

WORKMANSHIP
The relevant specifications of item K-1 shall be followed except that the kotah stone shall be fixed for risers, steps, dedo or skirting in C.M. 1:3 and the polishing shall be done manually instead of machine polishing.

M-1 Rough chiselled dressed (Kotah stone green) stone flooring over 20mm thick base of cement mortar 1:5 (1 cement: 5 coarse sand) or L.M. 1:1.5 Including pointing with cement mortar 1:2 (1 cement: 2 stone dust) etc. complete 25mm thick.

MATERIALS
Water shall conform to S-1. Lime mortar shall conform to S-10. Cement mortar shall conform to S-11. Rough chisel dressed stone shall conform to S-48.

The relevant specifications of item K-1 shall be followed except that the rough chisel dressed stone of 25mm thickness of approved quality are to be cement mortar bedding in C.M. 1:5 or L.M. 1 :1.5 of 25mm average thickness.

DRESSING OF STONE SLAB
Every slab shall be cut to the required size and shape and rough chisel dressed on top, if required, so that the dressed surface shall not be more than 6mm from straight edge placed on it. The sides shall also be chisel dressed to a minimum depth of 20mm so that the dressed edge shall at no place be more than 30mm from straight edge butted against it. Beyond this depth, the sides may be dressed slightly played so as to form an inverted "V" shaped joint with adjoining slab. The surface shall be reasonable true and plane and all the angles and edges shall be square and free from chippings. Where the stone slabs are to be sured for nosing, exposed edges shall be rough chisel dressed to full depth and cut to the uniform thickness.

The thickness of the stone slag shall be 25mm with permissible tolerance of +/- mm.

LAYING
The surface of the sub-grade concrete shall be cleaned / wetted and washed clean before laying. It shall be then laid - on top pressed so that all hollows underneath filled up and surplus mortar works up through the joints. The lop shall be lapped and brought level to the adjoining slab. The thickness of the joints shall not exceed 5mm. Subsequent slabs shall be laid in the same manner.

CURING & FINISHING
Any surplus mortar on the surface of the slab shall the cleaned off and joints finished lush. The joints shall be raked out uniformly to a minimum depth of 12mm when be mortar is still green the slabs which are fixed in the floor adjoining the wall shall enter not less than 12mm when be mortar, skirting of dedo. The junctions between wall plasters and floor shall be finished neatly and without waviness. The pointing shall be done with C.M. 1:2. The pointing shall be cured for minimum period of seven days. The finished floor shall not sound hollow when tapped with wooden mallet and the finished surface shall be true to level and slopes as directed.

M-2 Rough chisel dressed (Kotah stone green) stone flooring over 20mm thick base of cement mortar 1:5 (1 cement: 5 coarse sand) or L.M. 1:1.5 including pointing with cement mortar 1:2 (1 cement: 2 stone dust) etc. complete 40mm thick.

MATERIALS
The relevant specifications of item S-1 shall be followed except that the thickness of stone slab shall 40mm thick.

N-1 Cement concrete for L.P.S. 1:2:4 (for Indian patent stones) (1 cement: 2 coarse sand: 4 graded stone aggregate 20mm nominal size) laid in one layer finished with a floating coat of neat cement 40mm thick.

MATERIALS
Water shall conform to S-1. Cement shall conform to S-3. Sand shall conform to S-6. Stone aggregate 20mm nominal size shall conform to S-12.
Cement concrete 1:2:4 proportion measured by volume shall conform to relevant specification or ordinary grade 1:2:4 concrete.

WORKMANSHIP
The cement concrete flooring of 40mm thick (Average) is to be laid as per the site condition. The concrete shall be mixed in a mechanical mixer at the work. Hand mixed any however be allowed for smaller quantities of work and incase of failure of machines or as permitted by the O.O.W. It shall carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in color and consistency. However, in such cases 10% more cement than otherwise shall have to be used without any extra cost. The mechanical mixing shall be done for period of 1/2 to 2 minutes. The quantity of water shall be just sufficient of produce a dense concrete of required workability for the purpose. Flooring of specified thickness shall be laid in accordance with approved pattern or as directed. Finishing operation shall start shortly after the cessation of beating and shall be spread over a period one to viz. hours depending upon the temperature and atmospheric conditions. The surface shall be left for some time till moisture disappears from it. Fresh quantity of cement shall be mixed with water to form a thick slurry and spread over the surface while the concrete is still green. Use of dry cement or cement and sand mixture sprinkled on this surface to stiffen the concrete or absorb excessive moisture shall not be permitted. The cement slurry shall then be properly pressed twice by means of iron floats, once, when be slurry is applied and the second time when cement starts setting and finished smooth. The surface shall be marked with string or B.R.C. fabric jali to make the surface non

slippery as and when directed. The junction of floors with wall plaster, dedo or skirting shall be rounded off where so required up to 25mm radius. Flooring in lavatories and bath rooms shall be laid after fixing of water closet and squatting pans and floor traps which shall be plugged while laying the floors and opened after the floors are completed. Any damage, done to water supply or sanitary fittings during execution of work shall be made good.

After the final set, the concrete shall be kept continuously wet, if required by ponding for a period of not less than 7 days from the date of placement.

The form work shall be provided if necessary as directed by the O.O.W. Concreting shall be done as per alternate bay method with necessary centering either by mastic or cement mortar as directed.

N-2 Cement concrete flooring (Indian patent stone) 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20mm nominal size) laid in one layer finished with floating cost of neat cement 50mm thick.

MATERIALS & WORKMANSHIP
The relevant specification of Item N-1 shall be followed except that the thickness of concrete flooring shall be 50mm.

N-3 Cement concrete pavement (25mm to 50mm thick) with 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20mm nominal size) including finishing with a floating coat of neat cement complete.

MATERIALS & WORKMANSHIP
The relevant specification of Item N-1 shall be followed except that the thickness of concrete flooring vary from 25mm to 50mm.

O-1 20mm thick precast concrete tile with aggregate of sizes up to 6mm land in floors treads of steps and landing on 20mm. thick bed of cement mortar 1:6 (1 cement: 6 coarse sand) or L.M. 1:1.5 jointed with neat cement slurry with pigments to match the shade of the tiles complete with precast tiles of dark shades using ordinary cement.

MATERIALS
Water shall conform to S-1. Cement shall conform to S-3. 8and shall conform to S-6. Lime mortar 1:1.5 shall conform to S-10. Cement mortar shall conform to S-11. Tiles shall conform to S-17(A).

Cement concrete tiles shall conform to I.S. 1237-1959 and pigments to be admixed with mortar or for grouting shall conform to I.S. 2114-1962.

WORKMANSHIP
The tiles shall be laid on the sub-grade of concrete of the R.C.C. slab. Bedding shall be in lime mortar 1:1.5 or cement mortar (1:6). The amount of water added shall be minimum required for sufficient plasticity and workability in C.M. or lime mortar where the ingredients shall be thoroughly mixed dry, hard lumps removed and water added to give a good workability.
The base shall be cleaned of all dust, dirt and serum and properly wetted without allowing water pools. For a bedding of cement mortar the mortar shall be then spread evenly over the base of two rows of tiles and three to five meters in length. The top shall be kept rough so that cement slurry can be observed. The thickness of the bedding shall be not less than 10mm at any places. The laying of tiles shall be commenced with neat cement slurry of honey like consistency and shall be spread over the mortar bed over an area sufficient to receive about 20 tiles. The tiles shall then be fixed in this grout one after the other, each tile being gently tapped and properly

bedded in line and level with the adjoining tiles. The joints shall be as narrow as possible and normally shall not exceed 1.5mm. After the day's work the excess cement slurry on top shall be cleaned as also the joints with a broom stick and washed before the slurry sets hard. Next day the joints shall be filled with the cement grout of the same shade as the matrix of the tiles. Tiles which are fixed in the floor adjoining the wall shall go a minimum of 10mm. under the wall plaster, skirting or dedo. For the purpose, plaster etc. may be left unfinished by about 50mm above the proposed finished level of the floor. The unfinished strip shall be plastered after laying the floor tiles. Where full tile cannot be used, tile shall be cut to the size to be used.
The flooring shall be cured for 7 days.

O-2 Chequered precast concrete tiles 22mm thick with aggregate of sizes up to 6mm in floors, treads of steps and landings on 20mm thick bed of C.M. 1:6 (1 cement: 6 coarse sand) jointed with neat cement slurry with pigment to match the shade of tiles.

MATERIALS
The relevant specifications of item F-1 shall be followed.
The relevant specification of item E-1 shall be followed except that chequered precast cement concrete tiles 22mm thick shall be used in floors, treads of steps and landings on average 20mm thick bed of C.M. 1:6 or L.M. 1:1.5.

WORKMANSHIP
Grinding and rubbing shall normally be commenced after 14 days of laying the tiles, except for skirting or small areas; machine shall be sued for the purpose.

First grinding shall be done with carborundum stones of 48 to 60 grade grit fitted in machine. Water shall be properly used during grinding. When the chips show up and the floor has been uniformly rubbed, it shall be cleaned with water bearing all pin holes; it shall be covered with a thin coat of grey or white cement mixed with or without pigments to match the color of the topping of the tiles. Pin holes if any shall thus be filled. This grout shall be kept most for sufficient period as directed.

Thereafter, second grinding shall be started with carborundum of 120 grit. Grouting and curing shall be followed again. Final grinding shall be done when other works are finished. The machine shall be fitted with carborundum of grit 220 to 350 using water in abundance. The floor shall then be washed clean with water. Oxalic acid powder shall then be dusted as needed on the surface and the surface rubbed with machine fitted with Hessian bobs or rubbed hard with pad of woolen rags. The floor shall then be washed cleaned and dried with soft cloth of Linen. The finished floor shall floor shall not sound hollow when tapped with a mallet.
If any tile is destructed or damaged it shall be refitted or replaced properly jointed and polished.
For skirting dedo or small areas where it is not possible to do machine polishing all the above operations are to be done manually.

O-3 Providing and laying brick on edge flooring laid dry, grouted with C.M. 1:6 (1 cement: 6 coarse sand) including finishing the joints flush, curing etc. complete.

MATERIALS
Water shall conform to S-1. Cement mortar shall conform to S-15.

WORKMANSHIP
The flooring shall be laid on concrete sub-grade where so provided. The slope in the floor shall be provided in the sub grade. Where sub-grade in not provided, the earth below shall properly stopped, watered, rammed and consolidated. Before laying the flooring it shall be moistured. Plinth masonry offsets shall be depressed so to allow the sub-grade concrete to rest on it.

LAYING

The brick shall be laid in plain, diagonal herring bond, or other pattern as directed. The brick shall be dry laid properly and set home by gentle tapping. On completion of the portion for flooring, the vertical joints shall be grouted with C.M. 1:6 and all joints shall be finished flush. The joints shall be as fine as possible and not exceeding 5mm. These points shall be fitted with cement mortar 1:6.

CURING

The brick paving shall be cured for 7 days.

PLASTER WORK

1. EXTENT AND INTENT

The Contractor shall furnish all materials, labour, scaffolding, equipment, tools, plant and incidentals necessary and required for the completion of all plaster and wall finishes. The Contractor shall be responsible to take proper precautions to protect already installed work from damage.

2. GENERAL

Plaster as here in specified shall be applied to all internal and external surfaces where called for Glazed tile dedo, terrazzo dedo, and other wall finishes are to be provided where indicated on drawings and schedules. Areas called for on drawings and typical shall be considered to apply to appropriate, adjoining areas whether shown on same drawings or not and whether indicated or not. All plaster work and other wall finishes shall be executed by skilled workmen in a workman like manner and shall be of the best workmanship and in strict accordance with the dimensions on drawing.

3. PLASTER WORK

The primary requirements of the plaster work shall be to provide an absolutely water tight enclosure, dense, smooth and hard and devoid of cracks on the interior and exterior. The Contractor shall do all that is necessary to ensure this result. All plastering shall be finished to true plane, without imperfections and square with adjoining work and shall form proper foundations for finishing materials such as paint etc.

Masonry and concrete surfaces to which plaster is to be applied shall be clean, free from efflorescence, damp and sufficiently rough and keyed to ensure proper bond.

Wherever directed all joints between concrete frames and masonry in filling shall be expressed by a groove cut in the plaster. Said groove to exactly coincide with the joint beneath.

Where grooves are not called for the joints between concrete members and masonry in filling shall be covered by 245 gauge galvanized chicken-mesh strips 40mm wide or as shown, installed before plastering.

4. CHASING

All chasing, installation of conduits, boxes etc. to be completed before any plastering or other wall finish is commenced on a surface. Chasing or cutting of plaster or other finish will not be permitted. Broken corners shall be cut back not less than 150mm on both sides and patched with Plaster of Paris or rich cement paste as directed. All corners shall be rounded to a radius of 8 mm or as directed by the Architect.

5. SAMPLES

Samples of each type of plaster and other wall finishes shall be prepared for approval of the Architect.

6. MATERIALS

Cement	As specified under concrete work
Water	As specified under concrete work.
Sand	Washed fine sand and / or stone aggregate as called for sand and stone aggregate to conform to the requirements given under "concrete work"

7. PROPORTIONS

The materials used for plastering shall be proportioned by volume by means of gauge boxes.

8. PREPARATION OF SURFACE

The joints in all walls, both existing and freshly built shall be raked into a depth of 15mm brushed clean with wire brushes dusted and thoroughly washed before starting plaster work. Concrete surfaces shall be roughened by hacking over the entire surface shall be roughened by hacking over the entire surface as approved by the Architect to ensure proper key for the plaster.

9. MORTAR MIXING

Mortar shall be prepared as specified under "Brick Work" it shall be made in small quantities only as required and applied within 15 minutes of mixing

10. APPLIANCES

Plaster application shall be commenced only after the preparatory work is approved by the Architect. Correct thickness of plaster shall be obtained by laying plaster screeds gauges at intervals of 1.50 meters.
Mortar shall be firmly applied, well pressed into the joints, rubbed and finished as approved by the Architect to give a smooth and even surface.

11. **CURING**

Finished plaster shall be kept wet for 10 day after completion. In hot weather walls exposed to sun shall be screened with matting kept wet or any other approved means.

12. EXPOSED AGGREGATE PLASTER

Exposed aggregate plaster to external wall faces of community hall and other locations as called for shall be 30mm thick and applied in two coats. A base coat 15mm thick and a finishing coat 15mm thick, laid panels as called for.

13. MATERIALS

Cement: Ordinary gray Portland cement, white or colored cement conforming to IS: 269-1967 or blast furnace slag cement conforming to IS: 455-1967 as specified by the Architect.

Aggregates: Coarse and fine aggregate shall conform to the requirements of IS: 383-1963.
Water: Water tank shall be clean, free from grits, acid, alkali, soluble salts etc.
Chips: Chips for the terrazzo layer shall be of the color, grade and size as approved by the Architect. They shall be machine crushed free from foreign matter and of approved quality.

Workmanship: The whole of the work of laying, making finishing washing and setting terrazzo, shall be carried out by tradesman fully experienced in the class of work required. All terrazzo work shall be finished to true, even plane and line with shuttering edge flush and corners and joints true and square.

Samples: The Contractor shall submit samples of the various colors, if any proposed to be used, for approval before laying floors. The Architect reserves the right to vary the proportions of materials in terrazzo until a satisfactory sample is submitted.

14. TERRAZZO PANELS

The terrazzo shall be divided into panel as per the drawings both while laying the base coat as well as the finishing coat, so as to reduce the cracking. The panels shall be separated by means of dividing strips where called for. Where dividing strips are not used the panels shall be formed by rigidly held strips of

wood or flat iron on edge forming grooves and the bays shall be laid alternately allowing for an interval of at least 48 hours between the laying of adjacent bays. The terrazzo shall be laid in the panels of required shape and all curved surfaces shall be even and corners square and clear.

15. MIXING OF MATERIALS

If the mixing is to be done manually, it shall be done in a trough or tub. The entire quantity of cement and pigment required for and operation shall be dry mixed at the beginning of the work and stored properly.

The required quantity of the mix shall be taken in a trough or tub and water added in small quantity, preferably by a spray and mixed thoroughly. The mix shall be plastic but not flowing. The mix shall be used in the work within thirty minutes of addition of water during preparation.

Where different colored chips are used, they shall first be mixed in the required proportions. After they are mixed in the dry state, they shall be well wetted before being used.

16. PVC DIVIDING STRIPS

PVC Dividing strips where called for on the drawings or schedule of finished shall be "FIXOPAN" rigid PVC strips of approved shade. The strips shall be fixed on the base to the exact surface level of the floor to divide the surface in to the required arrangement of panels. The strips cut to profile of the skirting to the full height.

17. BASE COAT

The mortar for the base coat shall consist of one part cement and five parts clean coarse sand. The mixing of mortar, preparation of surface and application shall be as specified earlier under "Internal Plaster" except that the plaster shall not be finished smooth it shall be finished evenly, combed with wire brushes to provide proper bond for the top coat. It shall be kept damp for 48 hours before the application of the finishing coat.

18. FINISHING COAT

Before applying the finishing coat the surface shall be thoroughly wetted and smeared over with a coat of cement slurry. The finishing coat shall consist of 1 part cement and 1 % parts crushed stone chips of approved quality, shade and size varying between 6mm and 15mm. The stone chips shall be specially selected from the heaps, screened and cleared of all foreign materials. The quality, size and color of all stone chips shall be subject to the approval of the Architect.

The materials shall be mixed properly to a stiff consistency, applied firmly to the prepared base coat, to the required thickness and compacted with a wooden straight edge / trowel in approved manner.

After about 6 hours or more, if required, of the laying of the finishing coat, the surface shall be carefully washed down with water and rubbed with jute brushes so that the stone aggregates are completely exposed. The washing down and brushing operation shall be carried out when the plaster has set and "hardened just sufficiently but not fully. The washing and brushing operation shall be very cautiously done so as to remove the mortar only but not to dislodge the aggregates. All work shall be done by workmen skilled in this type of work. Any loose particles shall be cleared away and the surface finished neat.

The finished surface shall show very little of matrix and maximum of exposed aggregates. The plaster shall be laid in panels of sizes as called for. The panels

shall be clearly defined by 8 mm wide square grooves. The grooves shall be of uniform width, straight and shall have clear, sharp edges as approved. Grooves shall be so formed with slightly sloping sides that edges are not damaged while removal of forming strips.

The finished surface shall be kept continuously wet for ten days.

19. CURING

The surface shall be left dry for air curing for a duration of 12 to 18 hours depending upon the atmospheric conditions. It shall then be cured for about ten days. Hessian shall be laid / tied over the surface and watered regularly to maintain the humidity.

WATER PROOFING TREATMENT

Unless otherwise specified, the contractor shall carry out water proofing treatment of basement, terraces and water retaining structure through reputed firms like Indian water proofing having specialization in the line and approved by the O. O. W. The contractor shall also furnish full details of such treatment to the Architects and provide all information / proof etc. regarding the effectiveness of the treatment when called upon to do so. All such treatment shall have to be guaranteed in the form approved by the Employer for a minimum period of Ten years. Any defects leakages noticed during the guarantee period shall have to be rectified free of cost by the contractor including reinstating the surface to its original condition and finish.

Water proofing of sunk portions of floor slabs or baths, W. C. sand kitchen mories etc. in residential building, unless otherwise specified shall be done as specified in the schedules and shall generally comprise of:

(I) A coat of hot bitumen, min, 6mm thick screened with stone grit.
(ii) Min. 20mm thick cement plaster in cement mortar 1:3 with approved, water proofing cement compound as per manufactures specifications.

The plaster shall be cured by ponding for seven days.

The plaster should be continued over the wall in bath up to 2 meters for shower area and up to a sufficient height in other area.

The work shall include drying and cleaning surfaces free of dust etc. and wiping with kerosene before application for bitumen. The vertical faces and returns shall also be treated similarity. The work should be done in such a way that the finished flooring in bath has a minimum slope of 20 to 25mm.

JOINTS IN BUILDINGS

GENERAL

The section deals with the installation of joints in masonry and concrete in buildings.

TERMINOLOGY

For the purpose of this, the following definitions shall apply.

1. Expansion Joint: Joints provide to accommodate the expansion of adjacent building parts and relieve compressive stresses that may otherwise develop. Expansion joints essentially provide a space between the parts and may sometimes be provided with the load transmitting devices between the parts and generally filled with expansion joint filler which filler which is compressible enough to accommodate the expansion of adjacent parts, and having ability to regain 75 percent of the original thickness, when pressure is release.

2. Construction Joint: Joint installed at location where construction stops for any reason and when the location of stoppage does not coincide with the planned location of an expansion joint or contraction joint.

3. Contraction Joint: These are essential separations or planes of weakness introduced in concrete structures to localize shrinkage of concrete, which would otherwise lead to unsightly cracks. They generally of the following types:

   A Complete Construction Joint
   B Partial Contraction Joint
   C Dummy Joint

4. Sliding Joint: When variations in temperature, moisture content or loading result in tendency in for one part of structure to move in a plane at right angles to the plane of another part it is necessary to provide a slip plane between the two parts thus enabling freedom of movement in both planes. Sliding joints are usually formed by applying a layer of plaster to one of the surfaces and finishing it smooth before the other is cast on it or by other approved suitable method.

5. Joint Filler: A strip of compressible material used to form and fill the expansion joints in structure.
6. Sealing Compound: A material of plastic consistency applied to the joint in the form of liquid or paste. The function of the sealing compound is to prevent the ingress of water foreign matter.
7. Water; a strip that is placed across the joint during construction so as to form an impervious diaphragm.

MATERIAL JOINT FILLER

1. The joint filler is a strip of compressible material used to form and fill the expansion joints in structures. The main functions of the joint filler are to permit the components of the joint to expand without developing compressive stresses as a result of thermal or other changes and also to support the sealing compound.

2. The joint filler shall satisfy the following performance requirements:
   A Comprehensibility without extrusion, that is, it must be cellular
   B Ability to recover as early as possible 75 percent of its original thickness when pressure is released.
   C Durability and resistance to decay to termite and weathering and
   D Sufficient rigidity during handling and placing to permit the formation of straight joints.

3. Joint filler may be produced from a variety of materials, such as bitumen, bitumen containing cellular materials, cork stripes or granules, natural or cellular rubber, expanded plastics, material fiber, polythene foam and coconut pith and cashew nut shell liquid resin.

4. For garage and factory floors the joint filler shall have high resistance to ingress of foreign matter. Resistance to chemicals, amount of extensibility, etc. will depend upon the nature of exposure, therefore, the joint filler shall be specially designed for the purpose.

5. For external joint in buildings, the joint filler shall have excellent resistance to weathering and also resistance to flow, adhesion and extensibility; for internal joints resistance to weathering may not be necessary. Resistance to chemical fumes, oils, fats, fuel gases may be necessary for internal or external joints depending on exposure conditions.

6. Bituminous joint filler shall confirm to IS: 1838-1961

SEALING COMPOUND

1 Sealing compound shall satisfy the following requirements:

A. To seal the joint against the passage of water,
B. To prevent the ingress of grit or other foreign matter, and
C. To provide protection to the joint filler where necessary

The various characteristic properties of the sealing compound those require consideration are adhesion, good extensibility, resistance to flow, resistance to ingress of foreign matter, resistance to weathering and resistance to oil, fuel and fat.

2. Hot applied bituminous sealing compound shall confirm to IS: 1834-1961.

WATER BAR

1 The function of waterbar is to seal the joint against water penetration. Water bars may be necessary where the joint is subject to ground water pressure or where the method of construction makes it difficult the accurate sealing of surface cavity, and where it is very necessary that there shall not be any risk of penetration of water.

2 Water bars that have to rely on adhesion on length of path for its proper functioning shall not be used in structures of dubious bearing properties. Water bars to be used in such structures shall have good flexibility, large width and low modulus of elasticity.

3 Water bars may be of natural and synthetic rubber, PVC of metal.

4 Metallic sheet waterbar - The metallic sheet for use as a waterbar in joints shall confirm to the requirements as follows:

A Of the metals available copper is most suitable for use as waterbar as regards ductility and resistance to corrosion in air, water and concrete. It may, however, be attacked by some wastes. If sheet lead or aluminium are used, they shall be insulated from concrete by a good coat of bitumen. Galvanized steel sheets may also be used with specific permission of engineer-in-charge provided the liquid stored or the atmosphere around the liquid retaining structure is not exactly corrosive, for example sewage.

B The thickness of metallic sheet shall correspond to not less than 0.56mm Indian Standard gauge sheets.

C The strips shall be supplied in uniform lengths of 2.5 to 3.5 m at the option of the manufacture, unless otherwise ordered.

INSTALLATION OF JOINTS

1 The finish of the joint shall be such as to provide a neat appearance. It is very important that formwork is accurately constructed and the concrete mix is sufficiently workable to permit thorough compaction.

2 It may cases expansion joints will have to be incorporated as architectural features and the choice of the choice of joint filler, the pattern of joint and further finishes to mask the joint, it necessary, would depend or architectural considerations. Expansion joints may advantageously be located in corners where they will be hidden from view. The joints in floors may best be located at or near the junction between the wall and the floor.

3 Defects may arise in expansion joints due to incorrect construction procedure, such as discontinuous joints, badly formed sealing cavities, poor compaction and misalignment of water bars.

4 Inspection: some of the important aspects which require supervision while installing joints are cleanliness of cavity, through application of the mortar or concrete around the cavity and its through compaction, accurate location of waterbar, and cupious oiling of the filed for forming of the sealing cavity, accuracy and smoothness of the joint, continuity of the joints, and accurate cutting and fitting of the joint filler. If more than one piece is used for joint filler, pieces should be closely butted together tightly in order to prevent concrete bridging across the cavity.

5 Application of Sealing Compound: For application of the sealing compounds the concrete or masonry shall be in dry condition. The subsequent climatic conditions compounds and its application on that the sealing compound is able to withstand the stress and maintaining adhesive bond with the masonry or concrete. After allowing the concrete to dry, the sealing cavity shall be cleaned and exposed to sealing compound may be provided.

6 While applying compounds, the manufacturer's advice may be followed with regard to application of primer, if necessary. The application of primer shall be such as to cover the sealing cavity to the full depth. No excess primer shall be applied. Sufficient time shall be allowed after the application of primer so that it dries completely before the application of sealing compound. Hot applied sealing compound shall be heated to the correct temperature as recommended by manufacturer. Building mastics may be applied with trowel or by means of a gun for application.

7 Installation of Expansion Joint to Walls

A In brick or stone missionary expansion joints normally need not be necessary, except in the case of long walls exceeding 30 m in length. In such long walls the expansion joints shall be not less than 15mm wide and shall be spaced not more that 30 m apart.

B In the case of walls above ground level where the width of the joint is less than 15 mm, use of sealing compound will suffice, but for, wider joints, a joint filler shall be used. The installation of joint with joint filler and sealing compound shall be as per relevant specification of IS 3414-1968

C For walls below ground level or for walls subject to water pressure, use of efficient waterbar is essential in the expansion joints. The water bars shall be installed as per relevant specification of IS 3414-1968

8 Installation of Expansion Joints in Roof, Floors

A. The expansion joints used in roofs shall be finished such as to obtain an effective seal against penetration of water. A waterbar shall be installed in the expansion joint. The joint and the cover slabs shall be suitably treated for water proofing Expansion joint shall be installed as per the relevant specifications of IS: 3414-1968.

B. In the case of expansion joints in floors, provision of water bar may not be shall be provided on either side of the joint to improve appearance. If and open joint is not acceptable, a cover plate fixed to one side and free to slide over the concrete on the other side may be provided.

C. In the case of long chajjas, balconies and parapets the joints shall be at intervals of 6 to 12 m. The expansion joints shall not extend into the portion where sun shade is embedded into the masonry but shall stop short of face by 5 cm, and the distribution reinforcement in the embedded portion and in the 5 cm portion of chajja slab, where there is no expansion joint, shall be increased to 0.3 percent of the gross cross sectional area to take up temperature stresses. In case of covered verandah slabs the expansion joint shall not be extended beyond the wall. The gap may be sealed by copper cradle. Aluminium cradles insulated with a thick coat of bitumen may also be used in place of copper cradles.

D. To prevent cracks in the masonry below or above the expansion joint it cases where it is not possible to provide a vertical joint in the masonry, RCC or plain cement concrete bed-plates shall be provided on the bearing.

9 Floor or Roof to Wall Joints - The roof slab shall be free to move at the bearings on the walls and sliding joints shall be provided for at the bearings. This may be achieved by resting the slab over a smooth surface obtained by a plaster finish over the bed blocks or bearing surface of wall, giving a white wash finish will give smoother surface. A similar treatment may be given in the case of floor slabs bearing on walls.

10 Installation of Expansion Joints in Framed Buildings - The details of Joints between the panel wall of the frame shall be as illustrated in IS: 3414-1968. In the case of continuous expansion joints between two parts of buildings twin columns shall be provided and the details of expansion joints between them shall be as shown IS: 3414-1968. In addition to the expansion joints necessary in the reinforced concrete frame, contraction joints shall be provided in the masonry in the facade. These joints my be either straight or staggered joints in the masonry and the joints finished with suitable sealing compound to match the appearance for the cladding. Resin based building mastics may be found suitable for sealing joints in the facade as they will be available in various colors. PVC cover strips may also be used. In the case of glass block partition felted mineral fiber will be particularly suitable as joint filler.

11 Contraction Joints in Roofs - Contraction joints are generally of two types namely parapet type and lip type. Typical details of these are as shown in IS: 3414-1968

STEEL SHUTTERS, WINDOWS, VENTILATORS

(A) Steel work reverted, in built up sections, framed work Including cutting, hoisting fixing In position and applying a priming coat of red lead paint. In beam and joints, channels, angles tees, flats with connecting plates or Angle cleats as In main & cross beams, Hop and jack rafters, purlins connected to common rafters and the like.

MATERIALS
The structural steel work shall confirm to relevant specifications of the item, Red lead paint primer shall conform to I.S.: 102-1962.

WORKMANSHIP
The steel sections as specified or required shall be cut, square and to correct lengths, as per drawings and design. The cut ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise jointed to make up the required length of member, except as indicated in the drawing or as directed. All straightening and shaping to form shall be done by application of pressure and not by hammering. Any bending or cutting shall be carried out in such a manner as not to impair the strength of the metal. All operations shall be done in cold state unless otherwise directed / permitted.

Steel riveted or bolted in built up sections, framework.

The steel structure as shown in the drawings or as per direction of the O.O.W. shall be laid out on a level platform to full scale and to full size or in parts. A steel tape shall be used for measurements to ensure maximum accuracy.

Wooden templates 12mm to 19mm thick or metal sheet template shall be made to correspond to each connecting gusset plate and rivet holes .shall be accurately marked on them and drilled. The templates shall be laid on the steel members, and holes of the steel members staff also be marked for cutting. The base of steel columns and the position of Anchor bolts shall be carefully set out.

All stiffeners shall be formed by pressure and where practicable, the metal shall not be cut and welded in making these. In major works of where so specified, shop drawings giving complete details and information for the fabrication of the component parts of the structure including location type site, length and details of rivets, bolts, or weld shall be prepared in advance of the actual fabrication and as approved; The drawings shall indicate/the shop and field rivets and bolts. The steel members shall be distinctly marked or stenciled with paint with the identification mark as given in the shop drawings. The bars shall be thickened at the ends, so as to provide for screwed threads and gradually tapered off to tacet their normal section.

Great accuracy shall be observed in fabrication of various number, so that these can be assembled without being unduly packed, strained or forced into position and when built up, shall be true and free from twists, bricks, buckets, or open joints. Before making holes individual members for fabrication, the steel work intended to be riveted or bolted together shall assembled or clamped properly tightly so as to ensure close abutting or lapping of the different members. All stiffeners shall bear tightly both at top and bottom without being drawn or caulked. The abutting joints shall be cut or dressed true and straight and fitted close together. Web splice plates and filters under stiffeners shall be cut to fit within 3mm or flange Angles, web plates of Girders shall have not cover plates, shall have their ends flush with the top of angles forming the flanges unless otherwise required. The web plates when spiced shall have clearance of more than 6mm.

The reaction, clearance for cleared ends of members condencting steel to steel to steel shall preferably be not greater than 1.5 mm. The erection clearances at the ends of beams without web cleats shall not be more than 3mm at each end but where for a practical reason greater clearance is necessary, suitably designed seating shall be provided.

Pins and rollers shall be accurately turned to gauge. These shall be straight and smooth and free from flaws. The roller bearing shall be provided with adequate arrangement for holding the girders or truss resting on it. On columns caps and bases, the ends of shafts together with the attached gussets Angles, channels etc. after riveting together shall be accurately mechanized so that the parts connected but against each other over the entire surfaces of contract connecting angles or channels shall be fabricated and placed in position with greater accuracy so that they are not unduly reduced in thickness by machining.

The ends of bearing stiffners shall be mechanized or ground to fit tightly both at the top and bottom. All holes shall generally be drilled to the required size and at required position. Sub punching shall be permitted, provided It is done 3 mm. or less In diameter, and reamered thereafter to the required size. The holes for rivers and bolts shall be larger by 0.4 to 6 mm than the nominal diameter of rivets or black bolts depending upon the diameter of rivets.

Holes shall have their axis perpendicular to the surface bored through. The drilling or reamering shall be free iron butts, and the holes should be clean and accurate. Holes for counter shunk bolts shall be made in such a manner that their heads fit flush with the surface after fixing.

The fabrication work shall be completed in workshop as far as it is practicable to do so. Site joints shall be done with rivets and fitted bolts or black bots, as shown in the drawings or as directed. Generally the following principles shall govern the use of rivets turned and fitted bolts, and black bolts.

(I) Rivets and turned and fitted bolts shall be used where the connection is such that slip under load has to be avoided.

(ii) Black bolts may be used very sparingly where a force is carried through a connection with impact, vibration or reversal of stresses.

Riveting: The parts 8 for riveting shall be in close contact with each other and the bearing stiffeners shall bear rightly both at top and bottom without being drawn or caulked. Members to be riveted shall be properly pinned or bolted and rigidly held together while riveting. Drifting of holes shall not be permitted except to draw the parts together and the drifting tools so used shall have maximum diameter not exceeding the nominal diameter of rivets or bolts. Drifting done during assembling shall not distort the metal or enlarge the holes.

The shanks of rivets shall project beyond the plate - surface sufficiently so as to fill the hole thoroughly and from the required head after riveting. .

The riveting shall be done by hydraulic or pneumatic process. However, where such facilities are not available, hand riveting may be permitted. The rivet shall be healed red not, care being taken to control the temperature of heating so as not to burn the steel. Rivets of diameter less than 10mm may be fitted cold. Rivets shall be of heat finish with heads full and of equal size. All toose, burnt or badly formed rivets with concentric or difficentric heads shall be cut out and replaced. The heads of rivets shall be central to shanks and shall grip the assembled members firmly. In cutting out rivets, care shall be taken so as not be injure the assembled, members, caulking or recuppying shall not be permitted.

For testing rivets, hammer weighing approximately 0.25 Kg shall be used. Both heads of the rivets shall be tapped stack rivets will give a hollow sound and a jar.

All rivet heads shall be painted with red lead paint within 3 week of their fixing.

Bolting all bolt heads and nut shall be hexagonal and of equal size unless specified otherwise. The screwed heads shall conform to I.S. 1363-1960 and the threaded surface shall not be tapered.

The bolts shall be of such length so as to project two clear threads beyond the nuts when fixed in position and these shall fit in the holes without any shakes. The nut shall be fit in the threaded ends of bolts properly. Where turned and fitted bolts are required to be used in place of rivets they shall be provided with washers not less than 6mm thick so that the nut when tightened shall not bear on the unthreaded body of the bolt. Tapered washers shall be provided for all heads and nuts bearing on leveled surfaces. The threaded portion of the bolts shall not be within the thickness of the parts bolted together. The faces of the bolt heads and nuts abutting against steel members shall be machine finished. Where there is a risk of the nut being removed or becoming loose due to vibrations or reversal of stresses, these shall be secured from stacking by the use of lock nuts, spring washers, cross cutting or harmering down of threads as directed.

Bolts, nuts and washers shall be thoroughly cleaned and dipped in double boiled linseed oil before use. The whole steel work shall be painted with a coat of printing coat of red Iead, as per relevant specifications of painting.

(B) Providing and fixing in position collapsible shutters with vertical channels 20x10x2 mm braced with flat Iron diagonal 20x5 mm size with top and bottom rails T iron 40x40x6mm with 38mm dia. steel pulleys corJ1plete with bolts, units, locking arrangements, stoppers, handles, including a priming coat of red lead paints.

MATERIALS
The Collapsible steel gate shall conform to S-33

WORKMANSHIP
T-Rails shall be fixed to the floor and to the lintel at top by means of Anchor bolts, embedded in cement concrete on floor and lintel. The anchor bolts shall be placed approximately at 45mm centre alternatively in the two flanges of the T iron. In the bottom tuner for the purpose. The collapsible gate shall be fixed at the sites by fixing the end double channels in the T iron .rail and also by hold fats bolted to the end double channel and fixed in the masonry of the side walls or the otherwise.

In case where the collapsible gate is not required to the lintel beams or slop above, a fee iron suitably designed may be fixed at the top embedded in masonry and provided with necessary clamps and roller arrangement at the top.

All the adjoining work damaged while fixing of gate shall be made good to match the existing work without any extra payment. All the members of the collapsible gate including T-iron shall be thoroughly cleaned of rust, scales, dust etc. and given a priming coat of red lead before fixing them in position.

(C) Providing and fixing 1mm thick M.S. sheet sliding shutters both frame and. diagonal braces of 40x40x6mm Angle Iron 3.15 mm M.S. gusset plates at junctions and corners 25mm dia. pulley 40x40x6mm Angle and T-iron guide rail at top and bottom respectively with handles, stoppers and locking arrangements etc. Including applying priming coat of red lead paint.

MATERIALS
M.S. sliding shutters shall be fabricated of M.S. component as given in the description of item. M.S. sheets 1mm thick shall be fixed to the frame with rivets or welds as approved. The shutters shall be provided with top and bottom guide rails of Angles or T-iron as specified and 25mm dia. steel pulleys at the top. The frame shall be riveted and / or welded and wherever riveting shall be done 3.15 mm gusset plates shall be provided at the junctions.

WORKMANSHIP
The shutters shall be single or double leaf shutters as specified. The guide rails shall be sufficiently long an continued along the wall on both ends so that the sliding shutters can rest against walls, living full opening when so required.

The guide rails shall be fixed to the floor by means of anchor bolts embedded in the cement concrete floor. The steel section at the top shall be suitably supported from the walls. Two channel sections shall be suitably fixed vertically below the extreme clamps in the wall and floor to avoid the shutters from going out of the supports at the top and bottom. A suitable clamping arrangement will be provided at either end of the opening to avoid the shutters from rolling back into opening.

All the adjoining work damaged while fixing shall be made good to match the existing work.

All members of the sliding shutter including T-Iron shall be thoroughly cleaned of rust, scales, dust etc. and given a priming coat of red lead before fixing them in position.

METAL WORK

1. EXTENT AND INTENT

The Contractor shall furnish all materials, labour, operations, equipment, tools, plant and incidentals necessary and required for the completion of all metal work in connection with doors, windows, and other items of metal work as called for in the drawings. The supplying of additional fastenings, accessory, features and other items not mentioned specifically herein but which are necessary to make a complete installation shall be part of this contract.

2. GENERAL

All metal work shall be free from defects impairing strength, durability and appearance and shall be of the best commercial quality for purposes specified. Made with structural properties to withstand safely strains, tresses to which they shall be normally subjected.

3. SHOP DRAWINGS

The Contractor shall submit shop drawings and / or samples of each type of doors, railings and other items of metal work to the Architect for his approval. The shop drawings shall show full size selections of doors, windows, etc. thickness of metal, details of constructions, hardware as well as connection of doors, windows and other metal work to adjacent work I supports. Samples of all joints and methods of fastening and joining shall be submitted to the Architect for approval well in advance of commencing the work.

4. SAMPLES

Samples of all typical metal work, such as doors, windows glazing, flashing railing etc., shall be fabricated, assembled and erected or submitted to the Architect as directed by him, for his approval. .

5. APPROVED MANUFACTURERS

All floors, windows, railings and other work shall be manufactured by an approved manufacturer / fabricator. The entire work shall be carried out by workmen skilled in this kind of work in a shop fully equipped to carry out all phases of fabrication in accordance with the best accept practices.

6. FITTINGS

Hinges, locks, handles, stays, tower bolts, rubber buffers, door closers and other fittings shall be provided as called for in the schedule of hardware / drawings.

7. FIXING

The Contractor shall fix doors, windows, etc., in prepared openings. Steel door frames, wherever possible, shall be fixed in place before erecting partitions. Where this is not possible, prepared openings shall be left for hold-fasts. Breaking of partitions or walls for fixed to column / wall faces they shall be fixed with raw bolts / expansions bolts of approved make in approved manner.

The Contractor shall be responsible for assembling composites, bedding and pointing with mastic inside and outside at the mullions and transomes, fixing lugs to the frames, placing the doors / windows in their respective openings and bedding with mastic. The Contractor shall be responsible for all builders work including all cutting out and making good, forming fixing holes for inserting loose lugs, bolts and clips and for stacking of windows, doors adjacent to the opening for necessary hoisting. The Contractor shall be responsible for the doors and windows being set straight, plumb and level and for their satisfactory operation after operation after the fixing is complete. .

8. RAILING

Mild steel and other types of railing called for on the drawings shall be executed by craftsmen specially trained in the trade in a shop fully equipped to carry out all phases of fabrication in accordance with the best accept practices and as shown on the drawings. All work, as far as possible shall be shop fabricated and brought on site for erection. The railings shall be assembled square true to proper plan or curved to the radius shown on the drawings. Joining methods shall be flush type designed to produce an adequately strong for a particular application, and approved by the Architect.

Welding shall be executed from the non-exposed side, as far as possible and in each case the welds shall be ground smooth and finished with a texture matching the parent metal. All welds shall be finished smooth and square.

9. PAINTING

All doors, windows, louvers, railing etc. shall be phosphated and given two coats of red oxide primer in the shop before dispatch and shall be enamel painted as per specifications after installation.

FIXTURES AND FASTENERS

(A) Fixing metallic tower bolts of size with necessary screws etc. complete

WORKMANSHIP

(1) This item provides for labour fixing metallic tower bolts of any size with screws, nuts etc.
(2) The tower bolts shall be fixed in proper position as shown in the drawings or as directed. There shall be fixed truly vertical or horizontal as the case may be.
(3) The screws shall be driven home with screwdriver. The screws shall not be hammered in, under any circumstances.
(4) All recesses and seats shall be cut to the exact size for counter sinking etc. where so required.
(5) Care shall be taken to see that no gaps are left between the fitting and the surface meant to receive the fittings.
(6) The fittings shall be properly cleaned and left in original finish after fixing.

(B) Fixing metallic flush bolts of sizes with necessary screws etc. complete

WORKMANSHIP

The relevant specifications shall be followed as per item 'A' except for fixing metallic flush bolts instead of tower bolts.

(C) Fixing metallic or plastic door handles of size with necessary screws etc. complete

WORKMANSHIP

The relevant specifications of item 'A' shall be followed except fixing.

(D) Fixing metallic gate and shutters and eyes of sizes

WORKMANSHIP

The relevant specifications shall be followed as per item 'A' except that the fixing of eye and books instead of tower bolts.

(E) Fixing metallic door latches of sizes with necessary screws

WORKMANSHIP

The relevant specifications of item 'A' shall be followed except that fixing metallic door latches instead of tower bolts.

(F) Fixing metallic mortise night latches with necessary screws including making necessary screws holes in wooden door shutters etc. complete

WORKMANSHIP

The relevant specifications of item 'A' above shall be followed except that the fixing of mortise night latches instead of tower bolts.

(G) Fixing metallic ball catchers 100mm dia.

WORKMANSHIP

The relevant specifications of item 'A' shall be followed except fixing of ball catches 100mm dia.

(H) Fixing metallic casement window fasteners with necessary screws etc. complete.

WORKMANSHIP

The relevant specifications of item 'A' shall be followed except fixing metallic casement windows fasteners.

(I) Fixing metallic casement stays of sizes with necessary screws etc. complete.

WORKMANSHIP
The relevant specifications of item 'A' shall be followed except fixing of metallic casement stays.

(J) Fixing metallic cupboard or wardrobe locks of sizes with necessary screws etc. complete.

WORKMANSHIP
The relevant specifications of item 'A' shall be followed except that fixing metallic cupboard or wardrobe locks of size with necessary screws etc. complete.

(K) Fixing metallic or plastic cupboard or wradrobe knobs of size with necessary screws / bolts etc. complete.

WORKMANSHIP
The relevant specifications of item 'A' shall be followed except that fixing of metallic or plastic cupboard or wardrobe knobs of sizes with necessary screws / bolts etc. complete.

(L) Fixing metallic floor stoppers of sizes with rubber cushion, screws etc. to suit shutter thickness complete.

WORKMANSHIP
The relevant specifications of item 'A' shall be followed except that fixing of metallic floor door stoppers.

(M) Fixing metallic door handles or knobs for mortice locks with necessary screws etc. complete.

WORKMANSHIP
The relevant specifications of item 'A' shall be followed except that fixing of metallic door handles or knobs for mortice with necessary screws etc. complete.

WOOD WORK

MATERIALS

Timber shall comply with specification of material No. S-29 for timber.

WORKMANSHIP

All the wood work shall be neatly and truly finished to the exact dimensions required. Unless otherwise specified the exposed wood works shall be accurately planned to the required dimensions perfectly smooth and to lines, planes, curves or shapes as per the Architects drawings.

All necessary nortising, tenoning, grooving, touguing housing, rebating etc., for joinery shall be carefully done as per details and instructions of Architects I Engineer in charge so that all joinery work fits truly and without wedging or filling. All framed mortise and tenon joints with hard wooden pins or bamboo pins. Joints shall be coated with white lead before being fitted together. The joints of frame may be glued with approved adhesive and pinned, for internal work unaffected by moisture.

Framed wood work includes all sawing, cutting, planning jointing, framing sample of strip bolts holdtask wall epike etc., necessary for painting and fixing. Driving of screw with hammer is prohibits. Screws shall be dipped in oil before being inserted in wood. The heads of nail or screws shall be sank and puttied. The type, gauge and length of screws and nails subject to approval of the O.O.W. Framing and trussing are to be done in the best possible manner and as shown on the drawings or as directed by the O.O.W.

The contractor shall provide, labour, ladders, tools and teckle necessary for hoisting and fixing wood work in position and afford facilities for its inspection during construction.
The contractor shall be responsible for the safety of the work, workmen and for any action or compensation that may arise in this connection.

All iron work connected with wood work and going to be embedded in masonry shall before erection receive 2 coats of hot coal tar. If it is to be painted, it shall be given first coat on the ground before being fixed in position and the two coats afterwards. The position of limber built into or buried in ground shall be painted with 2 coats of hot coal tar or solignum or whiteant proof liquid or approved quality wood primer as directed by the O.O.W. in charge.

All wood work shall be inspected and passed by the O.O.W. before being put in to work. The O.O.W. shall reject any wrought timber on account of defective quality despite his having previously passed the same before it was worked upon. In no case the wood work shall be painted of otherwise before it is inspected and approved O.O.W.

If within defect liability period, any undue shrinkage or bad workmanship is discovered, the contractor shall forthwith replace or refix the same to the satisfaction of the O.O.W.

The sizes of various member shown on the drawing shall be the finished sizes after planning. A tolerance of 3mm will be allowed for thickness.

DOORS

Timber used shall be best Butar teak wood. Three hold fasts shall be fixed to each post of door frame. The iron hold fasters shall be of the size 150mm x 45mm x 6mm of M.S. flat bar and each shall have two holes drilled in for fixing screws. The holdfasts shall be fixed to the flames by means of screws and / or bolts and nuts and not by nails and, embedded in cement concrete 1:3:6. The unrebated edges of the frame shall be embedded in sill masonry for 100mm length in ground floor and 25mm on the upper floor. The frames shall be erected in position and held plumb with strong supports from

both sides and built in solid masonry as it is being built. The shutters shall be fixed later. The joints with the frames with the wall shall be mapa neatly with pointing or plaster as the case may be. The born of the frame should be cut in such a may that when plaster is done it should not crack. If required mailing should be done to homing for skirting of plaster free of cost. If directed by O.O.W. architrave of approved size and shape should be fixed to door frame after plaster work is over. If frames are likely to be damaged by sun, protected. When ventilator is included, it shall be provided by having full length one piece posts for door and ventilator extending the frame from top of the head to the required extent.

PANEL SHUTTERS

The panel shutters shall be of specified thickness and may be of single or double leaf shutters. Timber used shall be best Bulsar Teak wood. The details of single or double leaf shutters and the pattern and size of panels shall be shown on the drawings or as directed by the O.O.W. All fixtures and fittings shall be brass chromium plated / brass copper oxidized / aluminium / iron oxidized or as specified in schedule of quantities. The size, shape design and finish shall be as shown on drawings or as directed by the Architects / Engineer. If samples of fittings are not specified In the Item or shown on drawings, they shall specified in the item or shown on drawings, they shall be decided by the Architects / Employer. All fixtures and fittings shall comply with the relevant Indian Standard I.S. 204, 205, 206; 207, 208, 281, 363 and 362. A superior brass mortise lock shall be provided when mentioned in the item.

Finishing (Painting) of doors shall be as specified in the item.

FLUSH TYPE SHUTTER (& OLD CORE)

The door shutter shall be flush type solid core and single / double shutter of commercial or Teak veneered typed as specified in the item manufactured by M/s. Site Board Mysore Commercial Union Ltd., or other equivalent and of approved quality. An approved sample shall be deposited in the office of Architect / Engineer for reference. It shall confirm to the shutter shall be as mentioned in the item. Face venners used shall be of the pattern and of color approved by the Architect I Engineer. When glazing and / or venetian are provided in the item, the glazing shall be done in door shutters in the position shown in the details drawings or as directed by the O.O.W. The size of opening and position of venetian shall be as shown in the drawings. Venetians shall be of fixed type.

LIPPING

Edges of the core shall be lipped with 1st class teakwood batten of 25mm minimum depth as specified in I.S. 1659 gluioed under pressure and the leaping shall be internal. In the case of double shutters doors, the depth of the lipping at the meeting of styles shall not be less than 38mm. and the meeting of the styles shall be rebated 20mm. The rebating shall be of either spluyer or square type.

FULLY GLAZED SHUTTER

For fully glazed doors the size of opening for glass panels shall be shown on the drawings or as approved by the Architects / Engineer. The glazing shall be with sheet of ground glass 5mm thick sheet glass or glass as specified. The sanbarts, styles and rails shall be suitable rebated for fixing the glass. The glass panels shall be fixed with wooden bendings. When specified, single or double acting spring hinges shall be provided in accordance with I.S. 453, 1953 as required and as shown on drawings, schedule of quantities. The glass panels shall be with 5mm. thick sheet glass or as specified.

WINDOWS AND VENTILATORS

The shutters shall be either fixed, side hung, top hung, or provided. The shutters shall have panels of approved quality 4mm thick sheet glass of teak wood panels as

specified in schedule of quantities. All other specifications are same as per specifications of doors.

FIXED GLASS LOUVERS (VENTILATIONS) IN T.W. FRAME

The frame shall be of approved wood and size same as described in schedule of quantities. The louver shall be made from 4mm. thick sheet glass and shall be fixed at required degree angle to the horizontal surface. 12mm dia mild steel bars shall be provided between two fixed glass louvers as shown in drawings.

Required paints, cost of M.S. 12mm dia. bars and required hold fasts are inclusive in items.

HAND RAILS

The hand rail shall be moulded, shaped and finished to the dimensions and scope as shown of the details drawing of the architects or as directed. It shall be secured to the new posts and to the top of balusters, Grill work as .the case may be. The railing shall follow the inclination of the stairs. In geometrical staircase, the hand rail is required to wind so that its cross section may be normal to the stairs with raising and simultaneously following the lateral bends. Railing shall be jointed in lengths with plain butt joints, welled and held together by hand rail bolts and clamps. The rate includes necessary fixing arrangement i.e. M.S. Flats / Anchor bolts and screws as per Architects details and three coats of French or was polish or 3 coats of synthetic enamel paintings etc. complete as directed. The rounding at handing showed prepared from monolithic one piece and nothing extra shall be pain on this account. This will be paid in running meter.

FINISHES

1. EXTENT AND INTENT

The Contractor shall supply all materials, labour, tools, ladders, scaffolding and other equipment necessary for the completion and protection of all painting / finishing work. Painting & finishing, as herein specified shall be applied to all surfaces requiring painting / finishing throughout the interior and exterior of the buildings as given in the schedule of finishes or elsewhere. The painting / finishing shall be carried out by a specialist sub-Contractor, approved by the Architect.

2. STORAGE

Storage of materials to be used on the job shall be, only in a single place approved by the Architect. Such storage place, shall not be located within any of the buildings included in the contract.

3. MATERIALS

Materials used in the work shall be of manufacture approved by the Architect., Ready mixed paints, varnishes, enamels, lacqures, stains, paste fillers, distempers and other materials must be delivered to the job site in the original containers, with the seals unbroken and labels intact. Each container shall give the manufacturer's name, type of paint, color of paint and instructions of reducing. Thinning shall be done only in accordance with directions & manufacturer's specification. Remove rejected materials immediately from the premises.

4. SHADES

All shades, as provided in the shade schedule, shall be approved by the Architect. The Contractor shall as far as possible use pre-mixed manufacturer's shades and shall prepare sample of the shades selected and submit same for approval by the Architect. No work is to proceed until the Architect has given his approval, preferably in writing, of the shade samples.

5. COMMENCEMENT OF WORK

Painting / finishing shall not be started until the surfaces to be painted / finished are in a condition fit to receive painting / finishing and so certified by the Architect.

Painting / finishing work shall be taken in hand only after all other civil work is completed.

Buildings where painting / finishing work is to commenced shall be thoroughly swept and cleaned up before commencement of painting / finishing.

6. SCAFFOLDING

Only double scaffolding having two sets of vertical supports shall be provided for all, painting / finishing work. The supports shall be tied together with horizontal pieces over which the scaffolding planks shall be fixed.

All the vertical and horizontal members of the scaffolding shall be placed sufficiently away from the surfaces to be painted to ensure proper and unit erupted application.

7. WORKMANSHIP

The workmanship shall be of the very best, all materials evenly spread and smoothly flowed as without running sags, using good quality tools, brushes, etc., as required. Only skilled painters / applicators shall be employed. A properly qualified foreman shall be constantly on the job whilst the work is proceeding. All surfaces to be painted / finished shall be cleaned free of all loose dirt and dust before painting / finishing is started. AII work where a coat of material has been applied must be inspected and approved before application of

the succeeding specified coat. Each undercoat shall be distinct shade of the approved color.

Before painting / finishing, remove hardware, accessories, plates and similar items or provide proction to all such items. Upon completion of each space, replace all fixtures removed. Remove doors if necessary to paint bottom edge. Use only skilled mechanics for the removal and replacement of above items.

8. CONCEALED SURFACES

All interior and exterior trim, door frames, doors, shelving, cabinet work shall be thoroughly and carefully back painted as all surfaces and edges which will be concealed when installed. Such surfaces shall be clean, dry, sanded and properly prepared to receive the paint. Tops, bottom and edges of doors shall be finished same as the rest of the door.

9. PROTECT AND CLEAN

The agency shall protect not only his own work at all times, but shall also protect all adjacent work and materials by suitable covering during progress of his work. Upon completion of his work, he shall remove all paint and varnish spots from floors, glass and other surfaces. Any defaced surfaces shall be cleaned and the original finish restored. He shall remove from the premises all rubbish and accumulated material and shall leave the work in clean, orderly and acceptable conditions.

10. PREPARATION OF SURFACES

WOOD: Sand paper to a smooth even surface and then dust off and wipe clean. Touch up all knots and pit pockets with shellac on interior wood and without distiller on exterior work. After priming coat has been applied thoroughly fill all nail holes, irregularities and cracks. Use plaster wood filler for stained or natural finish and putty for painted work.

PLASTER WORK: Fill all holes, cracks and abrasions with plaster of parish / cement slurry as directed, properly prepared and applied and smoothed off to match adjoinint surfaces. Do not use sand paper on plaster surfaces. Plaster shall be allowed to dry for at least 12 (twelve) weeks before the application of paint / finishes.

STEEL AND IRON: All surfaces shall be washed with mineral spirits to remove any dirt or grease before applying paint. Where rust or scale is present, it shall be wire brushed and sand papered clean. All cleaned surfaces shall be given one coat of approved phosphate before prime coat in accordance with the manufacturer's, Instructions. Shop coats of paint that have become marred shall be cleaned off, wire brushed, and spot primed over the affected areas.

GALVANISED METAL: Galvanized metal shall be thoroughly cleaned with naphtha and treated with a solution consisting of 5 gallaons of 36% acetic acid, 1.36 kg of blue vitrol and 1.36 kg of powdered alum dissolved in 225 liters of water, prepared in a wooden container and applied with a brush. Allow to dry thoroughly and brush off before applying paint.

11. APPLICATION

The paint shall be continuously stirred in the container so that its consistency is kept uniform throughout.

The painting / finishing shall be laid on evenly and smoothly by means of crossing and laying off, the latter in the direction of the grain of the wood. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time and then brushing alternatively in opposite directions, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process no brush marks shall be left after the

laying off is finished. The full process of crossing and laying off will constitute one coat.

Where so stipulated, the painting / finishing shall be carried out using spray machines suited for the nature and location of the work to be carried out. Only skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner. Spraying shall be carried out only in dry conditions. No exterior painting / finishing shall be done in damp foggy or rainy weather. Surface to be painted shall be clean, dry, smooth and adequately protected from dampness. Each coat shall be applied in sufficient quantity to obtain complete coverage, shall be well brushed and evenly worked out over the entire surface and into all corners, angles and crevices allowed to thoroughly dry. Second coat shall be of suitable shade to match final color, and shall be approved by the Architect before final coat is started. Allow at least 48 hours drying time between coats for interior and 7 days for exterior work, and if in the judgment of the Architect more time is requested it shall be allowed. Finished surfaces shall be protected from dampness and dust until completely dry. Finished work shall be uniform of approved color, smooth and free from runs, sags, defective brushing and clogging. Make edges of paints adjoining materials of colors sharp and clean, without overlapping.

In order to achieve a superior finished surface, putty paste fillers shall be used on, all surfaces to be painted. To fill pores, dents, etc. The putty / paste fillers shall be approved quality and manufacture and shall be applied to the surface with a knife or other sharp edged tools after the priming coat as well as after each undercoat. The surface, after filling with putty / paste tiller, shall be rubbed down with fine sand paper and dusted off before the application of the subsequent coat.

Paste wood filler when set shall be wiped across the grains of the wood and then with the grain to secure a clean surface. Surface to be stained shall be covered with uniform coat of stain wiped off if required.

FINISH: The painted surfaces shall be finished to require texture. Matt finish shall be achieved by use of sponge rollers or stippling brushes as called for.

12. TYPES OF PAINT FINISHES

Enamel Paint:

a. Wood or Plastered Surfaces: Pigmented priming coat followed by one undercoat and two more finishing coats of enamel paint. Paste filler to be applied after every excepting the final finishing coat and sanded.

b. Non-Galvanized Steel Surfaces: Coat of red oxide primer after phosphating followed by the three or more coats of synthetic enamel paint. Paste filler to be applied after every coat excepting final finishing coat and sanded.

c. Galvanized Steel Surfaces: Priming coat of galvanized metal primer after washing with galvanized metal cleaner, followed by three or more coats of synthetic enamel paint. Paste filler to be applied after every coat excepting final finishing coat and sanded.

PLASTIC EMULSION PAINT

Pigmented priming coat (emulsion thinned with water) followed by three or more finishing coats of plastic emulsion paint. Paste filler to be applied after every coat excepting final finishing coat' and sanded.

OIL BOUND DISTEMPER.

Pigmented primer (cement primer) coat followed by three of more finishing coats of oil bound distemper. Paste filler to be applied after every coat excepting final finishing coat and sanded.

GRANITE FLAKE FINISH

Providing and applying Exterior Grade Granite Flake type textured two coat homogenous wall coating of approved shade(s) manufactured by Bakelite Hylam Ltd. (Heritage Surface Textures) eqv., consisting of a two component system of dry flakes made of special grade of China Clay and acrylic copolymer bonding agent making up the first coat and a second coat of selvent based acrylic lacquer together forming the system with applied thickness of dry coating being1.5mm to be applied on two coat sand faced smooth level plaster without keying on plastered surface as per the manufacturer's specifications and Architect's Instructions in the required pattern.

GRANULE FINISH

Providing and applying Exterior Grade Granules textured double coat homogeneous wall coating of approved shade(s) manufactured by Bakelite Hylam Ltd. (Heritage Surface Texture) eqv. consisting of a two component system of dry granules of 92% silica particles coated with fade proof pigments and acrylic copolymer bonding agert making up the first coat with thickness of applied dry coating being 1.5-2 mm to be applied on two coat sand faced smooth level plaster without keying on plastered surface with a second coat of solvent based acrylic lacquer coating clear gloss / matt as per the manufacturer's specification and the Architect's instructions in the required pattern.

CLADDING

GENERAL

Specification of stone cladding on Masonry or Concrete surfaces in cement mortar of specified proportions and specified size - shape of stone and thickness or as per schedules of quantities, including scaffolding, curing, finishing etc.

MATERIALS

STONES : As specified in relevant specifications S-48 to S-52.

MORTAR : Stone slabs / panels as per design drawings to be laid on prepared surface in cement mortar 1:3 of 12mm thick.

SCAFFOLDING : As specified in MASONARY WORK scaffolding.

PREPARATORY WORK

As specified in PLASTERING Preparatory work.

STONE CLADDING WORK

The surface on which the stone slabs are to be cladded shall be cleaned or all dust and saturated with water, the stone slabs/panels shall be set in cement slurry over 12mm thick cement mortar (1:3) as specified above and as per the design drawings and instructions, and tamped with wooden mallet. The stone cladding shall be done in approved pattern in line, and require shape. The bedding shall be allowed to harden for 24 hours before the stone cladding is done. The joints shall be grouted with cement mixed with suitable pigment as to match stone, and cured for 7 days. The work should be in true plumb, no undulations is permitted; and slight unevenness shall be removed. Stone cladding shall be executed in best workman like manner.

WATER SUPPLY, PLUBMING AND SANITARY FITTINGS, DRAINAGE SEWERAGE

A-1. Providing and fixing to wall, ceiling and floor galvanized mild steel tube (Medium grade) of the following nominal bore, tube fittings and clamps including making good the wall ceiling and floor (A) 15 mm dia. (B) 20 mm dia. (C) 25 mm dia. (D) 342 mm (E) 40 mm (F) 50 mm.

MATERIALS

Galvanized mild steel tubes of specified dia. nominal bore shall confirm to I.S. 1239-1068. The galvanized fittings, clamps, etc. required for specified dia. bore pipes shall be of best quality and make as approved by the O.O.W.

WORKMANSHIP
CUTTING, LAYING AND JOINTING
When the tubes are to be cut or retheraded, the end shall be carefully filed out so that no obstruction to bore in offered. The ends of the tubes shall then be threaded confirming to the requirements of I.S. 554-1955 with pipe dies and taps carefully in such a manner as will not result in slackness of joints when the two pieces are screwed together.

The taps and dies shall be used only for straightening screw threads which have become bent or damaged and dies shall not be used for turning of the threads so as to make them slacks as the latter procedure may not result in a watertight joints. The screw threads for tube and fittings shall be protected from edge unit they are fitted.

In jointing the tubes, the inside of the socket and the screwed end of the tubes shall be oiled and smeared with white or red lead and wapping around with a few turns of fine spun yarn round the screwed end of the tube. The end shall then be tightly screwed in the socket, tees, etc. with a pipe wrench. Care shall be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust, and dirt during fixing. But joints shall be removed after screwing. After laying, the open ends of the pipes shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

Any threads exposed after jointing shall be painted or in the case of underground piping thickly coated with approved anti-corrosive paint to prevent corrosion.

FIXING OF THE TUBE FITTING TO WALL CEILING AND FLOORS
In case of fixing of tubes and fittings to the walls or ceilings, these shall run on the surface of the wall or ceiling (not in chase) unless otherwise specified. The fixing shall be done by means of standard pattern, holder clamps keepings the pipes about 15 mm, clear of the wall. When it is found necessary to conceal the pipes and when specified so, chasing may be adopted or pipe fixed in ducts or resesses etc. provided that there is sufficient space to work on the pipe with usual tools. The pipe shall not ordinarily be buried in walls or solid floors, where unavoidable, pipes may be buried for short distances provided that adequate protection is given against damages and where so require joints are not buries. Where required M.S. tube sleave shall be fixed at a place a pipe is passing through a wall or floor for expansion and contraction and other movements. In case the pipe is embeded in walls or floors, it should be painted with anti-corrosive bitumastic paint of approved quality. The pipe should not come in contact with time mortar or lime concrete as the pipe is affected by lime. Under the floors, the pipe shall be laid in layer of sand filling.

All pipes and fittings shall be fixed truly vertical horizontal unless unavoidable. The pipes shall be fixed to walls with standard pattern clamps of required size and shape, one end of which shall be properly plugged or cemented into walls with cement mortar

1:3 (1 Cement: 3 coarse sand) and the other tighted round the pipes to hold it security. These clamps shall be spaced at regular intervals in straight length at 2 M C/C interval in horizontal run and 2.5 M. interval in vertical run. For pipe of 15 mm. dia, the holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work or concrete. However for bigger diameter pipes, the holes shall be carefully made of the smallest required size. After fixing the pipe the holes shall be made good with cement mortar 1:3 (1 Cement: 3 Coarse sand) and properly finished to match the adjacent surface.

TESTING OF JOINTS
After laying and jointing, the pipes and fittings shall be inspected under working conditions of pressure and flow. Any joint found leaking shall be redone, and all leaking pipes removed and replaced without extra cost.

The pipes and fittings as they are laid shall be tested to hydraulic pressure of 6 Kg / Sq. cm. The pipe shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock, and water hammer. The draw off takes and stop cock shall then be closed and specified hydraulic pressure shall be applied gradually. The pressure gauge must be accurate. The pipes and fittings shall be tested in sections as the work of laying proceeds keeping the joints exposed for inspection during the testing.

A-2. Providing and laying In trenches galvanized mild steel (Medium grade) of the following nominal bore and tube fittings (earth work in trenches to be measured and paid for separately: (A) 15mm.dia., (B) 20mm. (C) 25mm. (D) 40 mm. (E) 60 mm. (F) 80 mm.

MATERIALS
Galvanized mild steel tube of specified dia. nominal bore and fitting shall confirm to I.S. 1239-1068.

WORKMANSHIP
The relevant specifications of item A-1 shall be followed for cutting, laying and jointing testing of joints except that the fixing of tube shall be done in trenches.

The width and depth of the trenches for different diameters of the tubes shall be us under: For 15 to 80 mm. dia tube width to trenches shall be 30 cm and depth of trenches 60 cm.

At joints, the trench width shall be widened where necessary, the work of excavation and refilling shall be done true to line and gradient in accordance with general specifications of earth work in trenches.

The pipes shall be painted with two coats of anti corrosive bitumasic paint of approved quality. The pipe shall be laid on a layer of 75mm sand filled up to 150mm above the, pipe so specified. The remaining portion of trench shall be then filled with excavated earth. The surplus earth shall be disposed of as directed.

When he excavation is done in rock, the bottom shall be cut deep enough to permit the pie to be laid and cushion of sand 75 mm. In case of bigger diameter of tube where the pressure is very high, thrust book of cement concrete 1:2:4 (1 Cement: 2 Coarse sand: 4 Graded stone aggregate of 20 mm nominal size) shall be constructed on all bends to transmit the hydraulic thrust without imparing the ground and spreading it over a sufficient area if so specified.

A-3. Making connection of galvanized M.S. distribution branch with galvanized, mills steel main 50 mm to 80 mm nominal bore by providing and fixing tee, including cutting and threading the, pipes etc. complete.

MATERIALS
The fittings required of specified dia. of pipe shall confirm to I.S. 1237-1968.

WORKMANSHIP
A pit of suitable dimensions shall be dagat' the point where the connection is to be made with the main and earth removed up to 1500 mm below the main. The flow of water in water main shall also be disconnected by closing the sluice of wheel valves on the mains. The main shall first be cut. Water if any, collected in the pit shall be bailed out, ends of the pipe threaded.

The connections of distribution pipe shall be made by fixing malleable galvanized mild steel tee of the required size and fittings such as jam nut, socket, connecting piece etc.

The testing of the joints shall be done as per relevant specifications of item A-1.

A-4. Providing and fixing to wall ceiling and floor 6 Kg / Sq Cm. working pressure polythene pipes of the following outside diameter low density complete with special flange compression type fittings wall clips etc. including making good the wail/ceiling and floor. (A) 20 mm dia. (B) 25 mm. dia. (C) 32 mm dia. (D) 40 mm. dia. (E) 50 mm. dia.

MATERIALS
The low density polythene pipe of specified diameter with 6 Kg / Sq. Cm. working pressure shall confirm to I.S. 3076-1968. The specials and fitting required shall be of best quality.

WORKMANSHIP
The P.V.C. Pipes of specified diameter shall be fixed as directed. Due to thermal expansion of rigid P.V.C. Pipes, due allowance shall be made particularly in over ground pipe lines for any change in length of pipe fine which may occur during installation or when pipe line is in service.
Above ground installation of rigid P.V.C. pipe should be undertaken after preparations are observed for their protection against direct sun rays and mechanical damage.
The rigid P.V.C. pipe lines should not be kept exposed above ground when if passes through public places, railway lines, road side and foot paths.

P.V.C. pipes shall be supported at the following intervals.
20 mm dia. 500 mm.
22 mm. dia. 750 mm.
32 mm. dia. 900 mm.

Closer support spacing shall be provided if recommended by the manufacture.
The guide lines indicated by the manufacturer regarding, handling, transportation, storing laying and jointing of pipes shall be kept in view during execution.
P.V.C. pipes shall be fixed on wall with wooden plugs and suitable plastic clamps.

JOINTING THE PIPES
The pipes and sockets shall be accurately cut. The ends of the pies and fittings should be absolutely free from dirt and dust. The outside surface of the pipes and the inside of the fittings shall then be roughened with emery paper, and then solvent cement joint. Since solvent cement is aggressive to P.V.C. care must be taken to avoid applying excessive cement to the inside of pipe sockets as any surplus cement cannot be wiped off after jointing. Empty solvent cement tins, brushes rags, or paper unpregnated with cement should not be buried in the trenches. They should be .gathered not left scattered about, as they can prove to be hazard to animals, which may chew them.

If manufacture recommends its own methods of jointing, .the same shall be adopted after necessary approval from the O.O.W.

LAYING PIPES IN TRENCHES
The pipes shall be laid over uniform relatively soft fine grained soil found to be free of presence of hard objects such as large flints, rocky projections, large tree roots etc. The width of the trenches shall be minimum width required for working.

The pipes laid underground shall not be less than one meter from the ground level. The pipe shall be positioned in the trenches so as to avoid any induced stresses due to deflection. Any deviation required shall be obtained by using proper type of rubber ring joints.

B-1. Providing and fixing water closet squatting pan (Indian type W.C. Pan) size 580 mm. (Earth work, bed concrete, foot-rests and trap to be measured and paid for separately). Vitreous china. Long pattern white color.

MATERIALS
Water closet squatting pan (India type W.C. Pan) shall confirm to 5.62 Cement mortar shall confirm to S-11.

WORKMANSHIP
The pan shall be sunk into the floor and embedded in a custion of average 15 cm cement 1:5:10 (1 Cement: 5 Fine Sand: 10 Graded stone aggregate 40 mm. nominal size) or as specified. This concrete shall be left 115 mm below the top level of the pan so as to allow for flooring and its bed concrete. The floor should be suitably stopped so that the waste water is drained into the pan. The pan shall be provided with 100 mm. 'P' or 'S' trap as specified in the item B-4 with approximately 50 mm. seal. The joints between the pan and the trap shall be made leak-proof with cement mortar 1:1 (1 Cement: 1 Fine Sand).

B-2. Providing and fixing cast iron spigot and sockets soil waste water and ventilating pipes of the following normal size (B) 75 mm. dia. (C) 100 mm. dia.

MATERIALS
The specified dia. C.I. Spigot and socket soil or waste pipe shall confirm S-68.

WORKMANSHIP
The fixing of C.I. spigot and sockets soil waste and ventilating pipe shall be carried out as per relevant specifications except the C.I. spigot and socket shall be fixed. The joints shall be fixed with cement mortar 1:2 (1 Cement: 2 Sand) and spun yarn. The pipes without cars shall be fixed low all, with M.S. clamps. The pipes with ears shall be secured with 40 mm before steel or iron barrel distance pieces or bobils and strout galvanized iron nails 10 cm long driven into hand wool plugs fixed in walls. Access doors to fittings shall be provided with 3 mm rubber insertion packing and secured without screws to make air and water light.
All soil pipes shall be carried up above the roof and shall have a wire ballon guard or a cowl.

The ventilating pipe or shaft shall be carried out to a height of at least one meter above the outer covering of the roof of the building or in the case of windows in a gable wall or a dormer windows, it shall be carried up to the ridge of the roof or at least two meters above the top of the windows. In case of flat roof to which access for use is provided, it shall be carried out up to a height of at least one meter above the parapet or two meters measured vertically from the top of any windows in opening which may exist up to a horizontal distance of five meters from the vent pipe into such building and in no case shall be carried out to a height less than three meters.

Where ventilating pipe are carried in pipe shafts, the shafts shall be of a minimum size of one meter. If the shafts are also used to give light and air to rooms, the ventilating pipes must be carried out to a horizontal distance at roof level not less than five meter from the site of the shaft.

The sand cast iron pipes above parapet shall be fixed with M.S. clamps and stays. The clamps shall be made from 1.5 mm. thick M.S. flat or 3 mm width band to the required shape and size to fit tightly on the sockets when tightened with screw bolts. It shall be formed of two semi circular pieces with flanged ends of both sides, with holes to fit in the screw bolts and nut 40 mm. dia. M.S. Bars. One end of the stay shall be bent to from a hook to be fixed with clamps by means of bolts and the other end shall be bent for embedding in wall in cement concrete block of size 200 mm. x 100 mm in 1:2:4 mix. The concrete shall be finished to match the surrounding surfaces.

The connection between the main pipe and branch pipes shall be made by using branches and bends with access doors for cleaning.
The waste from lavatories, kitchens basins, sinks, baths and other floor trps shall be separately connected to respective stacks of upper floors. The waste stack of lavatories shall be connected directly to main hole while the waste stack of other shall be separately discharged over gulley trap.
Providing and fixing case iron (spun) Nahni trap of the following nominal diameter of self cleaning design with C.I. Screwed down or hinged grating including cost of cutting and making good the walls and floors: 100 mm. inlet and 50 mm. outlet.

MATERIALS
The cast iron (spur) Nahni trap shall be confirm to S-69. The C.I. hinged of screwed down cover shall be of best quality.

WORKMANSHIP
The Nahni Trap with 100 mm. dia. inlet and 50 mm. dia. outlet shall be fixed as per drawing or as directed.

The rate includes shall be jointed with C.I. pipe 75 mm. dia. with lead joints. The lead joints shall be done in confirmations with I.S. 782-1976.

B-3. Providing and fixing wash down water closer (European type VI.C. Pan) with integral 'P' or 'S' trap including joining the trap with soil pipe in C.M. 1:1 (1 Cement: 1 Fine Sand) (seal and cover to be measured and paid for separately): Vitreous china pattern: In white color.

MATERIALS
Wash down water closet (European type W.C. Pan) shall confirm to S-60. Cement mortar shall confirm to S-11.

WORKMANSHIP
Closet shall be fixed to the floor by means of 75 mm. diameter conter sunk bolts and nuts embedded in the floor concrete using rubber or fiber washers so as not to allow any lateral displacement. The joint between the trap of W.C. and soil pipe shall be made with C.M. 1:1 (1 cement: 1 Fine Sand).

B-4. Providing and fixing 100 mm. size 'P' or 'S' trap for water closet squatting pan including jointing the trap with the pan and soil pipe in cement mortar 1:1 (1 Cement: 1 Fine Sand) Vitreous china.

MATERIALS
The 100 mm. size 'P' or 'S' trap for water closet shall confirm to S-62 Cement mortar shall confirm to S-11.

WORKMANSHIP
'P' or 'S' trap shall be fixed with pan and cast iron pipe with C.M. 1:1. The pan shall be provided with a 100 mm. 'P' or 'S' trap as specified in the with an approximately 50 mm. seal. The joint between the pand and the trap shall be made teak-proof with cement 1:1 (1 Cement: 1 Fine Sand).

B-5. Providing and fixing in C.M. 1:3 (1 Cement: 3 Coarse Sand) a pair of while vitreous china 250 mm x 130 mm foot rest for long pattern squatting pan water closet.

MATERIALS
The pair of white vitreous china foot-rests shall confirm to S-62. Cement mortar shall confirm to S-11.

WORKMANSHIP
After laying the floor, shall be suitably sloped so that the waste water is drained into the pan. A pair of foot-rests of size 250 mm x 130 mm x 30 mm. of white vitreous china shall be set in cement mortar 1:3 (1 Cement: 3 Coarse Sand). The foot-rests shall be fixed at a distance of 175 mm. from the inner edge of the back side of the pan and shall be fixed at convenient angle.

B-6. Providing and fixing 12.5 liters low level flushing cistern with a pair of C.I. or mild steel brackets complete with fittings such as lead valve less syphon, 15 mm. nominal size brass hall valve with polythene float, C.P. brass ball handled unions and coupling for connections with inlet, outlet and overflow pipes, 40 mm. dia. porcelain enameled flush including cutting holes in walls and making good the same and connecting the flush bend with cistern and closet. (Overflow pipe to be measured and paid for separately): Vitreous China in white color.

MATERIALS
The low level vitreous china (Enamel) flushing tank shall confirm to S-65, except that the flushing cistern shall be 12.5 liters low level type as mentioned in the item.

WORKMANSHIP
The low level-cistern shall be fixed firmly on two C.I. or mild steel brackets which shall be firmly embedded in the wall in C.M. 1:4 (1 Cement: 4 Fine Sand)

The height of the bottom of the cistern form the top of the pan shall be 30 Cm. The low level flushing cistern shall be connected to be closet by means of 40 mm. dia. white porcelain enameled flush bend using Indian rubber adaptus joint. The flush pipe shall be securely connected to the cistern outlet by means of coupling nut made of any non corrosive materials non-ferrous metal or galvanized steel. The flush Pipe from the cistern shall be connected to the closet by means of cement or red-lead.

B-7. Providing and fixing 12.5litres high level Col. flushing cistern with a pair C.I. or mild steel brackets, complete with fittings such as shphonic arrangement, 15 mm. nominal size brass ball valve with polythene flat, level G.I. China (60 Cm.) and pull unions and coupling for connections with inlet outlet pipes etc. Including cutting holes In walls and making good the same. (Overflow pipe to be measured and paid for separately).

MATERIALS
The high level C.I. flushing cistern shall confirm to S-66, except that the flushing cistern shall be of 12.5 liters high level C.I. flushing cistern as mentioned in the item.

WORKMANSHIP

The cistern shall be fixed on two C.I. or mild steel brackets which shall be firmly embedded in the wall in cement mortar 1:4 (1 Cement: 4 Fine Sand).
The height of the bottom of the cistern from the top of the pan shall be two meters.

The W.C. Pan shall be connected to the cistern by galvanized steel flushed pipes of 32 mm. nominal internal diameter. The flush pipe shall be used to wall by using clamps. The flush pipe from the cistern shall be connected to the closet by means of cement of red-lead. The flush pipe shall be securely connected to the cistern outlet by means of copuling out made of any corrosive materials non ferrous metal or galvanized steel.

The china and the pull union shall be fixed to the protruding lever arm of the flushing cistern.
The whole installation shall be tested for leak-proof joints and satisfactory functioning.

B-8. Providing and fixing in position with clamps etc. 32 mm. nominal internal dia. galvanized steel tube flush pipe for high level flushing cistern including connecting the flush pipe with cirstern and closet and making good the walls and floors.

MATERIALS
The 32 mm. nominal internal dia. galvanized steel tube flush pipe shall confirm to S-56.

WORKMANSHIP
The W.C. pan shall be connected to the cistern by galvanized steel flush pipe of 32 mm. nominal internal diameter. The pipe shall be fixed to wall by using clamps.
The flush pipe from the cistern shall be connected to the closet by means of closet or red-lead.
The flush pipe shall securely connected to the cistern outlet by means of copuling out made of any non-corrosive materials, non ferrous metal or galvanized steel.
B-9. Providing and fixing C.I. Inlet connection for flush pipe with W.C. Pan.

MATERIALS
The G.I. inlet connection for flush pipe shall confirm to S-56.

WORKMANSHIP
The flush pipe from the cistern shall be connected to the closet by means of cement or red-lead.

B-10. Providing and fixing wash basin with singly hole for pillar code with C.I. or M.S. brackets painted white including cutting holes, and making good the same but excluding hunges, vitreous china flat back wash basin 550 mm. x 400 mm. in white color.

MATERIALS
The white glazed earthenware wash basin shall be 550 cm. x 400 mm. of first quality and make as approved by the O.O.W. The wash basin shall confirm to S-59.

WORKMANSHIP
The wash basin shall be fixed on the wall as and where directed. The wash basin shall be supported on a pair or M.S. or C.I. brackets fixed in C.M. 1:3 (1 Cement: 3 Sand). The bracket shall confirm to I.S. 775-1062. The wall plaster on the rear shall be cut to rest the top edge of the wash basin. After fixing the basin, plaster shall be made good and surface finished to match with the existing one.

The bracket shall be painted white with ready mixed paint.

The C.I. brass trap and union shall be connected to 32 mm. dia. waste pipe which shall be suitably bent towards the wall and which shall discharge into an open dram leading

to a gully trap or direct into the gully-trap on the ground floor and shall be connected to a waste pipe through a floor trap on the upper floors C.I. brass trap and union may not be provided where the surface drain or a floor trap is placed strictly below the basin and the waste is discharged into vertically.

The height of the front edge of the wash basin from the floor level shall be 80 cm.

The necessary inlet, outlet connections and fittings such as pillar cocks. C.P. dress waste trap waste pipe, stop, cock chain wish rubber plug etc. shall be fixed.

B-11. Providing and fixing kitchen sink with C.I. or M.S. Brackets painted white Including cutting holes in walls and making good the same but excluding fittings, vitreous china Sink 600 mm. x 450 mm. x 150 mm. size.

MATERIALS
White glazed vitreous china sink 600 mm x 450 mm x 150 mm shall confirm to S-63.

WORKMANSHIP
The kitchen sink shall be supported on a pair of M.S. or C.I. brackets fixed in cement mortar 1:3 (1 Cement: 3 Coarse Sand). The M.S. or C.I. brackets shall confirm to I.S. 775-1972. The wall plaster on the rear shall be cut to rest over the top edge of the sink. After fixing the sink plaster shall be made good and the surface finished to match with the existing one.

The C.P. brass trap and union shall be connected to 40 mm dia common bore galvanized mild steel waste pipe which shall be suitable bent towards the wall and which shall discharge made on open drain leading to a gully-trap or direct into the gully-trap on the ground floor and shall be connected to a waste pipe through a floor trap on the upper floors, C.P. brass trap and union may not be provided where surface drain or a floor trap is placed directly under the sink and the waste is discharged to it vertically.
The height to front edge of the wash basin from the floor level shall be 80 cm.

B-12. MATERIALS: The C.P. brass waste trap and unions shall be of 32 mm. dia. and of best quality make as approved by the O.O.W.

WORKMANSHIP
C.P. brass waste trap and union shall be connected to 32 mm dia; waste pipe which shall be suitably bent towards the wall and which shall discharge into drain through a floor trap. The C.P. brass waste trap shall be provided for wash basin or sink as the caw may be.
B-13. Providing and fixing 40 mm. dia. C.P. Brass waste for wash basin of sink.

MATERIALS & WORKMANSHIP
The relevant specifications of item B-12 shall be followed except that the diameter of C.P. Brass waste is 40 mm. dia.
B-14. Providing and fixing 32 mm. dia. M.I. Fisher union shall be best quality and make as approved by the O.O.W.

MATERIALS
The 32 mm. dia. M.1 Fisher union shall be of best quality and make as approved by the O.O.W.

WORKMANSHIP
The 32 mm. dia. S-1 Fisher union shall be fixed to wash basin or sink in best workman like manner.

B-15. Providing and fixing 40 mm. dia., M.I. fisher union for wash basin or sink.

MATERIALS & WORKMANSHIP
The relevant specifications of item B-14 shall be followed except the diameter of M.I. fisher union shall be 40 mm. dia.

C-1. Providing and fixing 100 mm. dia sand cast Iron grating for gulley floor or Nahni Trap.

MATERIALS
The 100 mm. dia. sand cast iron gratings for gulley floor or Nahni Trap shall be of best quality and make as approved.

WORKMANSHIP
The cast iron grating shall be provided to gully trap floor or Nahni Trap as the case may be in best workman like manner.

C-2. Providing and fixing 100 mm. dia. C.P. brass shower rose with 15 mm. or 20 mm. Inlet.

MATERIALS
100 mm. dia. C.P. brass shower rose shall confirm to I.S. 2556-1972 part XI and of best quality and make as approved by the O.O.W. The inlet of shower rose shall be 15 mm. dia or 20 mm. dia. as directed.

WORKMANSHIP
The C.P. brass shower rose shall be fixed as directed 15 mm. dia. or 20 mm. dia. G.I. inlet pipe as the case may be.

C-3. Providing and fixing 600 mm x 450 mm bevelled edge mirror of superior glass mounted on 6 mm. thick A.C. Sheet or plywood sheet and fixed to wooden plugs with C.P. brass screw and washers.

MATERIALS
The 600 x 450 mm. size mirror shall be superior glass with edge rounded off or bevelled as specified. It shall be free from flaws specks or babbles and its thickness shall not be less than 6 mm. The glass for the mirror shall be uniformly sliver plated at the back and shall be free from silvering defects. Silvering shall have a protective uniform covering of red-lead paint. The 6 mm. thick plywood shall confirm to S-37.
The 6 mm. thick A.C. Sheets shall confirm to S-24.

WORKMANSHIP
The mirror of 500 mm. x 450 mm. size mounted on A.C. sheet or plywood 6 mm. thick with C.P. brass claps shall be fixed as directed, by fixing wooden plugs in wall and C.P. brass screws and washers. The work shall be carried out hi best workman like manner.

C-4. Providing and fixing 600 x 200 mm. C.P. brass towel rail complete with C.P. brass brackets fixed to wooden plugs with and C.P. brass screws.

MATERIALS
The C.P. brass towel shall be 600 x 20 mm. of best quality as approved by the O.O.W. The brackets shall be of C.P. brass. The rail staff confirm to I.S. 1068-1958.

WORKMANSHIP
The brackets of the towel rail shall be fixed by means of C.P. brass to crews wooden plugs firmly embedded in the wall with C.M. 1:3 (1 Cement: 3 Coarse Sand). The towel rail shall be fixed as and where directed.

C-5. Providing and fixing 600 mm. x 120 mm. glass shelf with C.P. brackets and guard rail complete, fixed to wooden plugs with C.P. brass screws.

MATERIALS
The shall be grounded. The C.P. over brass guard rail shall be of best quality and make.

WORKMANSHIP
The C.P. brass brackets of the glass shelf shall be fixed with C.P. Brass screws to wooden plug firmly embedded in the wall C.M. 1:3 (1 Cement: 3 Coarse Sand). The C.P. guard rail shall be fixed to glass shelf as directed.

C-6. Providing and fixing C.P. brass toilet paper holder.

MATERIALS
The C.P. brass toilet paper holder shall be of best quality and make. The chromium plating shall be of grade 'B' type confirming to I.S. 1068-2958.

WORKMANSHIP
The toilet paper holder shall be fixed in position by means of screws and wooden plugs embedded in wall with cement mortar 1:3 (1 Cement: 3 Coarse Sand).

D-1. Providing and fixing brass screw down bib taps of following size: Polished bright 14 mm. dia.

MATERIALS
15 mm. dia. brass screw down with bright polished finish shall confirm to I.S. 781-1977. The bib coach shall be best Indian make and quality.

WORKMANSHIP
The screw down bib cock 15 mm. dia. as specified above shall be fixed as directed. The threaded portion shall be smeared with white or red-lead and around with a few turns of fine spun yarn round the screwed end of the pipe. The bib cock shall be than screwed and fixed to water tight position.

D-2. Providing and fixing brass screw down bib taps of following size: Polished bright 14 mm. dia.

MATERIALS
The relevant specifications of item D-1 shall be followed except that the bib taps of 20 mm. dia. shall be fixed.

D-3. Providing and fixing Chromium plated brass screw down bib tips of the following size 15 mm. dla.

MATERIALS & WORKMANSHIP
The relevant specifications of item D-1 shall be followed except that brass chromium plated screw down bid tap of 15 mm. dia. shall be fixed.

D-4. Providing and fixing gun metal screw down bib taps of the following size: 15 mm. dia.

MATERIALS & WORKMANSHIP
The relevant specifications of item D-1 shall be followed except that the 0 mm. dia. gun screw down bib tap shall be fixed.

D-5. Providing and fixing gun metal screw down bib taps following size 20 mm dia.

MATERILS & WORKMANSHIP
The relevant specifications of item D-1 shall be followed except that the 20 mm. dia gun screw down bib tap shall be fixed.

D-6. Providing and fixing biller tap capstan head screw down, high pressure with screw shank and back nuts: (A) 15 mm. dia. (B) 20 mm. dia.

MATERIALS
The capstan head pillar tap of specified dia. of C.P. over brass shall be of best quality and shall confirm to I.S. 1795-1961 The pillar taps shall be of tested quality.

WORKMANSHIP
The capstan head pillar tap of specified dia. shall be fixed as directed with required washer of selected leather or rubber asbestos composition or of plastic as directed. The cock shall fixed with pipe line with white zinc end spun yam to make joint water tight. The work shall be carried out in best workman like manner.

D-7. Providing and fixing brass screw down stop cock (A) 15 mm. dia (B) 20 mm. dia. (C) 25 mm. dia.

MATERIALS
The brass screw down stop cock of specified dia, shall confirm to I.S. 781-1977. The stop cock shall be tested quality.

WORKMANSHIP
The stop cock shall be fixed in position by means of Jam nut and socket. The stop cock shall be fixed near the inlet of the water meter or as directed: The joints shall be done with white zinc and spun yarn. The joint shall be tested for leak proofing.

D-8. Providing and fixing gun metal check or non-return valve (A) 15 mm. dia. (B) 20 mm. dia. (C) 25 mm. dia. (D) 32 mm. dia. (E) 40 mm. dia.

MATERIALS
The gun metal check or non return valve shall be fully cleared of all foreign matter before fixing. The fixing of valve shall be done by means of bolts nuts and 3 mm. rubber insertions with flanges of spigot and socketed till pieces, drilled to the same specification as in case of socket and spigot and with flanges in case of flanged pipes. The jointing small be done leak proof.

D-9. Providing and fixing chromium plated brass half turn flush cock of approved quality Incl. fixing in pipe etc. complete (I) 20 mm. dia. (II) 25 mm. dia. (III) 32 mm. dia.

MATERIALS
Chromium plated brass half turn flush cock shall confirm to S-67.

WORKMANSHIP
The half turn flush cock of specified diameter shall be fixed as directed. The flush cock shall be fixed in G.I. pipe line with necessary fittings. The joints shall be made leak proof by using spun yarn and white zinc. The fixing work shall be carried out as per relevant specifications of item D-1.

D-10. Providing and fixing chromium plated bottle trap with necessary coupling of approved quality for wash basin.

MATERIALS
The chromium plated bottle trap shall be of approved make and of test quality. The bottle trap shall be provided with coupling.

WORKMANSHIP
The bottle trap shall be fixed on hand wash basin with wooden gullies and screws as directed. The work shall be carried out in best workman like manner.

E-1. Providing and fixing urinal of approved quality Including connecting the urinal with waste pipe, trap etc. complete: white earthen ware flat back or corner type size 430 mm x 260 mm x 350 mm.

MATERIALS
The white earthenware flat pack or corner type urinal of size 430 mm, 260 mm x 350 mm. shall confirm to S-64.

WORKMANSHIP
The urinals shall be fixed in position by using wooden plugs and screws and shall be at height 65 cm from the floor level to the top of the lip or urinal, unless otherwise ducted. The wooden plugs shall be 50 mm. x 50 mm. at base lappering to 38 mm. at top and 50 mm. in length shall be fixed is wall in cement mortar 1:3 (1" Cement: 3 Coarse Sand). The urinals shall be connected to 32 mm. galvanized mild steel waste pipe which shall discharge in the channel or floor trap. The connection between the urinal and flush or waste pipe shall b e made by means of putty or white clead mixed with chopped hemp.

E-2. Providing and fixing urinal of approved quality including connection, with trap and with integral longitudinal flush pipe squatting: plate pattern white earthenware 50 mm. x 300 mm.

MATERIALS
The squatting plate pattern, white glazed earthenware urinal of 550 mm. x 300 mm. shall confirm to I.S. 771-1063. It shall be of best Indian Make. .

WORKMANSHIP
The squatting plate urinal shall be fixed as directed.

The top edge of the squatting plate shall be flush with the finished floor adjacent to it. It shall be embedded on a layer of 25 mm. thick cement mortar 1:8 (1 Cement: 8 Fine sand) laid over a bed of burnt brick basement 1:5:10 (1 Cement: 5 Fine Sand: 10 Graded brick aggregate 20 mm. nominal size).There shall be 100 mm. dia. glazed earthenware of various china channels as specified with stop and outlet pieces suitably fixed in floor in cement mortar 1:3 (1 Cement: 3 Coarse Sand) and joint finished with white cement. The earth ware vitreous china shall discharge into 65 mm. C.P. brass outlet grating. The trap and fitting shall be fixed as directed.

F-1 Providing and fixing rubber plug for sink or wash basin.

MATERIALS
The rubber plut for sink or wash hand basin shall be best quality and make as approved by the O.O.W.

WORKMANSHIP
The rubber plug with chain shall be fixed in wash basin or sink as directed.

F-2 Providing and fixing hall cock of approved quality as directed (Cooper metal): (I) 25 mm. dia (II) 50 mm. dia.

MATERIALS
The ball cock of specified diameter shall confirm to S-75.

WORKMANSHIP
The ball cock of specified diameter shall be fixed as directed. The fixing of ball cock shall be carried out as per relevant specifications of item No. 23 (A) for joints etc.

F-3 Providing and fixing, ball cock of approved quality as directed. (Abonite (1) 25 mm. dia. (2) 50 mm. dia.

MATERIALS & WORKMANSHIP
The relevant specifications of item No. 23.00.5 (1) shall be followed except that the hall cock of specified dia of Abonic shall be fixed.

G-1 Providing and fixing C.I. Manhole cover 0.60 C.M. x 0.45 C.M. size having weight not less than 35 Kg.

MATERIALS
C.I. Manhole cover of 0.60 x 0.45 cm size shall be best quality. The weight of C.I. cover and frame shall not be less than 35 Kg. The C.I. manhole cover shall be light duty and confirm relevant I.S.

WORKMANSHIP
C.I. Manhole cover shall be fixed as per relevant specifications of Item except that the C.I. cover shall be fixed as and where directed.

G-2 Providing and fixing G.I. rain water spout of 50 mm. dia. and 20 cm length.

MATERIALS
G.I.M.S. pipe of 50 mm. dia shall confirm to S-56.

WORKMANSHIP
The G.I. Pipe of 30 cm fixed as rain water pipe as directed. The pipe shall be fixed about 1/4 dia. below the floor level so as to make approach of water easy. The inlet of pipe shall be rounded off for easy entry of rain water pipe. The pipe shall be fixed in C.M. 1:3.

H-1 Providing and fixing to wall ceiling and floor polythene pipe of specified diameter will 6 Kg / Sq. cm. working pressure outside diameter, low density completion with special, flange compression type fittings wall clips etc. incl. making good the wall, ceiling and floor, (A) 20 mm. dia. (B) 25 mm. dia. (C) 32 mm. dia. (D) 40 mm. dia. (F) 50 mm. dia.

MATERIALS
The low density polythene pipe of specified diameter with 6 Kg / F. Sq. Cm. working pressure shall confirm to I.S. 3076-1968. The specials and fittings required shall be of best quality.

WORKMANSHIP
The P.V.C. pipes of specified diameter shall be fixed as directed. Due to thermal expansion of rigid P.V.C. pipes, due allowance shall be made particularly, in over ground pipe lines for any change in length of pipe line which may occur during Installation or when pipe line is in service.

About ground installation of rigid P.V.C. pipe should be undertaken after precautions are observed for their protection against dirt sun rays and mechanical damage.

The rigid P.V.C. pipe lines should not be kept exposed above ground when it passes through public place, railway lines, roads, road side and footpaths.

P.V.C. pipes shall be supported at the followings intervals:

20 mm. dia.	500 mm
25 mm. dia.	750 mm
32 mm. dia.	900 mm

Closet support spacing shall be provided, if recommended by the manufacturer.

The guide line indicated by the manufacturer regarding handling, transportation, storing, laying and jointing of pipes shall be kept in view during execution.

P.V.C. pipes shall be fixed on wall with wooden plugs and suitable clamps.

JOINTING THE PIPES
The pipes and sockets shall be accurately cut. The ends of the pipes and fitting should be absolutely free from dirt and dust. The outside surface of the pipes and the inside of the fittings shall then be roughened with emery paper, and then solvent cement shall be applied to the matching surface and pushed home and joint. Since solvent cement is aggressive to P.V.C. care must be taken to avoid applying excessive cement to the inside of pipe sockets as any surplus cement cannot be wiped off after jointing. Empty solvent cement tins, brushes, rags, of paper unpregnated with cement should not be buried in the trenches. The should be gathered, not left scattered about, as they can prove to be a hazard to animals which may chew them.

If any manufacturer recommends its own methods of jointing the same shall be adopted after necessary approval from the O.O.W.

LAYING PIPES IN TRENCHES
The pipes shall be laid over uniform relatively soft fine grained soil ground to be free of presence of hard objects such as large flints, rocky projections, large tree roots etc. The width of the trenches shall be minimum width require for working.

The pipes laid underground shall not be less than one meter from the ground level. The pipe shall be positioned in the trenches so as to avoid an induced stresses due to reflection. Any deviation required shall be obtained by using proper type of rubber ring joints.

I.1 Providing and laying (to level or slopes) and jointing with stiff mixture of cement mortar in proportion 1:1 salt glazed stone-ware pipes, following nominal internal diameters Including testing of pipes and joints complete: 100 mm. dia.

MATERIALS
(1) Water shall confirm to S-1 (2) Cement mortar of proportion 1:1 shall confirm to S-11.
(3) 100 mm. dia glazed stoneware pipe shall confirm to S-71.

WORKMANSHIP
The trenches for stoneware pipe drains shall be carried out as per relevant specifications of Item No. A.2 except that the work is for stoneware pipes of 100 mm. dia.

LAYING
The pipes shall be laid accurately and perfectly true to line, level and gradients. Great care shall be taken to prevent sand etc. from entering the pipes. The pipes between two manholes shall be laid truly in a straight line without vertical or horizontal undulation. All junctions and changes in direction and diameter shall be made inside manholes by means of curved tapered channels formed in cement concrete finished smooth and benched on both sides. The body of the pipe shall rest for its entire length, or an even level bed grips being made or left on the bed to receive the sockets of the pipes.

JOINTING
Tarred gaskin or yarn socked in neat cement slurry first be placed around the spigot of each pipe and the spigot shall then be placed well home into the socket of the pipe, previously laid. The pipe shall then be adjusted and fixed in the correct position and gaskin culked home so as to fill not more than 1/4th of the total dept or (13mm in depth) of the socket.

The remainder of the socket shall be filled with stiff mixture of cement mortar in proportion of one part of cement and one part of sharp sand. When the socket is filled, a fillet, shall be formed round the joints trowel, forming an angle of 450 with the barrel of the pipe.

The mortar shall be mixed as necessary for immediate use.

After the joint is made, any extraneous materials shall be removed from the inside of the joints with a suitable scraper of "badger". The newly made joint shall be protected, until set, from the sun, dry winds, rain or frost, sacking or other suitable materials which shall be used for the purpose.
The mortar shall be cured to 10 days.

TESTING OF JOINTS
The pipeline shall be tested as directed.
If any leakage is visible, the defective part of the work shall be made good at no extra cost.
A slight amount of swcating which is uniform may be overlooked, but excessive swcating from a particular pipe or joints shall be watched for and taken as indicating a defect to be made good.

I.2 Providing and laying and jointing salt glazed stoneware pipes with the lime concrete1:2:4 (1 Lime: 2 Fine Sand: 4 Graded brick aggregate 40 mm. nominal size) bedding with necessary form work and curing etc. complete: 150 mm. dia.

MATERIALS & WORKMANSHIP
The relevant specifications of Item J.1 shall be followed except that the cement concrete work shall be carried out for bedding for stoneware pipe of 150 mm. dia. The average thickness of bedding shall be 166 mm. and width shall be 450 mm.
K.1 Providing and fixing S.W. gully trap with Col. grating, brick masonry chamber and water tight C.I. cover with frame of 300 mm. x 300 mm size (Inside) with standard weight: (A) square mount traps 100 mm. x.1 00 mm. size P type.

MATERIALS
(1) Water shall confirm to S-1 (2) Cement mortar of proportion 1:5 shall confirm to S-11 (3) Burnt, brick shall confirm to S-15 (4) The S-W. Gulley trap of 100 mm x 10.0 mm size shall confirm to S-70.

WORKMANSHIP
Excavation for gulley trap shall be done true to dimensions and levels as indicated on plans or as directed. The excavation work shall generally be done as per relevant specification of Item 4.0.0 of earth work.

FIXING
The gulley trap shall be fixed over cement concrete 1:5:10 (1 Cement: 5 Sand: 10 Graded brick bats aggregate 40 mm. nominal size) foundation 650 mm. square and 100 mm. thick. The depth of top of concrete below the ground level shall be 675 mm. The jointing of gulley outlet to the branch drawing shall be done similar to jointing of S.W. pipe as described in Item I.1.

BRICK MASONARY CHAMBER
After fixing and testing gulley and branch drawing a brick masonry 300 x 300 mm. inside with bricks in C.M. 1:5 (1 Cement: 5 Sand) shall be built with a 100 mm. brick work round the gulley trap from the top of bad concrete up to ground level. The space between the chamber walls and the trap shall be filled with cement concrete 1:5:10. The upper portion of the chamber i.e. above the top level of the trap shall be plastered inside with cement mortar 1:3 (1 Cement: 3 Sand) finished with floating coat of neat cement. The corners and bottom of the chamber shall be rounded of so as to slope towards the grating.

C.I. cover with frame 300 mm x 300 mm (inside) size shall than be fixed on the top of the brick masonry with C.C. 1:2:4 (1 Cement: 2 Coarse Sand: 4 Graded stone aggregate 20 mm. nominal size) 40 mm. thick and rendered smooth. The finished top of the cover shall be left about 40 mm., above the adjoining ground level so as to exclude the surface water from entering the gully trap.

K.2 Providing and laying (to level or slopes and Jointing reinforced concrete light duty non pressure pipes I.S. class N.P. 2 of the following internal diameters with collars and buttons prepared for collar Joints Incl. testing of Joints etc. complete (B) 150 mm. (C) 250 mm. (D) 300 mm. (E) 450 mm. (F) 500 mm. (G) 600 mm. (H) 900 mm. (K) 1000 mm. (M) 1200 mm.

MATERIALS
The reinforced concrete light duty non-pressure pipes of specified diameter shall confirm to I.S. 458-1971.

WORKMANSHIP
The relevant specifications of Item No. 24.1 (A) shall be followed for work of trenches except that the excavation in trenches shall be for reinforced concrete pipes of specified diameter.

LAYING
The pipes shall be lowered into the trenches carefully. Mechanical appliances may be used. Where necessary pipe shall be laid in straight lines or with easy curves and true to line and gradient as specified. The laying of pipe shall proceed upgrade of a slope. In the pipe with loose collars, the collars shall be slipped on before the next pipe is laid.

Incase where the foundation conditions are unusual such as the proximity of trees or holes, under existing or proposed around in 150 mm. thick cement concrete 1:5:10 (1 Cement: 5 find sand: 10 graded stone aggregate 40mm. nominal size) or compacted sand or gravel.

Incase where the natural foundation Is Inadequate the pipe shall be laid dieehter in concrete, cradle, supported on proper foundation or on any other suitably designed structure. If concrete bedding is used, the depth of concrete below bottom of the pipe shall be at least 1/4th of the internal diameter of the pipe subject to a minimum of 100 mm. and maximum 300 mm. The concrete shall be extended up to the sides of the pipe at least a distance of 1/4th of the outside diameter for pipes 300mm. and over in diameter.

The pipes shall be laid in the concrete bedding before the concrete has set. Pipes laid in trenched in earth shall be bedded evenly and firmly and as far as up to the naunches of the pipe as to safely transmit the load expected from the back fill through the pipe to the bed. This shall be done either bye excavating the bottom of the trenches to fir the curve of the pipe or by compacting the earth under round curve of the pipe to form an even bed, Necessary provision shall be made for joints wherever required.

JOINTING
The joints shall be done by slipping the collar over and clear of the end of the pipe. The recess of the end of the pipe shall be filled with jute threading dipped in hot bitumen. The new pipe shall then be brought forwarded until the bitumen ring in recess of first pipe is set into the recess of the second pipe. This process shall be repeated for two or three pipes which shall then be jacked up so as to thoroughly compress the bitumen. The quantity of jute and bitumen shall be just enough to fill the recess when pressed hard by jacking, care being taken that no offset of the jute braiding shall be visible either outside or inside of pipes. The collar shall then be set up over the joints covering equally I both the pipe and leaving an even caulking space all round Cement and Sand mortar 1:1.1/2 shall then be well punched or pressed home with a caulking tool within this caulking space. Care shall be taken that the underside of the joints is properly filled with mortar.

CURING
Every joint shall be kept wet for about 10 days for maturing, the section of the pipe line laid and joined shall be covered immediately to protect from weather effects. minimum bore of 100 mm. is considered adequate.

The joints shall be left exposed for observation.

TESTING OF JOINTS
The testing of joints shall be done as per relevant specifications of Item No. 24.1 (A) except that the testing of reinforced concrete pipes shall be done.

K.3 Constructing with R.C.C. top slab In 1:2:4 (1 Cement: 2 Coarse Sand: 4 Graded stone aggregate 20 mm nominal size) foundation concrete 1:3:6 (1 Cement : 3 Coarse Sand: 6 brickbats 40 to 50mm size) Inside plastering 15mm thick with C.M. 1:5 (1 Cement: 5 Coarse Sand) finished with floating coat of neat cement and making channels In C.C. 1:2:4 (1 Cement: 2 Coarse Sand: 4 Stone aggregate 20mm. nominal size) finished smooth complete incl. curing and testing (1) inside size 900mm x 120mm and required depth Including C.I. cover with frame size 560mm diameter, total weight of cover and frame to be not less than 18 Kg (Wt. of cover 64 Kg. and Wt. of frame 64 Kg.) (A) with 230mm thick walls of masonry using brick shaving crushing strength not less than 35 Kg / Sq. cm. in C.M. 1:5 (1 Cement: 5 Coarse Sand).

(I) A type depth 0.90 meter for 150mm sewer.
(ii) B type depth 150 meter for 150mm sewer.
(iii) C type depth 2.25 meter for 150mm sewer.
(iv) D type depth 315 meter for 150mm sewer.

MATERIALS
Water shall confirm to S-1. Cement shall confirm S-6. Burnt bricks shall confirm to S-15, Bricks bats of 40 to 50mm size shall confirm to S-14 stone coarse aggregate to 20mm nominal size shall confirm to S-12. Grit shall confirm to S-8. Cement mortar to specified proportion shall confirm to S-11. The cast Iron manhole cover of 560mm dia with frame shall confirm to I.S. 1726-1966.

WORKMANSHIP
The manholes of different types and sizes as specified shall be constructed in sewer line at such places and to such levels and dimension as shown in drawings or as directed.

BED CONCRETE
The manhole shall be built on a head of cement concrete 1:3:6 (1 Cement: 3 Coarse Sand : 6 Brick bats) (40 to 20mm nominal size) to the thickness of the bed concrete shall be 15 cm for manhole up to 1 M Depth and 20 cm for manholes over meter and up to 2 meters, depth and 30 cm for manholes of greater depth.

Projection of bed concrete beyond the masonry wall shall be 15 cm.

WALLS
The walls or manhole shall be carried out with burnt bricks using bricks, having crushing strength not less than 35 Kg/cm^2 in C.M. 1:5 (1 Cement: 5 Coarse sand). The thickness of brick masonry wall shall be 230 mm. The jointing face of such brick shall be well buttered with cement mortar before laying so as to ensure full joints.

PLASTER
The inside of walls shall be plastered 15mm thick with 1:5 (1 Cement: 5 Coarse Sand) and finished with floating coat of neat cement. All angles shall be rounded to 7.50 cm radius and all rendered internal surfaces shall hard impervious finish obtained by using a steel trowel. The external joints of masonry shall be finished smooth.

CHANNELS & BENCHING
Channels shall be semicircular in the bottom half and of diameter equal to the sewer. Above the horizontal diameter, the sides shall be extended vertically to the same level as the crown of the outgoing pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with the main channel and appropriate fall suitably rounded off in the direction of flow in the main channel shall be given.

The channel and benching shall be done C.C. 1:2:4 (1 Cement: 2 Coarse Sand: 4 Graded stone aggregate 20mm. nominal size) rising at a slop in line from edges of channel. The channels of the bottom of the chamber shall be plastered with C.M. 1:2 (1 Cement: 2 Coarse Sand) and steel trowelled smooth.

COVER SLAB
The cover slab of R.C.C. (1 Cement: 2 Coarse Sand: 4 Graded Stone aggregate 20mm nominal size) 15 cm thick reinforced with 10mm brass at 15 cm c/c both ways, surface and edges finished fair. Full bearing equal to the width of wall shall be given to the slab on all sides. The frame of manhole cover shall be embedded firmly in R.C.C. slab so that the top of the frame remains flush with the top of R.C.C. slab.

TESTING
Manhole shall be tested by filling with water to a depth not exceeding 1.2 M as directed.
After completion of work, manhole covers shall be seated by means of thick grease.

K.4 Providing and fixing C.I. steps of size 500 x 150mm x 22.5m and painting with two coats of anti corrosive paint etc. complete.

MATERIALS
The C.I. steps of size 500 x 150 x 22.5mm size shall Confirm I.S: 5455-1969. Paint shall confirm to S-44.

WORKMANSHIP
The C.I. steps of size 500 x 150 x 22.5 mm size shall be fixed in manhole as and where directed. The steps shall be staggered in vertical runs 380mm apart horizontally. The top step shall be 450mm below the manhole cover and lowest not more than 300mm above the benching. The steps shall be embedded in well of manhole with C.C 1:3 up to 200m depth and the surface finished with cement plaster 15mm thick in C.M. 1:5. The steps shall be painted with two coats of anti-corrosive paint.

K.5 Providing and erecting at the site of work steel ventilating column of 150mm internal dia and 1220m. high from G.L. to bottom of top grill Incl. C.I.

grill and, base plate, bolts and nuts etc. and excavation In foundation of size 120 x 120 x 165 cm and filling the pit with 1st layer of cement concrete 1:3:6 mix. (1 Cement: 3 Coarse Sand: 6 Graded stone aggregate 20mm nominal size) of size 120 x 120 x 90 cm and remaining pit with B.B.C.C. 1:3:6 mix. (1 Cement: 3 Coarse Sand: 6 Brick bats 40 to 50mm size) and providing filled in cement concrete 1:2:4 (1 Cement: 2 Coarse Sand: 4 Graded stone aggregate 20mm nominal size) at G.L. and 3 coats of silver paint etc. complete.

MATERIALS

The steel ventilating column internal dia. 150mm 12.20m high shall be of standard make and best quality as approved. Stone aggregate of 20mm nominal size shall confirm to S-12. Brick bats 40 to 50mm. nominal size shall confirm to S-14. Cement shall confirm to S-3. Water shall confirm to S-1. Silver (Aluminium) paint shall confirm to I.S. 2339-1963.

WORKMANSHIP

The vent shaft shall be provided at the starting point of main sewer and at such points where the flow of sewerage is disturbed i.e. at falls, syphons etc. As far as possible, the location shall be such a place where if receive sun rays for the maximum period of the day.

A pit of 120 x 120 x 165 cm size shall be dug. The cement concrete of 1:3:6 (1 Cement: 3 Coarse Sand: 6 graded stone aggregate 20mm nominal size) shall be first in the pit to form 90 cm thick concrete foundation which shall be allowed to set for 24 hours. The vent shaft shall then be erected at the centre of the pit truly in plumb by means of such as shear legs, pullies, tackles and rope etc.

The connection with sewer manhole shall be made using 150mm diameter cement concrete pipe. After the connection is completed the pit shall be filled with cement concrete1:3:6 (1 Cement: 3 Coarse Sand: 6 Brick bats 40 to 50mm. nominal size) round the vent shaft up to ground level except top 150mm. which shall be filled with, C.C. 1:2:4 (1 Cement: 2 Coarse Sand: 4 Graded Stone aggregate 20 mm nominal size) and rendered smooth. The junction of vent shaft with cement concrete shall be grouted with cement mortar 1:1 (1 Cement: 1 Sand). The concrete work shall be cured for 7 days.

The steel shaft shall be painted with silver paint (aluminium paint) 3 coarse. The relevant specifications of item of painting shall be followed for painting.

L.1 Providing and laying lime concrete 1:2:4 (1 Cement putty: 2 fine sand: 4 graded brick aggregates 40mm. nominal size) bedding for stoneware pipes of: following internal diameters with necessary from work and curing complete 100mm. dia. (112 mm average bed thickness).

MATERIALS

Water shall confirm to S-1. Lime mortar shall confirm to S-10. Brick aggregate 40mm. nominal size shall confirm to S-14.

WORKMANSHIP

The relevant specifications of item No. 5.1.8 shall be followed except that the proportion of mix shall be 1:2:4 (1 Lime putty: 2 fine sand: 4 graded brick bats aggregate 40mm. nominal size) and the concrete work shall be done in trenches for, beddings of stoneware pipes of 100 mm. dia. The width of concrete shall be 300 mm. and the thickness of bedding shall be 112mm average.

L.2 Providing and laying lime concrete 1:2:4 (1 Lime putty: 2 fine sand: 4 graded brick aggregates 40mm. nominal size) bedding for stoneware pipes of following Internal diameter with necessary form work and curing complete 150mm. dia. (166 mm. average bed thickness)

MATEIALS & WORKMANSHIP
The relevant specifications of Item L.1 shall be followed except that the concrete bedding shall be carried out for 150mm. dia. stoneware pipe. The width of concrete bedding shall be 450mm. and the average thickness shall be 166 mm.

L.3 Providing self glazed stoneware fittings: Bends of required degree (Any Radius) of following Internal diameters: A-100 mm. dia B-150mm. dia.

MATERIALS & WORKMANSHIP
The relevant specifications of Item No. I.1 shall be followed except that the said flazed stoneware bends of any degree of specified diameter shall be provided.

L.4 Providing self glazed stoneware fittings: Taper bend of required degree of following Internal diameters: 100mm x 15mm.

MATERIALS & WORKMANSHIP
The relevant specifications of Item No, I.1 shall be followed except that the saIf glazed stoneware taper bend of required degree of 100mm. x 150mm. shall be fixed.

L.5 Providing salt glazed stoneware fittings: Single junction of required angle of following Internal diameter (A) 100mm., dia (B) mm. dia.

MATERIALS & WORKMANSHIP
The relevant specification of Item I.1 shall be followed except that the salt glazed stoneware single junction of required angle of specified diameter shall be fixed.

L.6 Providing and laying jointing and pointing with stiff mixture of C.M. 1:1 (1 Cement: 1 Fine sand) 150 mm. internal diameter saIf glazed stoneware half round channels.

MATERIALS & WORKMANSHIP
The relevant specifications of Item I.1 shall be followed except that the half round channels of 150mm. internal diameters shall be fixed in cement mortar 1:1.

M.1 Supplying and fixing C.I. cover 300 x 300mm. without frame for gully trap (Standard pattern), The weight of cover to be not less than 4.53 Kg.

MATERIALS
The C.I. cover of 300 x 300mm. size shall be standard pattern and approved make the weight of C.I. cover shall not be less than 4.53 Kg. without frame.

WORKMANSHIP
The C.I. cover 300 x 300mm. size without frame shall be fixed on top of the brick masonry with cement concrete 1:2:4 (1 Cement: 2 Sand: 4 Graded stone aggregate 20mm. nominal size) 40mm. thick and sendered smooth. The finished top of the cover shall be left about 40mm. above the adjoining ground level so as to exclude the surface water from entering the gully trap.

N.1 Constructing brick masonry road gully chamber 500mm. x 450mm. x 600mm. incl. 500 mm. x 450 mm. C.I. horizontal gratings with frame complete.

MATERIALS

Water shall confirm to S-1. Cement shall confirm to S-3. Sand shall confirm to S-6. Brick shall confirm to 5-15 C.I. grating of 500 x 450 mm. size of standard make shall be approved quality. Stone aggregate 40mm. nominal size shall confirm to S-12. Coal tar shall confirm to relevant S-5.

WORKMANSHIP
The chamber shall be 3 of size 500 mm. x 450 mm. internal clear dimensions between the masonry wall faces. The height of 500 mm. shall be measured from the top of the head concrete to the top of the C.I. frame. The size of the grating indicates the clear internal dimensions of the C.I. Frame of the gratings.

The excavation shall be done to true dimensions and levels.

The foundations concrete shall consist of 15 cm. x 130 cm. 15 cm thick C.C. ,1:5:10 (1 cement: 5 sand: 10 graded stone aggregate 40 mm. nominal size).

The wall of the chamber shall be constructed in brick work with C.M. 1, 5 and 23 cm thick as per relevant specifications.

The walls and the bed, concrete of chamber shall be plastered inside with 12mm. thick cement plaster 1:3 (1 cement: 3 coarse sand) finished smooth.

The gully grating cover shall be hinged to frame to facilitate its opening for leaning and repairs. The frame of the gully gratings shall be fixed on the top of masonry walls of the chamber in 15 cm thick C.C. 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20mm. nominal size) laid over the full thickness of walls.

The chamber shall have connection pipe, the length of which in meter between the road fully chamber and the manhole of the drain shall not be less than 1.40 times the nominal diameter of the pipe in M.M. i.e. for 150 mm. connection pipe, the length shall not be less than 3.75 meter. The invert of the pipe at the junction with the walls shall be flush with the top of the cement plaster on the bed concreted.

PAINTING
After the completion of the work the exposed surface of the grating, and the frame shall /be painted with a thick coat of coal tar.

N.2 Constructing road gully chamber 450 mm. x 450 mm. x 775 mm. with vertical grating complete.

MATERIALS & WORMANSHIP
The relevant specifications of Item No.1 shall be followed except the size of road fully chamber is 450 mm. x 450 mm. x 775 mm. with vertical grating complete.

N.3 Constructing brick masonry road gully chamber 1100 mm. x 500 mm. x 775 mm. incl. 500 mm. x 450 mm. C.I. horizontal grating with frame and vertical grating complete.

N.4 Constructing brick masonry chamber for underground C.I. Inspection chamber and bends with brick having crushing strength not less than 35 Kg/cm^2 in C.I. 1:5 C.M. cover with frame (light duty) 445 x 610 mm. internal dimensions, total weight of cover with frame to be not less than 38 kg. (wt. of cover 23 and wt. of frame 15 kg.) R.C.C. top slab with C.C. 1:2:4 mix. (1 cement: 2 coarse sand: 5 graded aggregate 20 mm. size) foundation concrete 1:5:10 inside plaster 15 mm. thick with C.M. 1:3 finished smooth with a finished coat of neat cement on walls and bed concrete etc. complete. Inside dimensions 450 mm. x 610 mm. of required depth for single pipe line.

MATERIALS
Water shall conform to S-1. Cement shall confirm S-3. Coarse sand shall confirm to S-5. Brick shall confirm to S-15 stone aggregate shall confirm to S-12. Brick bat shall confirm to S-14 M.S. bar shall confirm to S-18.

WORKMANSHIP
C.I. inspections chamber with provisions of C.I. bends of specified size with bolts, nuts and left washers for underground drain shall be enclosed in masonry chamber which shall be constructed as under:
The excavation shall be done true to dimensions and levels shown on the plans or as directed.
Bed concrete shall be of 15 cm thick C.C. 1:5:10 (1 cement: 5 coarse sand: 10 graded brick bat aggregates). The projections of bed concrete beyond the masonry walls shall be 7.5 cm.
Masonry walls and plaster work shall be carried out as per relevant specifications of Items No.1.
The cover slab shall be constructed as per relevant specifications.

N.5 Constructing brick masonry chamber for underground C.I. inspection chamber and bends with brick having crushing strength not less than 35 kg./cm^2 in C.M. 1:1:5 C.I. cover with frame (light duty) 455 x 610 mm internal dimensions, total weight of cover with frame to be not less than 38 kg. (wt. of cover kg. and wt. of frame 15 kg.) R.C.C top slab with C.C. 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm. size) R.C.C. top slab with C.C: 1:2:4 mix (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm. size) foundation concrete 1:5:10 inside plaster 15 mm. thick with C.M. 1:3 finished smooth with a floating coat of neat cement on walls and bed concrete etc. complete. Inside dimensions 50 mm, 700 mm and 450 mm deep for pipe line with one or two inlets.

MATERIALS & WORKMANSHIP
The relevant specifications of Item No.4 shall be followed except that the inside dimension of brick masonry chamber shall be 500 mm. and 450 mm. deep for pipe line with one or two inlets.

N.6 Constructing brick masonry chamber for underground C.I. inspection chamber and bends with brick having crushing strength not less than 35 kg / cm^2 in C.I. 1:5 C.M. cover with frame (light duty) 455 x 610 mm. internal dimensions, total weight of cover with frame to be not less than 38 Kg. (wt. of cover 23 kg. and wt. of frame 15 Kg.) R.C.C. top slab with 1:2:4 mix (1 cement: 2 coarse sand: 4 graded stone aggregate 20m. size) foundation concrete 1:5:10 inside plaster 15mm. thick with C.M. 1:3 finished smooth with a finished smooth with a finishing coat of neat cement on walls and bed concrete etc. complete. Inside dimensions 600mm, 850mm and required depth for pipe line with three or more inlets.

MATERIALS & WORKMANSHIP
The relevant specifications of item N-4 shall be followed except that the inside dimension of brick masonry chamber shall be 600mm x 850mm and 450mm. deep for pipe lines with three or more inlets.

O.1 Providing soak pit of 2 cum. volume incl. excavating and filling brick bats with dry masonry work at top for 450 cm height incl. conering the top with stone incl. providing vatas in C.M. 1:3 with finishing, curing etc. compete as directed.

MATERIALS

Water shall confirm to S-1. Cement mortar shall confirm to S-11. Burnt Brick shall confirm to S-15. Rough stone slab 40x50 mm. thick shall confirm to S-48. Brick bat shall confirm to S-14.

WORKMANSHIP

The excavation for soak pit shall be carried out as per relevant specifications except that the size of soak pit shall be such that the clear volume shall remain 2 cu. m. The diameter and depth shall be as directed.

The perfary of the soak pit shall be provided with dry masonry with burnt bricks in 23 mm thick. The masonry wall be done with best workman like manner in true line and plumb.

The soak pit shall be filled in. with brick bots of burnt brick 40 mm. nominal size in 45 cm height. The work of filling brick-bats shall be done in such a way the no dry masonry shall be damaged during filling of brick bats.

The top of the soak pit shall be covered with rough kotah stone slab 40to 50 mm. thickness. The length of the stone shall be in single piece in length.

The cement mortar 1:3 shall be used to fill up the joints and preparing vatas as directed.

The cement work shall be cured for 4 days.

O.2 Providing soak-pit of 5 cm volume incl. excavating and filling brick-bats with dry masonry work at top for 45 cu m. height incl. covering the top with stone incl. Providing vatas in C.M. 1:3 with finishing curing etc. complete as directed.

MATERIALS & WORKMANSHIP

The relevant specifications of item 0.1 shall be followed except that the volume of soak pit shall be 5 cum. clear.

SITE DEVELOPMENT

The Contractor will do all site development as per the Architects Drawings, including the Parking Area, Paving, Hard and Soft Landscaping, Installation of Waste Baskets, Spit cans, Planters etc. as per the detail drawings and specifications:

The Construction Manager / Contractor will take special care to ascertain that all trees planted are properly guarded by tree-guards, watered regularly and are kept free of toxic civil / other wastes.

The tree varieties to be planted will be as per the scheduled drawings supplied by the Architect.

TECHNICAL SPECIFICATIONS FOR ELECTRICAL

1. Wiring Rules:

The installation generally shall be carried out in conformity with relevant Indian Standard Specifications and code of practices prevalent, Indian Electricity Rules, 1956 and Indian Electricity Act, 1910 as amended from time to time.

2. Definition:

The definition of terms shall be in accordance with Indian Standard code of Practice for Electrical wiring Installation IS- 732-1982 except for the definition of point in case of Internal Electrical Installation. For definition of point wiring and measurement of Electrical works IS-5908-1970 shall be referred to.

3. Voltage and Frequency of Supply:

All current consuming devices shall be suitable for frequency of 50 C/s and system of voltage meant for unless otherwise specified.

4. Layout of wiring and its description :

(i) The wiring shall be carried out as per Schedule "power" wiring must be in screwed conduit and shall be kept s eparate and distinct from lighting wiring. All wiring must be done on the distribution system with main and branch distribution boards at convenient centers and without isolated fuses. All conductors shall be run as far as possible along the walls and ceiling as to be easily accessible and capable of being thoroughly inspected. The balancing of circuits will be arranged before hand by the Ex. Engineer Electrical Division.

(ii) Within one month of the taking over the installation, the contractor shall supply to the Ex. Engineer, Elect. Division a complete set of wiring diagrams of the same on drawings to be supplied when available by the Executive Engineer, Electrical Division, and to the satisfaction of the Ex. Engineer, Elect. Dn. and these Wiring plans shall be "Drawings" within the meaning of the term as used in the General Conditions of contract.

5. Conductors:

All conductors unless otherwise specified shall not be less than 1.5 Sq. mm for point wiring and 2.5/4 Sq. mm for mains Conductors for power and lighting circuits shall be of adequate size to carry the designed circuit load without exceeding the permissible thermal limits for the installation, and such sizes will be stipulated in specifications and or drawings.

6. Cables:

All cables shall conform to relevant Indian Standards.

Conductors of all cable except the flexible cable shall be of aluminum. The smallest aluminum conductors for the final circuit shall have nominal cross sectional area of not less than 1.5 Sq. mm. The minimum size of the aluminum conductors for power wiring shall be 4 sq.mm

Conductors of flexible cables shall be of copper. The minimum cross sectional area of such a cables shall be 14.0193 mm.

Unless the flexible cables and conductors are protected by armor or though rubber or PVC Sheath, these shall not be used in workshops and other places where they are liable to mechanical damage.

Core flexible cables shall be used for connecting single phase Appliances for phase, neutral & earth connections.

7. Fall of Potential:

The cross sectional area of all conductors inside buildings shall be so proportioned to their lengths that the drop in voltage between main fuses and the farthest point or any lamp shall not exceed three percent of the voltage of the consumer's With all the consuming devices in use.

7.1 If the CABLE SIZE is increased to avoid the voltage drop in circuit current rating of the cable shall be more than that for which the circuit is designed. In each circuit or sub circuit every cable shall have a current rating not less

than that of the fuse which protects the circuit or sub circuit respectively for current higher than the full load current.

8. Ratings of lamps and fans socket out lets: Points and exhaust fans

In conedscent lamps installed in residential and non-residential buildings shall be rated at 60 watt as & 100 watts respectively.

Table fans and ceiling fans shall be rated at 60 watts, exhaust fan shall be rated according to their capacity.

5 Amp. socket outlet points and 15 Amp. Sockets outlet points shall be rated at 100 watts and 1000 watts respectively for the purpose of load assessment unless actual values of the load are know or specified.

9. Tests:

Before the installation is commissioned following tests shall be carried out.

(1) Insulation Resistance test

(2) Polarity Tests of Switches

(3) Earth continuity tests

(4) Earth electrodes Resistance test

The insulation resistance shall be measured between earth and the whole system of conductors or any section thereof with all fuses in place and all switches closed, and except in earthed concentric wiring all lamps in position or both poles of the installation otherwise electrically connected together a direct current pressure of not less than twice the working pressure provided that it need not exceed. 500 volts for medium voltage circuits where the supply is derived from the three wire D.C. or a poly phase A.C. System, the neutral pole of which is connected to earth either direct or through added resistance, the working pressure shall be deemed to be that which is maintained between the phase conductor and the neutral.

The insulation resistance shall also be measured between all conductors to one pole or phase conductor of the supply and all the conductors connected to the neutral or. to the order pole or phase conductors of the supply with all lamps in position and switches in 'OFF' position and its value shall be not less than in that specified in Sub Clause 9.2.1.3.

The insulation resistance in Me ohms measured as above shall not be less than 50 Me ohms divided by the number if outlet or when PVC insulated cables are used for wiring 12.5 me ohms divided by number 10 outlets

Where a whole .installation is being tested, a lower value than that given by the formula, subject to a minimum of 1 mega ohm is acceptable.

A preliminary and similar test may be made before lamps, etc. are installed and in this event the insulation resistance to earth should be not less than 100 meg a ohms divided by the number of outlet or when PVC insulated. Cables are used for wiring 25 mega ohms divided by number of outlets.

The term "Outlet" includes every switch except that a switch combined with a socket outlet; appliance or lighting fitting is regarded as one outlet.

Control rheostat heating and power appliance and electric sign may, if required, be disconnected from the circuit during the test, but in that event the insulation resistance between the case or frame work, and all live parts of each rheostat, appliance and sign, shall be not less than that specified in the relevant Indian Standard Specification or where there is no such specification shall be not less than half' a mega ohm.

Polarity Test :

In a two wire installation a test shall be made to verify that all switches in every circuit have been fitted in the same conductor through' out & such conductor shall be labeled or marked for connection to the phase conductor or to the non-earthed conductor of the supply.

In a three wire or a four wire installation a test shall be made to verify that every non-linked single pole switch is fitted in a conductor which is labeled or marked for connection to one of the phase conductor of the supply.

The installation shall be connected to the supply for testing. The terminals of all switches shall be tested by a test lamp one lead of which is connected to the earth. Glowing of test lamp to its full brilliance when the switch is in 'on' position irrespective of appliance in position or not shall indicate that the switch is connected of the right polarity,

Earth Continuity Test :

The earth continuity conductor including metal conduits and metallic envelops of cables in all cases shall be tested for electric continuity and the electrical resistance of the same along with the ear thing lead but excluding any added resistance or earth leakage circuit breaker measured from the connection with the earth electrode if any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

Earth Electrode Resistance Test :

Earth electrode Resistance test may be carried out by Meggar Earth Testers containing a direct reading ohm-meter a hand driven generator and auxiliary electrodes

9.3 On completion of an electric installation (addition and alteration) a certificate shall be furnished by the contractor countersigned by the certified Supervisor under whose direction supervision the installation was carried out. This certificate shall be in the prescribed form as given in Appendix-'B' in addition to the test certificate:!required by Local Electrical Supply Authorities.

10. Joint and looping back:

Unless with the sanction of Ex, Engineer Electrical Divisions all joints in conductor shall be means of approved mechanical connectors in suitable and approved junction boxes but looping back system shall be preferable. In wiring unless otherwise specified Phase and live conduct shall be looped at the switch box

where a neutral conductor can be looped from light. fan or socked. In non-residential buildings, neutral and earth continuity wire shall be brought to each of the switch boards should be of adequate size to accommodate at least one number of 5 Amps socket outlet and control switch in future.

11. Switches :

Main Switch gears, Switch Board and their location:

All main switches (other than those of iron clad pattern) carrying current of 10 Amp. and above shall be fitted for back connections land shall be suitably protected.

All switches and circuit breakers shall be constructed in accordance with the I.S. 4237-1967. General requirement for switchgear and control gear for voltage not exceeding 1000 Volts and other relevant I.S..provided also that, spring shall be either of phosphor bronze or if steel shall be copper or Nickel plated and that handle shall be so fastened that they do not tend to unscrew or become loose.

All main switches shall be either of metal clad enclosed pattern or of any insulated enclosed pattern which shall be fixed at close proximity to the point of entry of supply.

Switch boards shall not be erected above gas. stoves', or sinks or within 2.5 m of any washing unit in the washing rooms of laundries or in the bath rooms, lavatories. toilets or kitchens.

Switch boards, if unavoidably fixed in places likely to be exposed to weather. to drip or to abnormal moist temperature the outlet casing shall be weather proof and shall be provided with glands or bushing of adopted to receive screwed conduit according to the manner in which cables are run, PVC and double flanged bushe s shall be fitted in the holes of the switches for entry and exit of wires.

A switch board not be installed so that its bottom is within 1.25 m above the floor unless the front of the switch board is completely enclosed by a door or the switch board is located in a position to which only authorized persons have access.

Switch boards shall be recessed in the wall if so specified in the schedule of work or in the special specification. The front shall be fitted with hinged panel of other suitable material such as Bakelite in wood frame with locking arrangement. the outer surface of door being flush with the walls. Ample room shall be provided at the back for connections and at the front between the switchgear mountings and the door.

Equipment's which are on the front of a switch board shall be so arranged that inadvertently personal contact with live parts is unlikely during the manipulation of switchgears, changing of fuses or like operations.

No holes other than the holes by means of-which the panel is fixed shall be drilled closer than 1.3 cms. from any edge of the panel.

The various live parts, unless they are effectively screened by substantial barriers of non-hydroscopic, no-inflammable insulating material, shall be so spaced that space shall not be maintained between such parts and earth.

The arrangement of gear shall be such that they shall be readily accessible and their connections to all instruments and apparatus shall also be traceable.

In every case in which switches and fuses are fitted on the same pole, these fuses shall be so arranged that the fuses are not alive when their respective switches are in the off position.

No fuses other than fuses in instrument circuit shall be fixed on the back of or behind a switch board panel or frame.

All the metal switchgears and switch boards ~hall be painted, prior to erection with one coat of antirust primer, After erection they shall be painted with two coats of approved enamel or aluminum paint as required on all sides wherever accessible.

All switch boards connected to medium voltage and above shall be provided with 'Danger Notice Plate' conforming to relevant Indian Standards.

12. Control at Point of Commencement of Supply:

There shall be a linked main switchgear with fuse on each live conductor of the supply mains at the point of entry. The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of a linked switchgear The neutral shall also be distinctly marked. In this connection Rule 32(2) of the Indian Electricity Rules, 1966 (See Appendix- 'A') shall also be referred.

The main switchgear shall be situated as near as practicable to be termination of service line and shall be easily accessible without the use of any external aid.

On the main switchgear, where the conductor of a two wire system or an earthed neutral conductor of a multi-wire system or a conductor which is to be connected thereto, an indication of a permanent nature shall be. provided to identify the earthed neutral conductor. In this connection Rule 32(1)of Indian Electricity Rules, 1956 (see appendix. 'N) shall be referred.

Switch Board & Distribution Boards:

Metal clad switch gear shall preferably be mounted on any of the following types of Board.

Hinged type Metal Boards:

These shall consist of a box made of sheet metal not less than 2 mm thick and shall be provided with a hinged cover to enable the board to swing open for examination of the wiring at the back. The joints snail be welded. A teak wood board, thoroughly protected both inside and outside with good insulating varnish conforming to IS : 1347-1952 specification for varnish shellac, for General purpose and of not less than

6.5 mm thickness. shall be provided at the back for attachment of incoming and outgoing cables. There shall be a clear distance of not less than 2.9 cm between the teak wood board and the cover, the distance being increased for larger boards in order that on closing of the cover, the insulation of the cables is not subjected to damage and no short length of cables is subjected to excessive twisting or bending in any case. The board shall be securely fixed to the wall by means of rag bolts, plugs or wooden Gutties and shall be provided with a locking arrangement and an earthing stud. All wires passing through the metal board shall be bunched. Alternatively, hinged type metal boards shall be made of sheet covering mounted on channel or angle iron frame.

Note: Such type of boards is particularly suitable for small switch-boards for mounting metal- clad switchgear connected to supply at low voltages.

Fixed type Metal Boards:

These shall consist of an angle or channel of iron frame fixed on the wall or on floor and supported on the wall at the top if necessary. There shall be a clear distance of one meter in front of the switch board. If there are attachments of base connections at the back of .the switch board Rules 51 (1) (c) of Indian Electricity Rules, 1956 is gall apply.

Note : Such type of boards are particularly suitable for large switchboard for mounting large number or switchgears or higher capacity metal clad switchgears or both.

Teakwood Boards:

For small installations connected to a single phase 230 volts supply teak wood boards may be caused as main boards or sub- board. These shall be of seasoned teak or other durable wood with solid back impregnated with varnish of approved quality with all joints dovetailed.

In large size medium voltage installations, before proceeding with the actual construction of the boards, a proper drawing showing the detailed dimensions and design including the disposition of the mountings, which shall be symmetrically and neatly arranged for arriving at the overall dimensions, shall be prepared and approved by the Engineer-in- charge.

Recessing of Boards:

Where so specified the switch boards shall be recessed in the wall. The front shall be fitted with a hinged panel of teak wood or other suitable materials. such as Bakelite, or with unbreakable glass doors in track wood frame with locking arrangement, the other surface off the doors being flush with the walls. Ample room shall be provided at the back for connection and at the front between the switchgear mountings.

Arrangement of Apparatus:

a) Equipment which is on the front of a switch board shall be so arranged that inadvertently personal contact with live parts is unlikely during the manipulation of switches, changing of fuses or like operation.

b) No apparatus shall project beyond any edge of panel .No fuse body shall be mounted within 2.5 cm. of any edge of the panel and no hole other than holes by means of which the panel is fixed shall be drilled closer than 1.3 cm. from any edge of the panel.

c) The various live parts, unless they are effectively screened by substantial barriers of non-hydroscopic, non-- inflammable insulating material, shall be so spaced that an arc cannot maintain between such parts and earth.

d) The arrangement of the gear shall be such that they shall be readily accessible and their connections to all instruments and apparatus snaII also be easily traceable.

e) In every case in which switches and fuses are fitted on the same pole, these fuses shall be so arranged that the fuses are not alive when their respective switches are in the 'OFF' position.

f) No fuses other than fuses instrument circuit shall be fixed on the back of or behind a switchboard panel or flame.

Marking of Apparatus:

a) Where a boards is connected to voltage higher than 250 volts, all the apparatus mounted on it shall be marked in the following, colors to indicate the different poles or phases to which the apparatus or its different terminals may have been connected.

Alternating Current	**Direct Current**
Three-phase-red, wires Yellow, & blue, Natural-black	Three wire system-2 outer Positive red & negative blue Natural-black

Where fuse-wire three phase wiring is done, the neutral shall be in one Color and the other three wires in another color.

b) Where a board has more than one switch each such switch shall be marked to indicate which section of the installation it controls.

c) All markings required under the rule shall be clear permanent.

13.7.A Main & Branch Distribution Board:

Main and branch distribution boards shall be of any type mentioned in 13.1

Main distribution boards shall be provided with a switch or air circuit breaker on each pole of each circuit, a fuse on the phase or live conductor and a link on the neutral or earthed conductor of leach circuit. The switches shall always be linke

Branch Distribution Board:

Branch distribution boards shall be provided with a fuse or a miniature circuit breaker or both the adequate rating setting chosen on the live conductor of each circuit and the earthed neutral conductor shall be connected to a common link and be capable of being disconnected individually for testing purposes. At least one

spare circuit of the same capacity shall be provided on each branch distribution board.

In residential installations, lights and fans may be wired on a common circuit such sub circuit shall not have more than total of ten points of lights, fans and socket outlets. The load of such circuit shall be restricted to 800 watts. If a separate fan circuit is provided, the number of fans in the circuit shall not exceed ten. Power sub- circuits shall be designed according to the load but in' no case shall there be more than two outlets on each sub-circuits.

In industrial and other similar installations requiring the use of group control of switching operation, circuits, for socket outlets may be kept separate from fans and lights. Normally fans and lights may be wired on a common circuit, however, if need is felt separate circuits may be provided for the two. The road on any low voltage sub- circuit shall not exceed 3000 Watts. In case of new install ation, all circuits and sub- circuits shall be designed by making provision of 20. per cent increase in load due to any future modification. Power sub-circuits shall be designed according to the load .but in no case shall there be more than four outlets in each sub- circuits.

Installation of Distribution Boards :

The distribution fuse-boards shall be located as near as possible to the center of the load they are intended to control.
These shall be fixed on suitable stanchion or wall and shall be accessible for replacement of fuses.

These shall be of either metal-clad type, or all insulated type. But. if exposed to weather or damp situations, they shall be of the weather proof type a nd, if installed where exposed to explodes to explosive dust, vapor or gas, they shall be of flame proof type.

Where two or more distribution fuse boards feed low voltage these distribution boards shall be :

(1) Fixed not less than 2 m apart or,

(2) Arranged so that it is not possible to open two at a time, namely they are interlocked and the metal case is marked 'Danger 415 Volts', or

(3) Installed in a room or enclosure accessible to only authorized persons.

All distribution boards shall be marked 'Lighting', 'Power', as the case may be and also marked with the voltage and number of phases of the supply. Each shall be provided with a circuit list giving details 'of each circuit which it controls .and the current rating of the circuit and size of fuse-element.

Triple pole distribution boards shall not be generally used for final circuit distribution unless specific approval of Engineer- in-charge is obtained. In special cases where use of Triple pole distribution boards are inevitable they. shall be of H.R.C. fuse type only.

Wiring and Distribution Board:

In wiring a branch board, total load of the consuming devices shall be divided, as far as possible, evenly between the number of ways of the boards leaving the spare circuit for future extension.

All connections between pieces of apparatus or between apparatus and terminals on a board shall be neatly arranged in a definite sequence following the arrangement of the apparatus mounted thereon, avoiding unnecessary crossing.

Cables shall be connected to a terminal only by soldered or welded or crimped lugs using suitable sleeve, lugs or ferrules unless the terminal is of such a form that it is possible t6 securely clamp them without the cutting away of cable strands.

All bare conductor shall be rigidly fixed in such a manner that a clearance of at least 2.5 cm. is maintained between conductor of opposite polarity or phase and between the conductors and any material other than insulating material.

If required, a pilot lamp shall be fixed and connected through on independent single-pole switch and fuse to the bus bars of the board.

In a hinged type board, the incoming and outgoing cables shall be fixed at one or more points according to the number of cables on the back of the board leaving suitable space in between cables and shall also, if possible be fixed at the corresponding points on the switch board panel. The cables between these points shall be arranged to form a "U" or "S" shaped loop which shall be of such length as to allow the switch board panel to swing through an angle of not less than 90°.

Capacity of Circuits :

Lights and fans may be issued on a common circuits and such a circuit shall not have more than a total of ten points of lights, fan and socket outlets, or a load of 800 watts whichever is less. The power circuits shall be designed with a maximum of two outlets per circuits generally when load is not known or specified. In non-residential buildings at important District centers however one outlet per circuit may be preferred. The circuit shall be designed based on the loading of the circuit where not specified the load shall be taken as 1 KW per outlet, Where the load is more than 1 KW it should be controlled by a isolator switch or miniature circuit breaker.

Passing Through Walls and Floors:

Where conductors pass through walls one of the following methods shall be employed. Care shall be taken to see that wires pass very freely through protective pipe or box and that the wires pass through in a straight line without any twist or cross in wires, on other ends of such holes.

(a) A teak wood box extending through the whole thickness of the wall shall be buried in the wall and casings or conductors shall be carried so as to allow 1 .3 cm. air space on three sides, of the casing conductor.

(b) The conductor shall be carried either in a rigid steel conduit conforming to *IS: 1653-1964 specification
for Rigid Steel conduits of Electrical wiring (Revised) or a rigid non-metallic conduit conforming to *18 : 2509 1963 specification for Rigid Non-Metallic conduits for Electrical Installations, or in a porcelain tube- of such size which permits easy drawing in, The end of conduit shall be neatly bushed with porcelain, wood or other approved material.

(c) Insulated conductors while passing through floors shall be protected from mechanical injury by means of rigid steel conduit (see *18 1653-1964) to a height not less than t.5 m above the floors and flush with the ceiling below. This steel conduit shall be earthed and securely bushed.

Where a wall tube passes outside a building so as to be exposed to weather, the outer end shall be belt mounted and turned down wards, and properly bushed on the open end.

Fixing to Walls and Ceilings:

Plugs for ordinary walls or ceilings shall be of well seasoned teak or other approved hardwood- not less than 5 cm long 2.5 cm. square on the inner end and 2 cm. square on the outer end. They shall be cemented into walls to width 7.5 mm of the surface, the remaining being finished according to the nature of the surface with plaster or lime punning.

Where owing to irregular crossing or other reasons the plugging of the walls or ceiling with wood plugs presents difficulties, the wood casing, wood batten, metal conduit, or cleat (as the case may be) shall be attached to the wall or ceiling in an approved manner. In the case of new building, wherever possible teak wood plugs shall be fixed in the walls before they are plastered.

To achieve neatness, plugging of walls or ceiling may be done by an approved type of asbestos, metallic or a fiber fixing plug.

17.0 Branch Switches:

Where the supply is derived from a three-wire or four-wire source, and distribution is done on the two wire system, all branch switches shall be placed in the outer or live conductor of the circuit and no single-phase switch or fuse shall be inserted in the middle wire, earth or earthed neutral conductor of the circuit. Single-pole switches (Other than for multiple control) Caring not more than 15 amperes may be of tumbler type which shall be 'CN' when the handle known is down.

Fittings:

Where conductors are required to be threaded through tubes or channels formed in the metal work of fittings these must be free from sharp angles or projecting edges and such size that will enable them to be wired with the conductors used for the final sub Circuits without removing the boarding, taping or outer covering. As far as possible, all tubes and channels should be of sufficient size to permit 'Looping back; of wires .cables and flexible cords other than those designed for high temperature shall not be used for wiring fittings except for portable fit tings. All fittings must have not less than a half inch male nipple. Fittings and lamp holders for gas filled lamps shall be adequately ventilated.

Where light fitting is supported by one or more flexible cords, the maximum weight to which the twin flexible cords may be subjected shall be as follows:

Nominal cross sectional Area cord.	No. & Dia. In mm of wires.	Max. Permissible Weight
mm^2		Kg.
0.5	16/0.2	1.7
0.75	24/0.2	2.6
1.0	32/0.2	3.5
2.5	48/0.2	5.3
3.5	80/0.2	8.8
4	128/0.2	14.0

No inflammable shade shall form a part of light fitting unless such shade is well protected against all risks of fire. Celluloid shade or light fitting shall not be used under any circumstances.

Fitting of Wire :

The use of fitting wire shall be restricted to the internal wiring and the lighting fittings. Where fitting wire is used for wiring, for the sub-circuit" loads shall be terminated in a ceiling zone or connector from which they shall be carried into the fittings.

19.0 Lamp Holders :

Lamp holders for use on brackets and the like shall be in accordance with *IS : 1258 1967, specification for Bayonet lamp holders and all those for use flexible pendants shall be provided with cord grips. All lamp holders shall be provided with shade carriers. Where center contact Edison screw lamp holders are used, the outer or screw contacts shall be connected to the middle wire, the natural, and the earthed conductor .of the circuit.

20.0 Outdoor Lamps:

External and road lamps shall have weather proof fittings of approved design so as to effectively prevent the admission of moisture. An insulating distance piece of moisture proof materials shall be inserted in the fittings. Flexible cord and cord grip lamp holders shall not be used where exposed to whether. In verandahs and similar exposed situations where pendants are used, they shall be of fixed rod type.

21.0 Lamps:

All incandescent lamps, unless otherwise required and suitably protected, shall Be hung at a height of not less than 2.5 m above the floor level. They shall be in accordance with IS : 418 : 1957 specification for Tungsten Filament General Service electric lamps.

22.0 Fans, Regulators and Clamps:

Ceiling fans :

Ceiling fans including their suspension shall conform to *IS 374-1960 specification for electric ceiling fans and regulators (Revised) & to the following requirements:

(a) All ceiling fans shall be wired to ceiling roses or to special connector boxes, to which fans rod wires shall be connected and suspended from hooks or shackles with insulators between hooks and suspension rods. There shall be no joint in the suspension rod, but if joints be avoidable then such joints shall be screwed to special couplers of 5 mm minimum length and both ends of pipes shall touch together within couplers, and shall in addition be secured by means of split pins; alternatively, the two pipes may be welded.

(b) Fans clamps shall be of suitable design according to the nature of construction of ceiling on which these clamps are fitted. In all cases fan clamps shall be fabricated from tested new metal of suitable sizes and they shall be as close fitting as possible. Fan clamps for reinforced concrete roots shall be buried with the casting and due care shall be taken that they shall serve the purpose. Fan clamps for wood beams shall be of suitable flat iron fixed on two sides of the beam and according to the size and section of the beam one or two mild steel bolts passing through the beam shall. hold both flat irons together. Fan clamps for steel joint shall be fabricated from test~ flat iron to fit in rigidly to the bottom flange of the beam. Care shall be taken during fabrication that the metal does not crack while hammering to shape. Other fan clamps shall be made to suit the position, but in all cases care shall be taken to see that they are rigid, and safe.

Note: All fan clamps shall be so fabricated that fans revolve steadily.

(c) Canopies on top and bottom of suspension rod shall effectively hide suspensions and connections to fan motors, respectively.

(d) The lead-in-wire shall be of nominal cross-sectional area not less than 1.0 mm^2 with copper and 1.5 mm^2 with Aluminum and shall be protected from abrasion.

(e) Unless otherwise specified, the clear distance between the ceiling fan and the floor shall be less than 2.75 m.

22.2.0 Exhaust Fans :

For fixing of an exhaust fan, a circular hole shall be provided in the wall to suit the size of the frame which shall be fixed by means of rag-bolts embedded in the wall. The hole shall be neatly plastered with cement and brought to the original finish of the wall. The exhaust fan shall be connected to exhaust fan point which shall be wired as neat to the hole as possible by means of a flexible, cord, care being taken that the blades rotate in the proper direction.

Attachment of fittings and accessories:

In other than conduit wiring, all ceiling crosses, brackets, pendants and accessories attached to walls or ceilings shall be mounted on substantial teak wood block twice Varnished after all fixing holes are made in them. Blocks shall be not less than 4 cm. deep, Brass screws only shall be used for attaching fittings and accessories to their base blocks.

24.0 Interchangeability :

Similar part of all switches, lamp holders, distribution fuse -boards ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable in each installation.

25.0 Conduit Wiring System:

Type and size of conduit - All conduit pipes shall b~ conforming to *IS : 1653-1964, furnished with galvanized or stove enameled surface. All conduit accessories shall be of threaded type and under no circumstances pin grip type or clamp type accessories be used. No steel conduit less than 16 mm in diameter shall be used. The number of insulated conductors that can be drawn into rigid steel conduit are given in Table II.

Bunching of cables - Unless otherwise specified, insulated conductors of AC supply and DC supply shall be bunched 'in separate conduits.

Conduit-joints-Conduit pipes shall be joined by means of screwed couplers and screwed accessories only (*IS : 2667-1964).

Specification for Fittings for Rigid Steel Conduits for Electrical Wiring). In long distance stance straight runs of conduit, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam-puts (in the latter case the bare threaded portion shall be treated with anti - corrosive preservative) shall be provided. Thread on conduit pipes in all cases shall be between 11 mm to 27 mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges nor any or buries left to avoid damage to the insulation of conductors while puling them through such pipes;

NOTE : 1. The cable shows the maximum capacity of conduits for the simultaneous drawing -in of cables. The table applies to 250 volts grade cable. The columns headed 'S' apply to runs of conduit which have distance not exceeding 4.25 M between draw in boxes, and which do not deflect from the straight by angle of more than 15°. The columns headed 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15°.

NOTE: 2 In case of inspection type draw-in box has been provided and if the cables is first drawn through one straight conduit, then through the drawn box, and then through the second straight conduit, such systems may be considered as that of a straight conduit even if the conduit deflects through the straight by more than 15°.

Protection against dampness In order to minimize condensation or seating inside the tube, all outlets of conduit system shall be properly drained and ventilated, but in such a-manner as to prevent the entry of insects as far as possible.

Protection of conduit against rust - The outer surface of the conduit pipes, including all bends, unions, tees junction boxes, etc., forming part of the conduit system shall be adequately protected against rust particularly when such system is exposed to weather. In all cases, no bare threaded portion of

conduit pipe shall be allowed unless such bare threaded portion is treated with anti-corrosive preservative or covered with approved plastic compound.

Fixing of conduit - Conduit pipes shall be fixed by heavy gauge saddles, secured to suitable wood plugs or any other approved plug with screws in an approved manner at an interval of not. more than one meter but on either
side of couplers or bends or similar fittings, saddles shall be fixed at a distance of 30 cm. from the center of such fittings.

Bends in conduit - All necessary bends in the system including diversion shall be done by bending pipes, or by inserting suitable solid or inspection type normal bends, elbows or similar fittings; or by fixing cast iron inspection boxes whichever is more suitable. Conduit fitting shall be avoided as far as possible.
On conduit
system exposed to weather, where necessary, solid type fitting shall be used. Radius of such bends in conduit pipes shall be not less than 7.5 cm. No length of conduit shall have more than the equivalent of four quarter bends from outlet, the bends at the outlets not being counted.

Outlets - All outlets for fitting switches etc., shall be boxes, of suitable metal or any other approved outlet boxes for other surface mounting or flush mounting system.

Conductors- All conductors used in conduits wirings shall preferably be stranded. No single -core cable or nominal Cross - sectional area greater than 130 mm^2 shall be enclosed 'in a conduit and used for alternating current.

Erection and earthing of conduit - The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit and permanently connected to earth conforming to the requirements specified under pipe in a workman like manner for a perfect continuity between each wire and conduit. Gas or water pipe~ shall not be used as earth medium. If conduit pipes are liable to mechanical damage, they shall be ad equitably protected.

Recessed Conduit wiring system with Rigid Steel conduits - Recessed conduit wiring system shall comply with all the requirements for surface conduit wiring system specified in 6.5.1.1 to 6.5.1.1 0 and in addition, conform to the requirements specified in 6.5.2.1 to 6.5.2.4.

Making of chase - The chase in the wall snail be neatly made and be of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of buildings under construction, chases shall be provided in the wall, ceiling etc., at the time of their construction and shall be filled up neatly after erection of conduit and brought to the original finish of the wall.

Fixing of conduit in chase. The conduit pipe shall be fixed by means of staples or by means of saddles not

more than *6G* cm. apart. Fixing of standard bends or elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with a Long radius which will permit easy drawing-in of conductors. All threaded joints of rigid steel conduit shall be treated with some approved preservative compound to secure protection against rust.

Inspection boxes – Suitable inspection boxes shall be provided to permit periodical inspection and to facilitate removal of wires, if necessary. These shall be mounted flush with the wall Suitable ventilating holes shall be provided in the inspection box covers.

Type of accessories to be used - All outlets such as switches and wall sockets, may be either or flush mounting type or surface mounting type.

25.2.5 Flush mounting type - All flush mounting outlets shall. be of cast iron mild steel boxes with a cover of approved insulating material or shall be a box made of a suitable insulating material. The switches and other outlets shall be mounted on such boxes as would be approved. The metal box shall be efficiently earthed with conduit by an approved means of earth attachment.

(b) Surface mounting type - If surface mounting type outlet box is specified, it shall be of any approved insulating material and outlet mounted in an approved manner.

25.25 When crossing through expansion joints in buildings, the conduit sections across the joint may be through flexible conduits of the same size as the rigid conduit.

Conduit Wiring System with Rigid Non-Metallic Conduits:

Rigid Non-Metallic conduits are used for surface. recessed and concealed conduit wiring.

Type and size - All non-metallic conduits used shall conform to IS : 2509-1963 and shall be used with the corresponding accessories (See IS : 3419~ 1965) specification for Fittings for Rigid Non-Metallic. Conduits).

Bunching off cables - Conductors of AC supply and DC supply shall be bunched in separate conduits. The number of insulated cables that may be drawn into the conduits are given in Table III. In this table space factor does not exceed 40 percent.

TABLE-III MAXIMUM PERMISSIBLE NUMBER OF 250 VOLTS GRADE SINGLE-CORE CABLE THAT MAY BE DRAWN INTO RIGID NON-METALLIC CONDUITS

Size of cable

		Size of conduit (mm)					
Nominal cross sectional area mm^2	No. Diameter in mm of wires	16	20	25	32 (Single cable Max)	40	50
1.0	1/1.12*	5	7	13	20	-	-
1.5	1/1.40	4	6	10	14	-	-
2.5	1/1.80	3	5	10	14	-	-
	3/1.06*						
4	1/1.24	2	3	6	10	14	-
	7/0.85*						
6	1/2..80	-	2	5	8	11	-
	7/1.06*						
10	1/3.55+	-	-	4	7	9	-
	7/1.40*-						
16	7/1.70	-	-	2	4	5	15
25	7/2.24	-	-	-	2	2	6
35	7/2.50	-	-	-	-	2	5
50	7/3.00+	-	-	-	-	2	3
	19/1.80						

* For Cu. Conductors only.

+For AI. Conductors only.

Conduit joints - shall be joined by means of screwed or plain couplers depending on whether the conduits are screwed or plain. Where there are long runs of straight conduit. Inspection type couplers shall be provided at intervals. For conduit fittings and accessories reference may be made to IS : 3419-1965.

Fixing of conduits -The provision of 25.1.6 shall apply except that the spacing between saddles or supports is recommended to be 60 cm for rigid non-metallic. conduits.

Bends in conduit - Wherever necessary, bends or diversions may be achieved by bending the conduits (See6.5.3.9) or by employing normal bends, inspection bends, inspection boxes, elbows or similar fittings

Conduit fittings shall be avoided, as far as possible on outdoor system.

Outlets - All the outlets for fittings, switches, etc.. shall be boxes of substantial construction. In order to mini secondensation or sweating inside the conduit, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects: etc. as far as possible.

For use with recessed conduit wiring system the provisions of 6.5.2.1 to 6.5.2.4 shall apply.

Heat may be used to soften conduit for bending and forming joints in case of plaint conduits. As the material soften when heated, fitting of conduit in close proximity to hot surfaces should be avoided. Caution should be exercised in the use of the conduit in locations where the ambient temperature is 50°C or above Use of such conduits in place where ambient temperature is 60°C or above is prohibited.

PVC INSULATED AND P. V.C. SHEATHED OR T.R.S. WIRING SYSTEM

GENERAL :

This system of wiring, is suitable for I()w pressure installation, and shall not be used in places exposed to sun and rain nor in damp places, provided they are sheathed in the special approved protective covering and well protected to withstand dampness.

Attachment to walls and ceiling :

All cables on brick walls, stone *or* plastered walls and ceiling shall be run on well seasoned, perfectly straight and well seasoned, perfectly straight and well varnished on four sides, teak wood or any approved hardwood battens not less than 10 mm finished thick, width of which shall be such as to suit total width of cables laid on the batten, prior to election, these shall be painted with one coat of varnish or approved paint of color to match with surrounding. These battens shall be secured to wall and ceilings by flat head wood screws to raw plug or Phil plug at an interval not exceeding 75 cm. Wood plug can be used only with special approval of the Engineer-in-charge. The flat head wood screws shall be counter within wood batten and smoothed down with file.

Where wiring is to be carried out along the face of the rolled steel joints a wooden batten of adequate width shall first be laid on the same and dipped to it as inconspicuously as possible. The wiring should then be fixed to this backing shall be suitably bushed to prevent the abrasion of the cables.

Attachment to false ceiling :In no case, the open wiring shall be run above the false ceiling without the approval of Engineer-in-charge.

26.20 Link dips: Only aluminum alloy clips/joint clips shall be used. The thickness shall be 0.32 mm (30 SWG) for lengths of 25 mm to 40 mm and 40 mm (28 SWG) for lengths o! 50 mm to 80 mm. The width shall not be less than 8 mm in all these cases. Link clips/joint clips shall be so arranged that one single clip shall not hold more than two core or three single core TRS of PVC insulated and PVC sheathed up to 2.5 sq. mm above while a single clip shall hold a single twin core or two single core cables.

The clips shall be fixed on varnished wood batten switch iron pins and space at interval of 15 cm both in the case of horizontal and vertical runs.

26.3.0 Bends in wiring :The wiring shall not in circumstances be bent so as to form an abrupt right angle but must be rounded off at the corners to a radius not less than six times the overall diameter of the cable.

Protection of wiring from Mechanical Damage:

In cases where there are chances of any damage to wiring, such wiring shall be drawn complying with all the requirements of conduit -wiring system.

Such protective covering shall in all cases be fitted on all down drops within 1.5 m from the floor, or from floor level up to the switch board whichever is less.

26.5.0 Passing through floors: All cables taken through floor shall be enclosed in heavy gauge steel conduit extending 1.5 to above the floor or up to the switch board whichever is less and flush with the ceiling below or by means of any approved type of metallic covering. The ends of all conduits or pipes shall be neatly bushed with porcelain wood or other approved material. The conduit pipes, shall be security earthed.

Passing>through walls: When conductors pass through walls, anyone of the following methods shall be employed. Care should be taken to see that wires pass very freely through protective pipe or box and that wires pass through in a straight line without any twist or cross in wires on either ends of such holes

(a)) A box of teak wood or approved hard wood extending through the hole thickness of the wall shall be buried in the wall and casings or conductors and casing or conductors shall be carried so as to allow 1 .3 cm air space on the three sides of the casing or conductor.

(b) The conductors shall be carried in an approved heavy gauge solid drawn or lap weld conduit or in a porcelain tube of such a size. that it permits easy drawing in, the ends of conduit shall be neatly bushed with porcelain, wood or other approved material,

Where a wall tube passes outside a building so as to be exposed to weather, the outer end shall be mounted and turned downwards and properly bushed on the open end. The conduit shall be neatly arranged so that the cables enter them without bending.

26.7.0 **Buried cables**: The TRS or PVC sheathed cable shall not normally be buried directly in plaster. Where so specified in the special specification they may be taken in tea k wood channeling of ample capacity or conduit pipe buried in the wall.

26.8.0 **Stripping of outer covering** . While cutting and stripping of the outer covering of the cable care shall be taken that the sharp edge of the cutting instrument does not touch the inner insulation of the conductors. The protective outer covering of the cables shall be stripped off near connecting terminal and this protective covering shall be maintained up to the close proximity of connecting terminals as far as practicable. Care shall be taken to avoid hammering on link clips with any metal instrument after the cables are laid. Where junction boxes are provided they shall be made moisture proof with a plastic compound.

APPENDIX - 'A'

Important Clauses of Indian Electricity Rules, 1956.

Following clauses of Indian Electricity Rules, 1956 shall in particular be taken care of in the execution of electrical works

Clause No.	**Subject**

3. Authorization :

29. Construction, installation, protection, opera tion and maintena nce of electric supply lines and apparatus.

31. Cut-out on consumer's premises.

32. Identifica ti on of earthe d and earthed neutral conductors and posi ti on of switches and cutouts therein.

33. Earthed terminal on consumer's premises.

34. Handling of electric supply lines and apparatus.

41. Distinction of circuits of different voltages.

42. Accidental charge.

43. Provisions applicable to protecti ve equipment.

44. Instructions for restoration of persons suffering from electric shock.

45. Preca utions to be adopted by consumers , owners , electrica l contra ctors, Electrica l workmen and suppliers .

46. Periodical inspection and testing of consumer's installation.

48. precautions against lea kage before connecti on.

50. Supply to consumers.

51. Provisions applicable to medium, high voltage installations. Point of commencement of supply.

58. Point of commencement of supply.

59. Precautions against failure of supply; Notice of failures.

61. Connecti on with earth, (low and Medium Voltage system.

64. Use of energy at high and extra -high voltage system.

67. Connecti on with earth. (High & Extra-high voltage system.

68. General conditions as to transformation and control of energy. All clauses under Chapter VIII on Overhead Lines.

137. Mode of entry.

138. Penalty for breaking seal.

139. Penalty for breach of rule-45.

SPECIFICATIONS

All Specification, sstandard. publication etc. sspecified mean the latestt standards. publication etc. pertaining to Electrical Installation and should conform to the following wherever applicable.

1) Indian Electricity Act, 1910 with its amendments .
2) Indian Electricity Rules , 1956 and its amendments .
3) India n Electricity s upply Act, 1948.
4) Regulation for Electrical Equipment in building by I.E.F. Landon.
5) The Factory Act. 1948 and its amendments .
6) I.S.-732-1982 Part-I, II & III code of practice for Electrical wiring and fittings in buildings for low and medium voltages .
7) I.S. 4064-1967 H.D. Airbreak switches and fuses for Voltages not exceeding 1100 volts .
8) I.S. 3043 - Earthing code of practice for
9) I.S. - 1554 Part-I - 1970 PVC insulated (Heavy duty) Electrical Cables for working voltages upto and including 110 volts .
10) I.S. : 694 - 1964 Part- II - PVC insulated cable with Aluminum conduits (revised) for voltages upto 110 volts .
11) I.S: : 5908-1970 - Electrical installations in buildings method of measurements of.
12) I.S.: 4237-1967 - General requirement for switchgear and control gear for voltage not exceeding 1000volts.
13) IS: 1653-1964 - Rigid steel conduits for electrical wiring (revised)
14) IS : 2509-1973 - Rigid s teel conduits for electrical installation. (First revision).
15) IS: 1258-1967 - Bayonet lamp holders (Firs t revi s ion).
16) IS: 418-1957 - Tungs ton-Fi la ment Genera l service electric lamps (Third revision).
17) IS: 374-1966 - Fans and Regulators . ceiling type, electric (second revi s ion).
18) IS : 2667-1964 - Fittings . for rigid steel conduits for electrica l wiring.
19) IS: 3419-1976 - Fitting for rigid non-meta llic conduits (Firs t revis ion).
20) National Electric Code, 1986.

ANNEXURE I
Abstract of the Wiring Rules of the
Institution of Electrical Engineer

Systems :
All electrical system in which all the conductor and apparatus are electrically connected to a common source of supply.

1) **Earthed**: Effectually connected t9 the general mass of the earth. Solidly earthed means earthed without the intervention of a fuse, switch, circuit -breaker, resistor reactor or solenoid.

2) **Un insulated Conductor**: A conductor without provision, by the interposition of a dielectric or otherwise, for its insulation from earth.

3) **Bare**: Not covered with insulating material.

4) **Dielectric** : any material which offers high resistance to the passage of an electric current.

5) **Bunch Conductor**: When more than one conductor is contained within a single duct or groove or when they
are run enclosed and not spaced apart from each other. .

6) **Points**: In wiring as per IS : 5908-1970-Method of measurements of electrical installation in buildings

7) **Switch board**: An assemblage pf switchgear with or without instruments, but the term does not apply to a group of local switches in a final sub-circuit where each switch has its own insulating base.

Note: In the electricity (Factories Act) special regulations,. 1908 and 1944 the term "Switch board" includes "Distribution board" .

8) **Single pole switch**: A switch suitable for closing and or opening a circuit on one pha se or pole only.

9) **Linked switches**: A switch the blades of which are so linked mechanically as to make or break all poles simultaneously or in a definite sequence.

10) **Fuse Switch**: A switch the moving part of which carries one or more fuses.

11) **Three Wire System:.**

a) **Outer Conductor**: Those between which there is the greatest difference of potential. This use of the word outer must not be confused with the use of the work when applied to the external conductor of a concentric main.

b) **Neutral Conductors**: The term includes the natural conductor of a 3 phase 4 wire system, the conductor of a single phase or d.c. installation which is earthed by the supply undertaking (or .otherwise at the source of the supply) and the middle wire or common return conductor of a 3 wire d.c. or single phase a.c. system.

12) **Semi enclosed machine**: One in which the ventilating openings in the frame are covered with

a) Grids expanded metal or wire gauge, with openings of less than 1/4 inch so as t6 obstruct free ventilation.

b) Wire gauge, in which the openings are less than 1/41 inch but not Jess than 3/32 inch (diameter or width) :

c) Screens with smaller openings than the above.

13) **Totally - enclosed Machine**:

One in which the enclosing case and bearings are dust proof and which does not allow circulation of air between the inside and outside of the case.

14) **Pipe Ventilated Machine**: An enclosed machine in which the frame is so. arranged that the ventilating air maybe conveyed to. it through a pipe attached to. the frame, the ventilation Opening maintained by the fanning action producted by the machine

- itself.

15) **Farced draught machine**: An enclosed machine in which the ventilating air supply is maintained by an independent fan external to. the machine itself.

16) **Protected Machine**: One having end shield bearings and in which there is free access to. the interior without opening doors removing

SECTION F-1A

GENERAL REQUIREMENTS

Scope of works :

The work covered by electrical specification consists supplying and installing, electrical wiring system complete in 'strict accordance with this specification and the applicable drawing and subject to. the terms and conditions pf the contract. It includes. .

(a) Conduit a wiring system far fans, lighting paints bells, clacks sockets, etc. including fixing of lighting fixtures and fans etc. and miscellaneous paints.

(b) Conduit and wiring system' far exhaust fans, power sockets.

(c) Panel boards, distribution boards. switch fuse units.

(d) Complete power and lighting cable systems. Grounding system.

(e) Grounding system.

(f) Conduits system.

(g) Street lighting system.

(h) Other miscellaneous electrical work.

Completeness of Contract:

Any work fittings accessories or apparatus which may not have been specifically mentioned in the specification but which are necessary in the equipment for efficient working of the plant should be deemed to be included in the contract and should be executed and provided by the contractors. All plant and apparatus should be complete in all the details, where such details, are mentioned in the specifications or not.

Three prints and one permanent negative of each' of the finally approved drawings incorporating all the modifications proposed by the Department should be submitted. No modifications should be made in a drawing already approved by the Engineer-in-charge without his prior consent.

Approval of the contractor's drawing will not relieve the contractor of any part of his obligation to meet all the requirements of the contract.

Guarantee :

The performance of all the equipment and the installations should be guaranteed at least for a minimum period of one year from the date of taking over the installation by the Department'. All equipment must comply with the relevant IS-BS specifications.

Interchangeability:

All corresponding parts of similar plant and equipment should be? interchangeable in every way.

Tools:

All special tools required for dismantling and assembly of the equipment covered by the contract shall be supplied as obligation under the contract.

A list of items to be supplied by the Contractor should be submitted along with the tender.

SECTION F-2A

Specifications for Electrical Installation in Buildings

1. GENERAL:

These specifications relate to the electrical installations in 'the buildings of P.W.D. Electrical. The specifications cover general requirements to be fulfilled. These general specifications are supplemented by the specifications for the particular buildings separately attached.

These specifications are governed by the General conditions of the contract attached hereto.

APPLICABLE RULES AND REGULATIONS:

Installation shall be carried out in conformity with the regulations for electrical equipment of buildings, published by the Institute of Electrical Engineers London (14th Edition 1966 and as amended up to date) herein after referred to as the I.E.E. wiring regulations. Where these specifications. or the special specifications for the particular building attached hereto are at variance with the I.E.E. regulations these specifications or special specifications ~s the case may be, shall be followed. The installation shall also comply with the requirements of the Indian Electricity Act, 1910 as amended up to date and rules issued hereunder and also the regulations for the Electrical Association of India. Where not specified otherwise, the installation should generally follow the Indian standard codes of practice and in their absence the relevant British Standard of practices. All the materials shall comply with the relevant Indian Standard of British Standard specifications.

DEFINITIONS:

The definitions of terms in the I.E.E. Regulations shall apply in general.

DRAWINGS:

The preliminary drawings only indicate the general scheme of requirement. The exact position of all points, control switch boxes, runs of wiring and/or conduits joint boxes, inspection boxes, mains, and sub-distribution boards, mains etc. shall be got approved by the Engineer-in-charge. All circuits shall be clearly numbered in wiring diagrams and building plans. The detailed design of a switch-board, special fixture or any other part of the electrical installation as may be called for by the engineer-in-charge shall also be supplied by the Contractor and should be got approved by the Engineer-in-charge. Three sets of completion drawings am wiring diagrams showing the installations as executed shall be supplied by the contractor along with the completion certificate.

MATERIALS:

All materials shall be new and of the best quality conforming to the relevant I.S.B.S. specifications. They must be the products of reliable manufacturers of many years or standings. All like parts of materials shall be interchangeable. In case pfequipment such as circuit breakers, switch fuses etc. a descriptive and illustrated literature shall accompany the tender. The names of manufacturers of various materials shall be furnished in proforma in Appendix. Samples of materials wherever required should be approved by the Engineer-in charge before use in the installation. One set of such approved samples shall be deposited with the Engineer-in-charge. All materials shall be rust-proof or rendered rust proof by application of suitable paints. The supply of all equipment, switchgears etc. 'shall be complete with accessories. fittings and mountings as may be required for their proper performance, and as specified in the relevant IS-BS Code of Practice and standards.

WORKMANSHIP:

Good workmanship and neat finished appearance are the prerequisites for complying with the clauses of these specifications. With a view' to ensure fine workmanship the tenderers shall employ licensed 'wiremen, with an experience of not less than 5 years in the type of work' they are engaged. The work should be done under supervisions of licensed Electrical Supervisors with good educational qualifications and considerable experience.

Tenderers shall furnish the names of Supervisor and their wiremen who will be engaged in this work with details
of their experience.

CO-OPERATIVE WITH CIVIL AND OTHER WORKS CONTRACTORS:

The tenderer, after the award of the contract. shall co-operate with the civil and other contractors and shall co-ordinate his work with the work of other contractors with the least amount of dislocation and interference to the other works. Tenderers shall go through the drawings carefully and shall furnish the Engineer-in-charge with all the details of openings in the walls etc. they may be required for concealing any of the electrical equipment or accessories. Where the contractor fails to furnish such information as may be required for the purpose of concealing the equipment etc. they shall be made at his (Contractor) cost and expense. Any alteration to parts of the building shall be carried out with prior permission of the competent authority. All chaises of the structural work shall be made good at the contractor's expense and brought to the original shape finish and concur.

TESTING:

The electrical contractor shall be completely responsible fo the testing and commissioning of those installations covered by these specifications in compliance with the standard procedure, in/obtaining permission of the Government Electrical Inspector. Any modification which is demanded by Government Electrical Inspector shall have to be carried out within the scope of the contract. The *contractor* shall submit four copies of drawings of installations as per regulations for shall be provided by the *contractor* for carrying out the installation work. All tests shall be carried out in the presence of the Engineer-in-charge or his authorized representative and his approval obtained for the test results.

. COMPLETION CERTIFICATE AND MAINTENANCE GUARANTEE:

1.10. 1 After the completion of the installation and testing, the contractor should furnish a certificate in the proforma In Appendix-III, at the time of taking over the installation by the Department. The installation shall be guaranteed for period of 12 months from the date of taking over by the Department. During the period of guarantee all defects in material or in workmanship shall be rectified or replaced free of cost to the Department.

TENDERER'S ABILITY:

In order to enable the Department to asses the ability of the tenderer to execute the work. the tenderer shall furnish evidence of his experience and capacity td carry out the work of the magnitude and nature.

RATES:

The rates of items shall include all taxes, transport, loading and unloading charge and all such charges that may be required to be incurred for the supply and installation of the materials at site. The rates shall be firm and variations in the market are not entertained. Break up figures as required in the schedule of work shall also be furnished. As far as possible indigenous materials only shall be included for supply. Where it is unavoidable, imported items may be included and tenderer should clearly indicate materials, quantity, rate and amount of these items.

STORAGE SPACE:

No covered storage space will be provided by the Department. The contractor has to make his own arrangement. However, the Department may give an open space near the place of execution where the contractor can build his own stores for executing the work.

DEPARTURE FROM SPECIFICATIONS:

The tenderer should clearly indicate departure, if any, from the specifications with reasons for the same.

EXTRA ITEMS:

Rates for extra items shall generally be derived from the rates already available in the schedule. Where it is not possible, the rates shall be mutually agreed upon and the contractor shall furnish a detailed analysis of the rates claimed by him.

2. TECHNICAL SPECIFICATION:

Supply System:

The wiring installation shall be suitable for 3 phase 4 wire. 400 -440 V 50 cycles system of supply. Colour code of different phase shall be followed as per standard.

Wiring for Lights and Fans:

Looping system of wiring shall be adopted. No joints shall be made at intermediate runs of cables and where they are unavoidable. such joints shall be through approved mechanical connections.

Point wiring:

Point wiring shall consist of the branch wiring from the switch board together with the controlling switch or push as far as and including the ceiling rose or any other approved connector or socket. outlets. In case of more than one light being controlled by one switch, the wiring upto the ceiling rose of the first light including the switch shall be considered as a 'Primary point. Loop wiring from light shall be considered as a 'Secondary' point and rates shall be quoted separately, including final connections to fixtures land plugs.

Conductors:

No conductor for final sub circuit wiring for light and socket outlets. shall have across-section less than that of 2.5 sq. m (aluminum).

Loading:

No final sub-circuit radiating from the fuse board of a sub- distribution board and wires with 25 sq. m. (AI.) cable shall carry more than 10 lights, fans or socket outlets or ai connected load of 800 watts whichever is grater. The {allowing wattages may be assumed for estimating the load on each sub-circuit unless otherwise known jar specified.

Incandescent Lamps	1 *00* watts
Ceiling fans	60 watts
5-A Socket Outlets (lighting)	100 watts
4. ft. fluorescent tube.	50 watts
1 ft. fluorescent tubes.	100 watts

In each sub-distribution board at least one way preferably two ways shall be left spare for future requirement. A wiring diagram giving the details of the exact utilization of the ways shall be prepared and fixed in the sub distribution board itself or any other easily accessible place. The ways of sub-distribution boards shall be accordingly numbered.

Local Control Switches (General) :

Local control switches for circuit carrying not less than 5-5 shall be piano type and shall conform to relevant I.S. Standards. The switch shall be 'ON' when the knob is in the down position. All local control switches shall be connected in the phase or live conductor only and not in the neutral conductor, switches shall be fixed in iron clad

box and shall be so placed that the center of the switch box is 1.3 mtr. from the finished floor level unless otherwise stated. All switch boxes shall be provided with 1/8" thick Perspex cover fixed to the switch box with chromium plated counter sunk screws (brass).

Switches (Two way) :

(a) Two way switches shall be piano type single pole, (double throw, 250V, suitable. for flush mounting and of 5A capacity as per the drawings. All switches shall be recessed in an embedded metal box.

(b) Each box shall have suitable outlet for fixing conducts directly.

(c) Each box shall have Perspex cover painted inside with the wall colour, if required.

(d) Each switch shall be suitable for the position in a corridor stairway wiring. Switch Boxes (General):

Electrical circuits shall be written suitably on the cover of all switch boxes. as approved by the Engineer-in-charge (Elect) whenever different phase are terminated in a switch box Bakelite partition shall be provided. Each case shall be provided with a G.I. Earth stud nut and washers for earth connectors.

Ceiling Rose:

Ceiling rose shall be used on circuits having a voltage normally exceeding 200V. Only one flexible cord shall be attached to a ceiling rose. Only 3 -pin 5A socket outlet shall be provided in lighting circuits. All socket outlets shall be provided with a control switch and they shall be mounted in switch boxes in an approved manner.

Fittings:

These shall be of approved type as specified in the tender schedule. The sub circuits leads should terminate in a . ceiling rose or conductor in the fitting and internal connection made there from. Wherever these fitting are suspended they shall be done so through the conduits and ball and socket joints. All fittings shall be grounded by a G.I. conductor not less than 16 S.W.G.

Flexible wiring:

Flexible cords of not less than *23/0076* size shall be used. The weight of suspension shall be governed by I.EE. Regulations.

Ceiling Fans:

All ceiling fans shall be wired to ceiling rose and suspended from a hook shackle or clamp and insulated from the same. All joints in the suspension road shall be screwed and secured. by means of split pins. The fan clamps supplied by the Contractor shall be suitable for the ceiling or proof member as the case may be. For concrete roofs,

fan hooks shall be buried in concrete during construction in an approved manner and securely bound to the reinforcement.

Conduits and Earthing:

All conduits feeding lighting and fan circuits shall be provided with earth continuity G.I. conductor as specified for power wiring. All conduits shall be as specified for power wiring.

Point wiring:

Point wiring for power shall be as defined under section 2.2.2 and shall include the switches and sockets.

Loading:

All distribution board for power wiring shall be not less than 15A per way. Loading per way shall not exceed' normally 100 watts. The following loads may be assumed if exact figures are not known.

3-Pin Outlets	15A	1,000	Watts
3-Pin 5A Outlets		100	Watts

Wiring for Motors:

Final sub-circuits loop in motors shall be connected to separate ways of the Distribution board even if the current in the sub-circuit is less then 15A. No looping is permissible.

All wiring shall be carried in H.G. conduit as specified in I.S. specification for gauge for different sizes of conduits.

When the motor is resiliently mounted flexible conduit with approved adopters shall be used for the last few feet. Where cables are used sufficient loop shall be left.

All switch fuse units controlling circuits feeding motor shall be provided with H.R.C. fuses or as specified.

The frame of every motor and its association control gear shall be earthed by two separate and distinct connections to earth connector shall be capable of carrying 3 times the rating of fuse or 1.1/2 time the setting or the circuit breakers but in no case less than No.8 S.W.G. or 7064" or equivalent cross section of copper. Where practicable, the earth connections shall be visible for periodical inspection. Gas or water pipes shall not be used for earth connections.

Socket Outlets and Control Switches 5A and 15A :

All socket outlets shall be of 3 pin type, the third pin being connected to the earth stud of nearest distribution board by separate earthing wire. The socket shall conform to I.S. : 1293/1938, single pole, piano type. Each socket outlets shall be provided with a control switch of appropriate rating and as specified. The switch and socket shall be mounted inside the iron clad box provided with 1/8" Perspex cover as directed by the Engineer-in-charge or as specified in schedule .of quantities. Inside switch box ample space shall be available around switches for connecting wires to switches. All socket outlets for power shall be mounted at the skirting level unless otherwise specified or as directed by the Engineer-in-charge.

The three phase plug receptacles shall have their earth terminals connected by independent earth wires to ring main earth strips on the building. In buildings where explosion proof fixtures are installed single phase plug receptacles as well as light points shall be connected to ring main ground bus installed in the building by separate earth wires of approved size."

Socket outlet shall have some provision not to receive the matching plug unless the grounding pin is in correct position. The grounding pin of the plug shall make the contract first and break the contract last at the time of . inserting or removing the plug respectively.

The grounding terminal shall be connected to the enclosed metal body by providing G.I. stud. nut washers welded to the box.

Each unit shall be suitable for flush mounting as required and indicated in the applicable drawings. Combination unit of socket outlet and switch shall be complete with necessary internal wiring. The witch/socket shall be mounted on M.S. bracket enclosed in a box.

Conduit Wiring:

Where conduit wiring is adopted the type and size of the conduit shall be as indicated in the drawing. The minimum of the conduit shall be 19 mm.

The contractor shall thoroughly study the' structural arrangements of the buildings and wherever, necessary shall in consultation with Department's representatives at site, make suitable adjustments in the cable routings, earthing arrangements, and location boxes, fitting etc. with a view to avoid interference with any part of the building, structure, equipment or any other work in the building or *to* effect any improvement in the arrangement.

Protection of conduit against rust:

Conduit shall be given two coats of oxide paint before they are placed in position. All exposed conduit shall be planted after installation with the colour as approved by the Engineer-in- charge. This do not apply to galvanized conduit.

2.4.3.A Protection against insects and damp:

In order to minimize cocensation or sweating inside the conduit, system shall be properly drained any ventilated in

such a manner as to prevent the entry of insects.

Conduit shall first be installed as a complete system without cables and shall be continuous from outlet to outlet from fitting to fitting and mechanically and electrically connected to all boxes and fittings.

SPECIFICATION FOR POWER CONTROL AND TELEPHONE CABLES :

1. SCOPE:

i. The specifications cover the supply and installation of medium voltage power and control cables either in ground or trench depending on the conditions at site including accessories for the same. The work in general, consists of supplying, laying, jointing terminating and connecting all. 1.1. KV APLSTS PVC power and control cables.

ii. The contractor shall supply all accessories including jointing and terminating materials, compound, tapes supporting materials, cleats cables lugs, concrete stabs, bricks sand, cable markers etc., as required to make the installation work including digging and back filling of the trenches as required.

II. SPECIFICATION:

i. All power cables to be supplied mentioned as 'APLSTS' in the Schedule should be mass impregnated, non draining, paper insulated lead sheathed. double steel tape armored and must comply with the latest ISI BS specifications.

ii. All cabling materials such as cable compound, cable lugs, tapes shall be of approved quality acceptable to the type recommended by the manufacturer of the cable for which it is used and approved by the Department.

iii. Installation of all equipment shall also conform to the applicable. Codes and practice as per the IS and shall be executed to comply with the late Indian Electricity rules as regards the safely. earthing of equipment and other essential provisions specified therein.

iv. Only approved make of cable shall be used. ICC and CCI will be preferred.

v. The cables shall generally be laid as per is Code of practice.

III. GENERAL RULES CABLE LAYING:

i. Installation shall be carried out in a neat. workmen like manner by skilled experienced and competent workmen in accordance with the standard practices.

ii. Cables shall be laid preferably in one piece length to avoid joins. If straight joints are found necessary. these can be introduced with prior approval of the Engineer-in-charge. The cost of the straight joint however. shall not be borne by the Department. But in no case joint shall be within the conduit G.I. pipe and duct.

iii. Proper care should be exercised in handling the cable to avoid formation of kind etc. and should it become necessary a cable be bent to a radius not less than 20 times the overall diameter of the cable.

iv. Method of installation, routing of cable etc. shall in every case be subject to the Department's approval and the contractor shall modify and or certify at no extra cost to the Department any portions of the installation which do not meet with the Department's approval. All damages to the civil and other works on this account shall be made good by the contractor at no extra cost to the Department.

The electrical contractor while notifying the building contractor for such work shall furnish the proper drawings, fully explaining the work involved or indicate at site actual work to be carried out as may be required by the building contractor. The electrical .of any such work as soon as the, electrical work with respect to the same has been completed.

v. Where cables pass through hume pipes. contractor shall fix hard wood bushed round the cables at the ends of hume pipes. Where the cables pass through the floors or chambers and in such other situations as the Engineer shall require. the contractor shall seal cable holes in a manner approved by Engineer-in- charge. Where cable pass through roads nallahs, etc. cables must be protected by Class 'A' Hume pipe of diameter not less than 6" (15cms.)

vi. The cable route shall be the shortest and these shall be minimum interference with built up areas, lawns etc.

vii. Care shall be exercised for providing suitable props for supporting other service lines on earth at the time of excavation. Where cutting of a lawn become inevitable it should be with the approval of the Engineer- in-charge.

viii. Excavation of the trenches shall be executed with vertical sides and the trenches shall be kept as straight as possible. The exact location of each trench shall be served by the Engineer- in-charge. On the site when the contract is in a position to commence each portion of the work.
The trench shall be not less than 1/2 meter wide and 90 cms deep.
If more. cables are to be laid. the width should be suitably increased.

ix. After the cables are laid. the trench shall. be filed in layers, the earth in each layer being well rammed by spraying water and consolidated and sufficient allowance made for settlement. The extra earth over the trench should be removed from the place of trench to a place as decided by the Engineer- in-charge at site.

x. Ends of cables shall be properly sealed to prevent entry of moisture prior to installation.

xi. Where it is as specified as 1/2 core cables the 1/2 core shall be a neutral conductor having reduced section.

xii. For all multicore cables each core and tails shall be brought out, marked and or coloured in on approved manner.

xiii. Cables termination shall be done with suitable compression brass glands in the case of PVC cables and cast iron triturating boxes in the case of APLSTS cables. The armor should be connected to the, right main earth in building with duplicate earth wires as per the relevant lS/BS specification. The core insulation over each conductor shall however be retained through out the run of the conductor upto the end where lugs shall be fitted thereon for connections. The lugs shall be fitted by means of

approved < solder and flux such as aleap, and Eyre NO.7 liberally used. The joint shall be mechanically strong and pressure tested.

DISTRIBUTION BOARDS AND PANELS:

General Requirements:

2.62 All distribution panels shall comply with I.E.E. Rules 60- 61. A clear distance of 0.91 b metre in front of the s witch board shall be kept. Where bare connections or attachments are provided 8t the back of the 'Switch board the space behind the panel shall be either less than 0.299 metre or more than 0.762 main width there shall be a passage way from the furtherest outstanding part of any attachment or conductor. If the space behind the switch board exceeds 0.70 main width there shall be a passage way from either end of the switch board clear to height of 1.928 m width 0299,m. All wiring connection shall be made neatly and securely.

For corciots carrying more than 10 Amps. tinned cable sockets shall be used.

All connections shall be so made as to form their own diagram Circuit shall be clearly numbered to correspond t 1 wiring diagram Names of the distribution boards shall be painted as directed by the Engineer-in-charge. All the switch fuse units and isolators D.Bs. shall be complete with earthing studs lugs neutral bar link, H.R.C. fuses and of approved make.

Skeleton type panels shall have a rigid form work adequately braced and supported. The switch and distribution boards shall be neatly arranged in the frame. The details of the frame work and the arrangement of switches shall be got approved by the Engineer-in-charge before the panel is fabricated:

All cubical type panels shall have rigid supporting frames adequately braced over which sheet metal shall be nearly secured. All switches, distribution boards e-c. shall be neatly arranged en the panels and all connections made from the back of switches. The panels shall be rendered dust and vermin- proof. The interior of the panels shall not be accessible to unauthorized persons.

The recess type boards shall be embedded in wall in a cupboard with a metal hinged door with locking arrangement. In all recessed conduit work all distribution boards shall be recessed. Whet e recessing is not possible, free standing panel may be provided as approved by the Engineer-in- charge.

All individual components i.e. switch fuse units D.Bs. etc. shall be connected by earth continuity wire of appropriate size with the main earth bus of the panel

D.H. etc. The panel switches or ').Bs. shall be earthed by the less than 2 distinctive paths to earth. Earthing of metallic parts of exposed metal shall not be effected through any structural metal work which houses the installation. Where metallic parts are not required to be earthed and are liable to become alive should the installation of the contractor become defective such metallic parts shall be separated by durable non-conducting material from any structural work.

(a) Power panels shall be 3 phase, 4 Wire, 400.230 volts for the distribution of 3 phase .01' single phase power loads. Lighting panels shall be 3 phase 4 wire 400/230 volts for single phase lighting load distribution on all 3 phase.

(b) All panels shall be done or protected front type with no mechanical or electrical defects. (c) . Bus bars shall be of electrolytic copper or aluminum as specified and the properly tinned sizes as indicated on applicable drawings as required.

(d) AU knock outs for branch circuits, conduit entries shall be drilled in und filled as required. For lighting panels the top and bottom cover plates shall be removable type.

(e) Main disconnect device for all panel boards shall be of switches of disconnect type and of the size as indicated shall be mounted directly below the panel or through a short thread conduit of required size.

(f) The main disconnect for all panel boards shall have an entry suitable for PVC armored cable from bottom.

(g) All panel boards shall be provided with an earthing terminal and lug for connection to the grounding system.

(h) Temperature rise of all electrical parts shall not be more than 3000 with full load amseres at room temperature. Buses shall be securely supported so that ordinary vibrations will not cause any of the parts to become loose.

(i) All barriers and supports of current carrying parts shall be of moisture resistant insulating material and shall not be adversely affected by arcing.

(j) The locations of panels shown in the drawings are only tentative. Panels nay be located at a place approved by the Engineer-in-charge.

(k) All civil works connected with fixing such as grouting chasing and making good shall be the tenderer's responsibility.

(m) Wires adequate capacity with proper size of lugs shall be used for inter connections.

(n) Panel should be self supported on angle channel iron frame work. It should be preferably of bolted construction in case of transportation and flexibility. The frames shall be of the required size for the mounting of the equipment on it. It shall be bolted or grouted rigidly alter leveling and alignment.

(o) The cupboard and D.B. should be of such size so to be accommodated in the excising room as per I.S. rules and I.S. codes of practice for installations of medium voltage switch gear.

(p) Fabrication drawing showing the detailed dimensions and panels and its components indicating the frame work. earthing positioning of switches. D.Bs. cable boxes. adopter chambers etc. shall be furnished to the Engineer-in-charge for his approval. All material to be got approved by the Engineer-in-charge. Panel should be guaranteed for satisfactory operations for a period of one year after handing over.

(q) The panel should be painted with anticorrosive paint suitable for humid and salty atmosphere on two coats of primer.

Switch Gears, Powers Panels D.B. and S.F. Us.

2.6.8 The main bus bar shall have continuous current rating as specified with neutral bar having half of full load rating of the phase bus bar . The sizes of the bus bars shall be ~o selected that the current density in bar does not exceed 150 amps. per sq.m. for copper. The length of bus -bar chamber should be as suitable length to fix all the switches etc. as per the prevailing standards, clear spacing of two adjacent buses shall be 1 1/2" minimum bar should be ltapted all alongwith colour coated 11 KV grade PVC tape. The maximum internal of support for each unsupported length shall exceed 600 mm.

The bus bar shall be of copper/ aluminum and fabricated to the relevant standards specification. In case aluminum bus bar is used special with high conductivity aluminum bus bar alloy E 91 C frame conforming to E.S.S. 2898 shall be used. The current density shall not exceed 800A per sq. inch. Hylam barners will be provided over the joints to prevent any short circuit.

The bus enclosing shall be made out not less than 16 gauges M.S. sheet construct on with angle iron support. All interconnections between bus bars S.F. Us. and D. Bs. shall be of adequate size and details of such inter connection shall be furnished to the Engineer-in-charge for his approval.

The bus bar shall be air insulated extensible type rectangular one. The bus bars chamber shall be dust tight by providing gaskets secured properly so as to tender it vermin proof.

The Combination Fuse-switch unit should comply with IS 4064 BS 861 and BBS 2510 wherever applicable. It should be suitable to accommodate High Rupturing Capacity Cartridge Fuse links complying with IS 2208 or BS 88 and having a certified rupturing capacity of not less than 35 MVA at 44 0 volts (AC5 duly). The switch gear (panes. D. Bs. etc.) shall be installed generally as per IS - Part- I 3072 and las specified and shown in drawings. All fuse switch units shall be provided with non-deteriorating HRC fuse links complying with IS 2208-1962 and having rupturing capacity of 35 MVA at 415 volts. or as specified.

All switches above 60 amps. rating shall be provided with suitable size adapted boxes. All switches mounted on the top of the bus bar s shall be

provided with detachable type reverse entry adapter boxes.

Suitably engraved labels shall be provided for each circuit as well as for the board.

A meters sector switches and LMH metre shall be provided where specifically mentioned. Small wiring for the inter-.connecting shall be colour coded and provided with numbered fuses for easy identification of circuits.

(a) The distribution boards should be totally enclosed metal clad complying with B. S. 214. The M. S. sheet steel enclosures for recessed D. Bs. shall be of not less than 14 gauge.

(b) The D. B. shall be with hinged door and the locking arrangements as approved by the Engineer-in-charge.

(c) All the components shall be enclosed in the enclosure. The mounting of D. B. shall be got approved by the Engineer-in-charge before carrying out the installation.

(d) The D. Bs. shall have proper size cut outs for conduits entry or cable entry as required and these shall be made on site.

(e) Adequate spacing shall be provided inside the D. Bs. for easy removal of the fuses and carry out the inter connection:

(f) A set of insulating barriers have to be provided between incoming breakers switches and fuses.

Switch fuse Units:

(a) All the D.P. T.P. and TP.N. switch fuse units shall be totally enclosed iron clad quick make, quick dreak type to best Indian make conforming to theI.S. or B.S. 3185 specifications. All the switch fuse units shall have mechanical interlock with a door, so that the door cannot be opened when the switches are in 'ON' position. The switches should be of double break solation type to ensure safely.

(b) Each TP. & TP.N. switch fuse unit shall be earthed with two distinct each connections.

(c) Suitable insulator shall be provided. Between phase.

(d) There shall be suitable neturallink in the fuse box.

(e) All T. P. & T.P.N. switch fuse units shall be rated for 500 volts and D. P. (required for single phase supply) and S.P.N. switches for 250 volts.

(f) The H.R.C. cartridge fuse shall conform to H.S. 88 (1952).

The O.C.Bs. ACB shall be suitable for 400/440 volts 3 phase 50 cycle supply capable of interrupting a fault MVA of not less than 31. The circuit breaker shall conform to the BSS-936-1940 BSS 3659 with such tripping arrangement as may as required under special specifications for the building. Efficient and foolproof mechanical interlocking shall be provided for the safe operation and maintenance. The rate shall be inclusive of the first filling of oil.

Instrumentation :

The instruments and meters wherever necessary shall be housed in special sheet steel box located between switch fuses units and bus bus bar chambers. The instruments etc. shall be mounted on the hinged cover with heir dial flushed. All instruments shall ha ve protective H. R. C. fuse links. All interconnections and small wiring shall be neatly dressed arranged and duly coloured for easy identification of circuits.

Meters shall be provided as required in the Schedule, Meters shall be dead head and be suitable for 400/440 volt 3 phase 4 wire 50 cycle (in balanced load) supply.

Each selector switch shall be 3 point and of minimum 250 volts grade with silver tipped contacts suitable for metering circuits, current transformers shall be of 5VA burden and commercial metering accuracy. indicating lamps shall be penal mounting type preferably of 250V grade. Every unit shall be rewired and interconnected to the system for its required Indicating performance. Indicating lamps shall have independent circuit fuse.

FIXING OF LIGHTING FIXTURES:

1. Location of fixtures their manner of fixing mounting height etc. are indicated in relevant drawing. Actual location and levels shall however be arrived at site in co- ordination with other service etc and prior approval of the Engineer-in- charge regarding the actual location. Manner of fixing shall be obtained before the work is taken up in hand.
2. In all cases the contractor shall provide necessary interconnection wiring earthing painting etc. all necessary for complete installation.
3. The contractor shall also test and commission the fixtures during completion of the work.
4. The inter-connections wiring from the light outlet point up to the fixture shall be carried out by means

   General arrangement of fixtures layout is indicated in drawings. Care snail be takento see that all light fixtures are in a row in a room or particular area, are in absolute line and plump and are symmetrically disposed with respect to finished surfaces of walls columns beams etc. of flexible copper wire of 'section not less than 1.5 mm .
5. All fixtures suspended by means of conduits shall be done with all and socket joints or as per approved design.

TECHNICAL SPECIFICATIONS

ELECTRICAL CREMATOR

6.1 Description: Electrically heated (resistance type) Cremation furnace (Double Chamber)
along with Charging machine and latest Control unit.

6.2 **Scope**: Design, manufacturing, supply, Erection & commissioning and provision of the
equipment's/ furnace according to its design parameters and capacity

6.3 Leading particulars: Type: Electrically operated Cremation Furnace along with Charging M/C and latest Control System.

6.4 Duty: Cremation of human body maintaining the norms of pollution Control Board.

6.5 Normal Working Temperature: Primary chamber temperature: Min 600°C Max 1100°C
Secondary chamber temperature: Design 650°C Max 1100°C

6.6 Mode of Charging: Manually operated charging Machine.

6.7 Residence time of flue gas in Secondary Chamber: 1 Sec at 650°C

6.8 Pressure -Static Under pressure main chamber min. -10 to -15 mm water column

6.9 **Charging** Door Operation: Electro mechanically operated rise and fall type with provision for
Manual operation. The operation of door will be provided with limit switches.

6.10 Control Philosophy: The heating power to be controlled from the control panel. The furnace
Pressure to be controlled through manually operated Damper.

6.11 The Advanced Technical Features of the Electrical Cremator include

Excellent Environmental Performance – emissions conforming to current Standards.

- Robust Hearth bricks providing the main support on which body/coffin is placed.
- Twin incineration chambers – One primary chamber and a secondary chamber with
  Heating elements embedded in it .
- Shaped Refractories - including over 40% or more Alumina in areas of heavy wear.
- Robust construction – a design capable of 8 to 10 cremations per day, and cremations
  Times around 45 to 60 minutes fully achievable.
- High Performance Cyclonic/Vane/Ventury type Wet Scrubber – which cleans the smoke and ensures almost pollution free discharge through the chimney.

- Automatic temperature control of both primary and post combustion zones.
- Automatic fail safe against over temperature.
- Compact design, enabling easy installation.
- The design of this cremator includes a secondary chamber which is capable of maintaining the flue gases combustion temperature at 650 deg C for a residence time of greater than 1 second during operation.

6.12 Cremator General Description

The basic cremator will consist of:

- Cremator Furnace
- Combustion Air supply system
- Wet Scrubber (Vane type)
- Stack (Self supported)
- Control Panel.
- Chimney
- Manual "Dead Body" charging systems and trolley

6.13 Principle of Operation:

- The cremator comprises a primary chamber of generous proportions into which the coffin /Dead Body are inserted and within which the primary combustion takes place. The Dead body/ coffin are placed on the hearth bricks, so as to keep the Body suspended in centre of the Primary chamber. The cremation of the body takes place due to Superheated Air introduced into the primary chamber and the heat transfer is mainly from the energy stored in the refractory mass. The temperature in this zone during the process of cremation can reach a maximum of 1000°C. The volatile product of combustion produced from this phase exits the primary chamber via the gaps between the hearth bricks descending below into the secondary combustion zone in which the combustion of gaseous phase takes place. The gases entering this zone then undergo complete combustion due to the heating elements in the secondary zone and this process is assisted by the introduction of additional air. The flue gases make numerous passes within the secondary combustion zone, where the flue gas temperature is maintained at the required combustion temperature of 600-620°C.

6.14 Main Combustion Chamber

The primary chamber is equipped with 2 banks of 80-20 Ni – Cr heating elements embedded in the side wall of the FURNACE and independently controlled air supply passes along the side wall of the cremator slightly above the hearth bricks and another passes below the grate brick. At the far end of the Hearth, through-port is provided to allow the Neutralized ashes to fall/manually scrapped through to the pivot grate and finally in the ash tray.

6.15 Secondary Combustion Zone

The cremator benefits from a specially designed secondary combustion zone, and is sufficiently sized to ensure a flue gas residence time of 1 second during operation.

The Cremator is designed with a secondary combustion zone comprising a series of passes below, a single bank of 80-20 Ni – Cr heating elements within this zone ensures that the temperature requirements are maintained while adequate supplies of secondary air in the flue path ensure complete combustion.

The post combustion of the flue gases is completed within these high intensity areas, eliminating all smells. The design of the post combustion chambers ensures a lengthy, complex passage through the cremator prior to the flue gas entering the scrubber system.

The secondary combustion chamber is specifically designed to ensure a flue gas residence time of 1 second at a flue gas temperature of 650 °C.

6.16 Control Valves and Instrumentation

The controlled addition of combustion air to the combustion process is effected by 2 modulating control valves, for the control of the individual supplies to the primary and secondary chambers. The primary chamber and secondary chamber temperatures are measured by type K thermocouples, temperatures all independently displayed on temperature instruments

6.17 Combustion Air System

The cremator installation is supplied with combustion air by a fan, with a design duty capable of providing the air pressure and flow requirements of the Cremator. The fan is located within / near the cremator.

6.18 Pollution **Control device (As per pollution control board rules and regulation)**

6.18.1 Induced Draft Fan and Ducting

A suitable designed ID fan pull out the flue gases from the furnace and release it to the chimney. Before coming to the chimney it passes through the ventury packed wet scrubber, separator etc. Suitable ducting is provided in the system along with valves to carry and control the flow of the flue gas.

6.18.2 **Scrubber**

Dust laden gases enter into cyclone - ventury inlet from where gases mixed with water jet entered tangentially through nozzles. In separator further scrubbing takes place through cyclonic effect. Further mist eliminator is provided to reduce the water droplets enter into the blower casing. The inlet and outlet ducting is made out of SS 304 and blower is dynamically balanced and fixed on top of the scrubber. It will suck the flue from the furnace through ventury scrubbing system and through to the outlet connected to the chimney.

Material of construction: S.S. AISI – 304

Position of water spray: from top

Water circuit: closed.

Efficiency: 95%

Nozzle: specially designed Brass made nozzle.

Concentration of particles: 150 mg/Ng (nominal cu. Mtr.) in exhaust air.
Velocity of exhaust air: 1M/ sec.

Fume discharge: 1500 cu. m. per hour.

Rating of re-circulation: 0.5 H.P. pump or as per standard design

6.19 Water Circulation System

Clean water is required for spraying in the scrubber mechanism and the return dirty water is also to be stored in another tank. One recirculation tank comprises three chambers and recirculation water pump with necessary pipe fittings are considered to feed clean water from the third chamber for spraying from the top scrubber mechanism and the return dirty water is stored in the first chamber. The process of sedimentation of water and particles is done with the help of three chamber system. In this process of sedimentation the particles are mostly sediment in the first two chambers and the clean water after sedimentation is collected in the third chamber. The sediment liquid from the bottom of first chamber is drained out by means of operating valve to Soak Pit with filter bed arrangement made of with different size granules. The sedimentation tank is cleaned every week or after cremation of 60 numbers body whichever is earlier. Provisions are also being kept to supply fresh water from alternate source of supply into third chamber.
Note: - **The induced draft fan should be in SS 304 and all ducting should be SS 304.**

6.20 Chimney (For Both Furnaces)

The chimney is self supporting MS construction having 30 mtr ht 620 mm dia at bottom , 350 mm dia top shall be supplied along with its foundation bolts. The chimney shall be provided with copper lighting Arrestor and provision to check the emission level of the flue gas at height of 10 mtr.

The chimney shall be protected with heat resistance aluminum paint, withstanding capacity 400 Deg. C. (Separate chimney for individual furnace) Each furnace have individual chimany

6.21 Furnace Control Panel:

The cremator is supplied with a dedicated control panel through which the operations and process parameters are controlled. The panel is fitted with digital temperature controllers for controlling primary and secondary chamber temperatures. Pressure gauge located on the panel helps the operator understand the chamber pressure. Energy meter provided helps in analyzing the total energy consumption. The operator by means of indicating lamps knows display of each Control valve position the control enclosure is located on the side of the cremator. Within the enclosure, all the

Equipment is located to minimize the effects of heat, and is adequately ventilated so ensuring
Trouble free operation.

The control system is capable of the total control of the cremator and all its functions in order to complete the cremation of the human body once the cremation chamber has been charged, and so simplifies the day-to-day operation of the cremator.
Note: - Main control panel with Digital A- meters, v meters KW meters and frequency with suitable
CT PT rating (Multiple function meters not to use)

6.22 Cremator Process Control – Safety Features

The blind temperature controller is provided in case of failure of any of the digital temperature controller. Safety features must be provide for temperatures, air presser and other parts

6.23 Cremator Construction Description

Casing and Framework The casing and framework of the cremator is fabricated from steel plate and sectional steel construction.

6.24 Refractory Lining

Refractories are of high quality, comprising firebrick, semi-insulating refractory and lightweight insulating refractory materials, backed by Hysil blocks insulation at the furnace casing. The firebrick used as the hot-face material for the primary and secondary chamber is a 40% alumina firebrick with a maximum working temperature of 1100°C.

In the areas of high wear, e.g. the main combustion area, hearth bricks is used which has high
Resistance to abrasion and thermal shock, and also a maximum working temperature of 1100°C.

6.25 Charge Door

The ceramic fiber lined charge door is situated at the front of the cremator and is counterbalanced and suspended on sprocket chains for easy operation. Operation is by means of a geared electric motor controlled by push buttons situated in the control panel and interlocked to prevent charging as previously stated. MS heavy duty, high thickness (Min 12 MM) TATA / ZINDAL or equivalent make must be used

6.25 Ash Removal (For both furnaces)

Access for raking is through the ash door. At the end of the cremation the door is opened manually and the ash then may be raked and removed directly via the pivot grate, into the ash container, which positioned below the ash door. Therefore both loading of coffins/body, and de-ashing of remains are carried out at different ends of the cremator.

6.26 Access for Maintenance (For both furnace)

Access for raking is through the ash door. At the end of the cremation the door is opened manually and the ash then may be raked and removed directly via the pivot grate, into the ash container, which is positioned below the ash door. Therefore both loading of coffins/body, and de-ashing of remains are carried out at different ends of the cremator.

6.27 External Finish (For both furnace)

Externally, the cremators main casing is painted with good quality heat resistant aluminum paint for thermal insulation and aesthetics.

Drives (for electrical furnace only)

1 Charging Door :- 0.5 HP/10 rpm geared motor, 415 V, 3 Ph sq.cage F class Insulation motor.

1 Re-circulation Water Pump; - 0.5 HP, 2800 rpm, 220 V, 1 Ph sq. cage, F class insulation motor.

2 Induced Draught Fan motor - 5 HP, 2800 rpm, 415 V, 3 Ph sq. cage F class I insulation motor.

4 Combustion Air Motor 1 HP, 2800 rpm, 415 V, 3 Ph sq. cage F class insulation motor.

Make; - ISI Standard

6.28 Cremation Capacity (for both furnace)

This design of cremator is robust, and will perform up to 8-10 cremations per normal working day for electrical however; it is fully capable of operating for extended periods beyond "normal working hours", as required. And 4 to 5 cremations per day, and cremations times around 90 to 110 minutes fully achievable for fuel fired

6.29 Earthing System (For both furnace)

The whole system must be made earthed by bore type electrode earthing as per IS: 3043 (1987). Earthing Electrode consisting Flat-in- Pipe technology made of corrosion free B Class G.I.Pipe having outer pipe dia. Of 76-80mm with 90-120 micron galvanizing and inner GI strip of 50mm X 5mm with 90-120 micron galvanizing including boring, installation and fitment of RCC earth pit with cover with all related civil work in at site including all labour and material and making site neat and clean after the work.The connection terminal of the electrode must be connected to the earth terminal of the feeder pillar with suitable connectors, nuts, bolts, lugs etc. The whole installation must be covered with highly conductive back filling compound of 50kg. All the materials must be approved by EIC before utilization at site.

Length of electrode	3 Meter
Diameter of the electrode	76 – 80 mm
Back filing compound	50 kg
Depth and size of the bore	As required
Earth Pit with Cover	RCC Earth pit with cover as required

Note :- separate earthing for main control panel, furnace, chimney and lighting arrestor

6.30 Painting (For both furnace)

The painting works, unless otherwise stated elsewhere, shall be applicable for the following items as follows. Various equipments inclusive of electric motors, pumps, panels, control desks and accessories All pipe work including supports, hangers All metallic duct work such as exhaust ducts including supports and hangers and other metallic works if any. All metal surfaces, after preparation of surface, shall be painted with two primer coats and two finish coats. All surfaces shall be cleaned of loose substances and foreign materials, such as dirt, rust, scale, oil, grease, welding fluxes etc in order that the primary coat is rigidly anchored to the virgin metal surfaces. The prime coat shall be applied as soon as possible after the surface preparation is complete. The procedure for surface preparation shall be solvent cleaning, hand tool cleaning, power tool cleaning, flame cleaning, blast cleaning, pickling or combination thereof as applicable. The primer coating shall be Red lead or zinc chromate. Finish paint shall generally be applied by brushing except that spraying may be used for finish coat only where brushing may damage the prime coat. Proper brushes shall be selected for specific work pieces. The brush marks shall not be left in the applied paint as far as practicable. Each coat of paint shall be allowed to dry sufficiently before application of the next coat to avoid damage such as lifting or loss of adhesion.

7 Gas cremator (Single Unit Compact Design Structure)

7.1 Supply, installation and commissioning of GAS cremator (PNG/LPG) complete air pollution control system basis with comprehensive maintenance for five years

7.1.1 Double Direction Corpse Carrier having fixed frame without visible wires or track Double direction stainless steel (SS304) caterpillar both auto and manual control should be available.

Steel Structure should be of High quality mild steel, Arc weld; with suction device for escaped tail gas. The Gas Cremator should be with burner, operation door, ash opening, ash urn, electric key board, label, etc. After the operation, the ash should be manually removable into ash urn or vessel from ash opening from main chamber.

7.2 Main Chamber Furnace

Chamber should have 2 burners (Baltur, Ecoflametlian make only) and it must be multi fired PNG / LPG ; High quality refractory clay brick, brickwork joint should be less than 3mm; High quality refractory material and insulation materials (support 1200oC); Work Pressure (pa):-10~-40Pa ; Work Temperature : 600oC ~900oC; Main Chamber should consist of furnace bed, furnace door, fire opening (air supply), burner mounting plate should be casting, operation door opening and ash opening inside the main chamber. The main burner should be with 45° ~ 60 ° angle to horizon and the angle should be manually adjustable. Gas consumption should be minimum.

Secondary Chamber With secondary burner, Fuel Type: PNG / LPG ; High quality refractory clay brick, brickwork joint should be less than 3mm; High quality refractory cartable material and insulation materials (support 1200oC)

7.3 Furnace Door Lifting should be of High quality steel frame, good speed reducer; Both auto and manual control should be available; The furnace door lifting device

should have motor, speed reducer, door support shaft, door plate, and electronic control components for automatically opening and closing furnace door. The door plate should be made of lightweight fireproof plate and stainless steel frame of minimum 4-5 mm thick.

7.4 Combustion System

The main chamber burner has a maximum rating of 358 kW and this enables normal operating temperature in the range of 800°C to be achieved in the main chamber. (The maximum allowable operating temperature is 1100°C to 1150°C).

The secondary combustion zone burner has a maximum rating of 358 kW which will enable temperatures of 850°C to be achieved in the secondary chamber as required by the local Environmental Regulations.
The burners are mounted at the rear of the cremator facilitating access for maintenance and repair.
Gas burners are configured for On/Off control, are ignited automatically and the burner system is protected against flame failure, thereby complying with the gas regulations.
NATURAL GAS fired burners, High/Low fire or fully modulating burners are optional.

7.8 Control Valves and Instrumentation

The controlled addition of combustion air to the combustion process is effected by 2 modulating control ball valves, for the control of the individual supplies to the main and secondary chambers. Each burner is fitted with its' own air supply fan and individual combustion air pressure switches to prove supply to each burner. The main chamber and secondary chamber temperatures are measured by type K thermocouples, temperatures all independently displayed on temperature
Instruments.

7.9 Combustion Air System

The cremator installation is supplied with combustion air by a fan, with a design duty capable of providing the air pressure and flow requirements of the AWL Cremator. The fan is located within an integrated enclosure within the cremator's decorative paneling, which is acoustically lined.

7.10 Air Ejector / Induced Draft Blower (I.D.Fan)

Air Ejector / Induced Draft Blower (I.D.Fan) with Work efficiency: Power: 5 to 7.5 HP; With shock absorption device with Induced Draft & positive ejection of the gases through the ducting and chimney. The ID Fan blower should be provided with manual damper for controlling the gas flow.Adequate SS304 Scrubber system with pumps and pipes as required and water recirculation storage tank of Droplet separator the induced draft fan should be in SS 304 and all ducting should be SS 304.

7.11 PLC Based Cremator Process Control

7.11.1 The cremator can be supplied with a dedicated Programmable Logic Controller; this controller supervises the operation of the cremator and the combustion process.

7.11.2 Crematorium's control panel design is based upon a modern "compact design"PLC, complete with 24 digital inputs and 16 digital outputs in standard configuration. The programmable logic controller is supplied, preloaded with our control software programmed.

7.11.3 The cremator is provided with a Human - Machine Interface to enable the cremator operator to communicate with the cremator. The graphical interface is made via a Liquid Crystal Alpha Numeric Display. This display comprises a backlit Liquid Crystal Display (LCD) which gives rise to a semi graphic display to control the cremator operation.

7.11.4 The H.M.I display is complete with screen and membrane buttons, this display unit is mounted on the control enclosure.

7.11.5 The control enclosure, including the Programmable Logic Controller system is located on the side of the cremator. Within the enclosure, all the equipment is located to minimise the effects of heat, and is adequately ventilated so ensuring trouble free operation.

7.11.6 The PLC based control system is capable of the total control of the cremator and all its functions in order to complete the cremation of the human cadaver once the cremation chamber has been charged, and so simplifies the day to day operation of the cremator.

7.11.7 The PLC control system automatically varies the combustion programme according to combustion conditions and controls the cremator at its optimum performance to operate quickly and without smoke whilst also controlling the emissions. Should the need arise, provision is also made for manual override. Manual control of the cremator is logged by the control system.

7.12 Cremator Process Control – Safety Features

The burner flame failure and burner safety systems are housed separately from the burner. They comprise flame failure safety relays connected to a flame rectification type probe, to monitor "start" flame and "main" flame, so as to automatically shut off gas and air supply valves in the event of flame failure of the main burner or afterburner, and to prevent burner ignition if the safety circuits are not energized.
Electrical interlocks also prevent the charging door being opened for the introduction of a “Dead Body” unless the temperature in the main chamber is below the set charging level.

8 Construction Descriptions

8.1 Casing and Framework

The casing and framework of the cremator is fabricated from steel plate and sectional steel construction, the whole braced for rigidity, so as to properly support the refractory and insulating materials with which the casing is lined.

8.2 Refractory Lining

Refractories are of high quality, comprising fire-brick, semi-insulating refractory and lightweight insulating refractory materials, backed by calcium silicate insulation at the furnace casing. Ceramic fiber is used for lining the front ashing door and the charge door. The firebrick used as the hot-face material for the main and bottom chamber is a 42% alumina firebrick with a maximum working
Temperature of 1400°C.

In the areas of high wear, e.g. the main hearth areas, a 63% alumina tile is used which has high resistance to abrasion and thermal shock, and also a maximum working temperature of 1600°C.

Calcium Silicate Insulation is used in areas around the casing between the refractories and the steel casing and this has a maximum working temperature of 1000°C.

The quality and thickness of the insulation is such that the cremator casing is kept at a safe temperature for the Operators.

9 Charge Door

The ceramic fibre lined charge door is situated at the front of the cremator and is counterbalanced and suspended on precision roller chains for ease of operation. Operation is by means of an electric motor controlled by adjacent push buttons, interlocked to prevent charging as previously stated.

10 Ash Removal

Access for raking is through the charge door. At the end of the cremation the door is opened by pushbutton operation to a safe, partially open position, which protects the operator from the radiated heat of the chamber.

The ash then may be raked and removed directly via the external ash chute, into the ash container, which is positioned below the charge door. Therefore both loading of Dead-body/coffins, and de-ashing of remains are carried out at one and the same end of the cremator.

11 Access for Maintenance

The need for access for maintenance has been carefully considered in the cremator design, and facilities have been provided for the cleaning out of accumulations of ash in any of the chambers and flue passages, access ports being provided for this purpose.

12 External Finish

Externally, the AWL crematorium's main casing is clad with pre-finished painted panels before leaving our Works. Consequently, no additional finishing of these items is required.

As well as giving the cremator a pleasing appearance, these panels ensure operator safety, by preventing any hot surfaces from being touched. The external cladding panels ensure a gap of air between the hot cremator casing, and the external surfaces, which can be touched. This greatly reduces the external surface temperatures experienced.

13 Cremator Loading Door

The loading door fitted to the main chamber opens to the full dimensions of the main chamber thus allowing for maximum coffin size. This door is ceramic fiber lined to minimize outer surface temperature.

14 HEAT RECOVERY & SCRUBBING SYSTEM

Heat exchanger is provided at the outlet of the secondary chamber to extract the heat from the flue gases and pre heat combustion air to be introduced in primary and secondary chamber. Due to this preheated combustion air, considerable energy is saved to heat the air from ambient to preheat temperature.
The flue gas coming out of combustion chamber passes through the heat exchanger where the flue gas cools to a temperature of 300 Deg. C. These hot dust laden gases

are conveyed in to the vane scrubber, which provide consistent, effective gas cleaning. Hot dust gases enter through gas inlet & scrubbing liquid is introduced on the wall through nozzles. The gas with the entrained solids and liquids then passes in to a mist separator where liquid & collected solid flow downwards to re circulation tank. The clean gas exit through a top gas outlet from where they are escaped to atmosphere through ID fan and thirty meter height self supporting chimney

15 Cremator Process Data

Sr. No.	Description	Requirements
1	Main chamber temperature	Min 700°C Max 1050°C Varies with progress of cremation
2	Secondary chamber temperature	Design 850°C Max 1150°C
3	Static under pressure main chamber	-1 to -7 mm water column
4	Flue gas volume ex post combustion chamber	1540 m3 N/ h
5	Flue Gas Condition Content of Carbon Monoxide Typical content over the cremation	<50 mg/Nm3 (using natural gas)
6	Flue Gas Particulate Content (typically)	<100mg/Nm3

Note :- All above figures are given at reference conditions of 273.15K, 1.013Bar, dry, 11 % Oxygen on a volume basis

16 TECHNICAL SPECIFICATION

Sr. No.	Item	Description
01	High Alumina Refractories	63% alumina content refractory tile is used for the main hearth and floor of the adjacent off take flue. This material has a high resistance to abrasion and thermal shock, a maximum service temperature of 1600°C, bulk density 2.25 g/cm3, and thermal conductivity of 2.0 W/m.K. The thickness of this tile is 100 mm. 42% alumina content refractory is used in the side walls of the cremator. This material has a high resistance to abrasion and thermal shock, a maximum service temperature of 1400°C, bulk density 2.25 g/cm3, and thermal conductivity of 1.9 W/m.K.
02	Calcium Silicate Insulation	This material is used in the areas around the casing between the refractories and the steel casing. It has a maximum service temperature of 1050°C, a bulk density of 0.20 g/cm3, and a thermal conductivity of 0.10 W/m.K. The

		thickness of this insulating material is 100 mm.
03	Cartable Refractories	Lintels, burner blocks and the flue gas outlet are all cast in a dense, medium alumina, high strength, high abrasion resistant castable refractory. This castable has an alumina content of **50%**, maximum service temperature of1600°C, and bulk density of 2.37 g/cm3.
04	Secondary Combustion Chamber	1. Secondary combustion chamber volume 1.5 m3 2. Residence time in Post combustion chamber > 1 second 3. A series of passages are made within the refractory lining of the cremator, to the side of the fabrication and under the main chamber hearth. The post combustion chamber is specifically designed to ensure a flue gas residence time of 1 second at a flue gas temperature of 850 °C and an oxygen content of 6%
05	Burners 1.Main chamber burner 2. Secondary chamber burner	 1. 358 kW Max fire 2. 358 kW Max fire Natural gas or FUEL
06	Burner control mode	On/Off in Main chamber & high/ low as required in Secondary chamber.
07	Make and standard	Manufacturer Baltur, Ecoflametlian or equivalent Model Spark gas 35PW/W Flame detector Ionization probe
08	Burner Gas Valves	Main Burner On / Off 240V Solenoid Gas Safety valve. Afterburner High/Low 240V Solenoid Gas Safety valve.
09	Utility / Consumption	Typical gas consumption of the cremator 20 m^3 of Natural Gas per cremation (Based upon five cremations per day,5 days per week operation). Typical Electrical consumption 5.0 kWh

17 Cremator Control/Instruments

Sr. No.	Item	Description	Remarks
1	Thermocouples		
	Main chamber No 1 Secondary chamber No 1	Type K Ni / Cr Element Type K Ni / Cr Element	Each of the above temperature probes is connected to a Temperature Indicator mounted on the control panel for visual indication of all process temperatures.
2	Cremator Air Valve Motors		
	Manufacturer	Any reputed make	

	Type	3 stage	
3	Programmable Logic Controller		The PLC software program processes the input information so that it can give output control signals for combustion air levels, burner operation, loading door enabling and various other functions. The software also monitors for combustion and component faults, taking appropriate action as required and transmitting the alarms to the operator display system as necessary. In this configuration the supplied PLC has 24 digital inputs, and 16 digital outputs, as well as 2 analogue inputs. AWL utilize the Scheidner PLC and associated AWL-PED computer software for process control of the AWL cremator.
	Manufacturer	Schneider	
	Base unit Type	TWD- LMDA 4T DTK or Equivalent	
	Additional Input Module	TWD ALM 3LT or Equivalent	
4	Operator Control Interface (H.M.I.)		
	HMI Manufacturer	Schneider	
	Model	XBT N400, Magelis or Equivalent	

8 Penalty clause for maintenance work

Sr.no.	Nature Of Defect Or Deficiency	Time Limit For Repair/Rectification	Penalty (per Day)
1	Change heating elements	2 Days	Rs. 500/-
2	Change any type of bricks	7 Days	Rs. 1000/-
3	Scrubber system with ID fan	1 Days	Rs. 500/-
4	Fault in panel board	1 Days	Rs. 500/-
5	Fault in charge door, trolley, ash removal door	2 Days	Rs. 700/-
6	Work in any type of motor, pump, valve, piping	2 Days	Rs. 500/-
7	Cleaning of all necessary equipment with furnace structure	5 Days	Rs. 1000/-
8	Scrubber to chimney maintenance	1 Days	Rs. 500/-
9	Oiling and grassing	1 Days	Rs. 500/-
10	Any type of minor fault	1 Days	Rs. 500/-
11	Cleaning and oil and greasing of all system in every 30 days	1 Day	Rs. 1000/-
12	Cremation furnace is not in working condition due to not attend the fault	1 Day	Rs. 1000/-
13	PLC panel fault (fuel fired) PLC cards	10 Days	Rs. 500/-

9 Scope of work for Comprehensive maintenance

- *In maintenance work of every 30 days, the electrical panel, scruber system, furnace mechanism, piping & plumbing, and cleaning, wiring, repairing, lubrication, oiling, burner cleaning, general service of furnace,*

- *All types of fabrication of Stainless Steel (SS-304) material and all its machining process and completing the work with necessary installation*
- All types of fabrication work for shafting (EN-8) to be completed at site including installation

- ***All types of fabrication work of M S material and its all related machining process and completing the work with necessary installation***
- ***Fixing of Insulation material like; Thermotech cement, castable, Equisite-50, ceramic fiber blanket (Glass wool) etc. with material, to be fixed in the furnace at site as per requirement.***
- ***The work related to any type of motor / pump rewinding - servicing, bushing, bearing and necessary overhauling (1.0 HP up to 5.0 HP)***
- ***Removing of bad/damaged bricks of furnace and replacing with new bricks with all types of insulation materials and chemical etc.***
- ***Repairing Hydraulic system of Dead body Trolley and carrying out all works to make it operative***
- ***Repairing /remove/replacement parts like motor, pump, burner, electric component, cable piping, valve, heating bricks, heating elements, PLC control, relay, all type of meters, wire and cables, etc in furnace, scrubber system and electric control panel with PLC programming***
- ***Agency must be arrangement for emergency call for breakdown***
- ***Agency must be depute technical person at Rajkot city area***
- ***Agency do routine maintenance work for healthy system and change /remove damage and faulty parts***
- Agency must be spares parts in stock at Rajkot

- Removal of leakage of all types of piping network
- To be maintained standard air pressure in both furnace chamber, For it regularly cleaning of all air channel
- regularly cleaning of gas burner as per instruction of OEM
- Any maintenance instruct by site engineer giving to agency, Agency must be follow it
- Labour work for balancing, bushing, alignment and through work regarding coupling / shafting of pump / motor with sundry material as required (1.0 HP to 5.0 HP).
- Replacement of fused/damaged heating element by supply, installation and testing (SIT) of new Heating Element/Coil as per the specification of furnace including all necessary civil work and required insulation material, porcelain pipe covering, end termination with gland-lugs, castables, thermotech cement etc.
  Heating element must be as per design and specifications of furnace chamber having necessary mix of 80:20 Nichrome (Canthal).
- Replacement/Removal of damaged or broken Wall Bricks and Supply, Installation and Testing (SIT) of new Wall Bricks of furnace chamber as per the specification of furnace including all necessary civil work with required insulation material, castables, thermotech cement, glass wool etc.
- Replacement/Removal of damaged or broken Bed Bricks and Supply, Installation and Testing (SIT) of new Bed Bricks of furnace chamber as per the specification

of furnace including all necessary civil work with required insulation material, castables, thermotech cement, glass wool etc.

- Providing insulation work on all surface of cremation chamber as and when required including all necessary civil work with required insulation materials like castables, thermotech cement, glass wool, paint coat, aquisit-50 etc.
- Overhauling and rewinding of Electrical Motor and Water Pump with all necessary material, servicing, bushing, bearing etc with dismantling and re-installing at site with all loading, unloading and transportation. (1 HP to 5 HP).
- Repairing of Hydraulic system of Dead body Trolley and Furnace Gate including its alignment, repairing of lifting and pulling chain mechanism and to carry all other works to make it operative with necessary materials.
- Dismantling and cleaning of complete scrubber system as and when required using water and other cleaning agents and re-installation of the same.

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Form of Bid Security (Bank Guarantee)

WHEREAS, _____ *[Name of Bidder]* (hereinafter called "the Bidder") has submitted his bid dated _____ *[Date]* for the construction of' _____ *[Name of Contract]* (hereinafter called "the Bid").

KNOW ALL MEN by these presents that We _____ *[Name of Bank]* of _____ *[Name of Country]* having our registered office at _____ (hereinafter called "the Bank) are bound as principal obligator unto _____ *[Name of Employer]* (hereinafter called "the Employer") and unconditionally and irrevocably guarantee the payment to the sum of _____ for which payment well and. truly to be made to the said Employer the Bank binds himself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this _____ day of _____ 20_____ .

THE CONDITIONS of this obligation are:

(1) If the bidder withdraws his Bid during the period of bid validity specified in the Form of Bid:
or
(2) If the Bidder refuses to accept the correction of errors in his Bid;
or
(3) if the Bidder, having been notified of the acceptance of his Bid by the Employer during the period of Bid validity;

(a) fairs or refuses to execute the Form of Contract Agreement in accordance with the' Instructions to Bidders, if required; or

(b) fails or refuses to furnish the Performance Security, in accordance with the Instructions to Bidders;

We undertake to pay to the Employer up to the above amount upon receipt of its first written demand, without the Employer having to substantiate its demand, provided that in its demand the Employer will note that the amount claimed by it is due to it owing to the occurrence of one or all of the three conditions, specifying the occurred condition or conditions.

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

DATE _____ SIGNATURE OF THE BANK _____

WITNESS _____ SEAL _____

_____
(Signature, Name, and Address)

FORM OF CONTRACT AGREEMENT

AGREEMENT

THIS AGREEMENT made the_____day of_____20_____ between

_____

of_____

(hereinafter called "the Employer") of the one part and_____of _____ (hereinafter called "the Contractor" of the other part.

WHEREAS the Employer is desirous that certain Works should be executed by the Contractor,viz.,

_____

and has accepted a Bid by the Contractor for the execution and completion of such Works and the remedying of any defects therein at a cost of Rs._____

and _____.

NOW THIS AGREEMENT WITNESSETH as follows:

In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.

The following documents shall be deemed to form and be read and construed as part of this Agreement, viz:

a) The Contract Agreement;

b) The Letter of Acceptance;

c) The Employer's Requirements;

d) The Bid;

e) The Conditions of Contract - Part II;

f) The Conditions of Contract - Part I;

g) The Specifications;

h) The Bid Drawings;

I) The Schedules; and

j) The Contractor's Proposal

In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all respects with the provisions of the Contract.

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

IN WITNESS whereof the parties hereto have caused this Agreement to be executed the day and year first before written.

The Common Seal of_____
_____
was hereunto affixed in the presence of:
_____or_____

Signed, sealed, and delivered by the said_____
in the presence of:_____

Binding Signature of Employer_____

Binding Signature of Contractor_____

FORM OF PERFORMANCE SECURITY (BANK GUARANTEE)

To: _____*(name of Employer)*
_____*(address of Employer)*
WHEREAS_____(name and address of Contractor) (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No._____dated_____to execute _____(name of Contract and brief description of Works) (hereinafter called "the Contract");
AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;
AND WHEREAS we have agreed to give the Contractor such as Bank Guarantee;
NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you as principal obligator, on behalf of the Contractor, un conditionally and irrevocably guarantee the payment of an amount to total of _____ (amount of Guarantee) _____(amount in words), such sum being payable in the types and proportions- of currencies in which the Contract Price is payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of _____(amount of Guarantee) as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.
We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.
We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed thereunder or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

this guarantee shall be valid until the date of issue of the performance certificate.

SIGNATURE AND SEAL OF THE GUARANTOR

Name of Bank _____
Address _____
Date _____

FORM OF ADVANCE PAYMENT SECURITY (BANK GUARANTEE)

To:_____*(name of Employer)*
_____*(address of Employer)*
_____
_____
_____*(name of Contract)*

Gentlemen:

In accordance with the provisions of the Conditions of Contract, ("Advance Payment") of the above-mentioned Contract,_____
_____[name and address of Contractor] (hereinafter called "the Contractor") shall deposit with _____
(name of the Employer) a bank guarantee to guarantee his proper and faithful performance under the Clause of the Contract in an amount of _____(amount of Guarantee)
_____
_____(amount of words).

We, the _____(bank or financial institution), as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to _____(name of Employer) on his first demand without whatsoever right of objection on our part and without his first claim to the Contractor, in the amount not exceeding_____(amount of Guarantee)
_____(amount in words), such amount to be reduced periodically by the amounts recovered by you from the proceeds of the Contract.

We further agree that no change or addition to or other modification of the terms of the Contract or of Works to be performed thereunder or of any of the Contract documents which may be made between _____ (name of Employer) and the Contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any change, addition, or modification.

This guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until _____(name of Employer) receives full repayment of the same amount from the Contractor.

Yours truly,
SIGNATURE AND SEAL: _____
Name of Bank or Financial Institution: _____
Address: _____

Date: _____

APPROVED LIST OF MATERIAL

Sr. No.	Material	Approved Brand	Remarks
1	CEMENT (OPC-53)	AMBUJA, ULTRATECH, SANGHI, HATHI, SIDDHI.	
2	REINFORCEMENT STEEL	ASR, GALLANT, NATIONAL, GERMAN–TMX, JINDAL, SAIL, VIZAG, TATATISCON, GRACE, ELECTROTHERM (ETTMT), UTKARSH.	
3	TMT STEEL FE–CRS500	GALLANT, NATIONAL, ELECTROCRS.	
4	CERAMIC FLOOR TILES	SOMANY, KAJARIA, BELL, JOHNSON, EURO, OREVA, MARBITO.	
5	VITRIFIED FLOOR TILES/ WALL TILES	AGL, SUNHEART, VARMORA, SOMANY, SWASTIK, OREVA, RAK, BONZER7, JHONSON, KAJARIA.	
6	CPVC PIPES (SDR-11) WATER SUPPLY	ASHIRWAD, ASTRAL, SUPREME, PRINCE, FINOLEX, KISSAN.	
7	CPVC PIPES (SDR-13.5) WATER SUPPLY	ASHIRWAD, ASTRAL, SUPREME, PRINCE, FINOLEX, KISSAN.	
8	SWR (U-PVC) AS PER IS:13592:1992 FORD RAINAGE (75AND110)	ASHIRWAD, ASTRAL, SUPREME, AJAY, PRECISION, DUTRON, PRINCE, FINOLEX, KISSAN.	
9	RAIN WATER PIPES (U-PVC) IS:4985:2000 (75mm Dia)	ASHIRWAD, ASTRAL, SUPREME, PRINCE, FINOLEX, KISSAN.	
10	C.P.FITTING	HINDWARE, JAQUAR, AQUEL, KOHLER, ESSCO, PLUMBER, CERA	
11	SANITARYWARE	SOMANY, HINDWARE, JAQUAR, CERA, PARRYWARE, JOHNSON, KOHLER	
12	TOILET KITCHEN SINK (SS)	NIRALI, NAVKAR	
13	SEMI ACRYLIC/ OIL PAINT	NERAOLAC, ASIAN, JOTUN, ICI, DULUX, BURGER.	
14	PVC DOOR FOR	RAJSHREE, VIKASPLASTICPLY, SINTEX	
15	FRP DOOR	FIBREVENT, TECHNO SKILLS OR EQUIVALENT (OR AS APPROVED BY EIC)	
16	FLUSH DOOR	CENTURY, GREENPLY, KITPLY	

17	GLASS /FLOAT/ SHEET	SAINT GOBAIN, MODI, ASAHI	
18	ALLUMINIUM SECTION	JINDAL, BANCO	
19	HARDWARE STAINLESS	DORMA, KITCH	
20	DOOR CLOSER/ FLOOR SPRING	GODREJ, EVERITE, NULITE	
21	DOOR LOCKS	GODREJ, HARRISON, PLAZA	
22	PARKING FLOOR TILES	JOHNSON-ENDURA, PAVIT, DURATO	
23	WALL TEXTURE	JOTUN, HERITAGE	
24	CONST CHEMICAL/ WATER PROOFING COMPOUND	SIKKA, FOSROC, PERMA	

a) The contractor shall produce samples of the materials for approval of the RMC/PMC. The materials of the makes out of the above as approved by the RMC/PMC shall be used
on the work. RMC/PMC member has not bide to give any reason for rejection of any brand from the above list and its decision will be consider as final.

b) In respect of materials for which approved makes are not specified above, these will be of makes to be decided by the RMC / PMC.

c) Contractor can use for any material of equivalent make of the above specified company after taking prior permission of RMC/PMC.

LIST OF MATERIALS OF APPROVED BRAND/ MANUFACTURER (ONLY FIRST QUALITY TO BE USED (ELECTRICAL WORKS)

MAKE LIST FOR ELECTRICAL WORKS		
SR.NO.	**ITEM**	**STANDARD MAKE**
1	LT PANELS	Standard powder coated panel builder with expirience
2	DISTRIBUTION BOARDS	LEGRAND / SCHNIEDER / HAGER / L&T / SIEMENS
3	MEDIUM VOLTAGE CABLE	FINOLEX / POLYCAB / KEI / HAVELLS
4	LT SWITCH GEAR (ALL RANGE)	AS PER SPECIFIED PANEL DESCRIPTION IN BOQ. MODEL AS PER SPECIFIED IN BOQ ABB/ SIEMENS/ L&T/ LEGRAND / SCHNIEDER
5	LT MCCB	SIEMENS / SCHNEIDER / LEGRAND / ABB / L&T
6	LT MCB, ELCB	LEGRAND / SIEMENS / SCHNEIDER / L&T
7	METERS (DIGITAL)	ENERCON / SCHNEIDER /L&T / SECURE / ABB
8	INDICATING LAMP	SIEMENS / SCHNEIDER ELECTRIC / ABB / KAPPA / TEKNIC
9	SELECTOR SWITCH	KEYCEE / SALZER / SCHNEIDER / SIEMENS
10	LUGS	DOWELL'S / 3D / JAINSON / COMET / HMI
11	BIMETALLIC LUGS	ISMAL / HMI / DOWELLS
12	CABLE GLAND	JAINSON / 3D / COMET / HMI
13	PVC CONDUITS AND ACCESSORIES	PRECISION / NIHIR / POLYCAB / ASTRAL
14	MODULAR SWITCHES, SOCKETS & OTHER ACCESSORIES	MK / LEGRAND / HAVELLS/ANCHOR
15	PVC TAPE	STEEL GRIP / ANCHOR
16	WIRES FOR INTERNAL WIRING	FINOLEX / HAVELLS / POLYCAB /RR

17	CONNECTORS (COLOURS AS PER PHASE & NEUTRAL)	SALZER / ELEMEX / L&T / CONNECT WELL / PHOENIX
18	LED LIGHT FIXTURES	PHILIPS / HAVELLS / WIPRO / CROMPTON / BAJAJ AS PER MODEL SPECIFIED IN BOQ
19	CEILING FAN/ EXHAUSTFAN	CROMPTON / USHA / HAVELLS / ORIENT AS PER MODEL SPECIFIED IN BOQ
20	CHEMICAL EARTHING (BORE TYPE)	ASHLOK / LPI/VASUDHA
21	CT & PT COIL	Narmada, C&S, ABB, Kappa, Silkans, Gibert, or PGVCL or CPRI approved

Special Note:-

1	Client has all right to check the challans of supplier.
2	The MCB and MCB DBs must be of same make.
3	Contractor has to take Prior approval for all the make of material from Client/Consultant/PMC before execution.
4	The Client/Consultant/PMC reserves the right to select the manufacture or approved make from the above list.
5	Any make not mentioned in the above lists must be approved from Client/Consultant before execution.
6	All the material should be ISI and as per standards mentioned in specifications and BOQ.
7	In case of shortage of material or un-time delivery or change in model take prior approval from client/consultant