इंडियन बैंक Indian Bank
इलाहाबाद ALLAHABAD

e-TENDER DOCUMENT FOR Proposed construction of G+1 floors Indian Bank INDSETI Building at Thirupapuliyar Village, Cuddalore.

TECHNICAL BID

VOLUME - II

TECHNICAL SPECIFICATION

KINDLY NOTE THAT ONLY ONLINE BIDS WILL BE CONSIDERED AGAINST THIS TENDER. MANUAL SUBMISSION OF BIDS WILL NOT BE ACCEPTED

EMPLOYER/OFFICE INVITING BIDS	ARCHITECT CONSULTANT
Indian Bank, Zonal Office Cuddalore, 3RD FLOOR AVR TOWER 4 BHARATHI ROAD, CUDDALORE. **Tel:** 041 - 42222 718 / 832	**OSCAR &PONNI + RAHUL ARCHITECTS,** **No2, Vivekananda Road, Srinivasa Nagar,** **Chetpet, Chennai-600 037.**

Tender reference No. : ZO: CUDDALORE: EST:01 Dated 28.08.2025

Cost of Tender : Free of Cost

इंडियन बैंक/INDIAN BANK ★ अंचल कार्यालय ZONAL OFFICE ★

(A Unit of Indian Bank Trust for Rural Development, Under the aegis of Ministry of Rural Development, Govt. of India)
No.68, Thanam Nagar, Sankara Naidu Street, Thirupapuliyur,
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इंडियन बैंक Indian Bank
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Indian Bank Rural Self Employment Training Institute
(A Unit of Indian Bank Trust for Rural Development, Under the aegis of Ministry of Rural Development, Govt. of India)
No.68, Thanam Nagar, Sankara Naidu Street, Thirupapuliyur,
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RSETI Rural Self Employment Training Institutes

TECHNICAL SPECIFICATION

FOR

ARCHITECTURAL WORKS

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इंडियन बैंक INDIAN BANK CHIEF OFFICE

I. TECHNICAL SPECIFICATIONS

GENERAL

PREAMBLE

1.0 GENERAL

These Specifications cover the items of work in structural parts coming under preview of this document. All work shall be carried out in conformation with this. These specifications are not intended to cover the minute details. All codes, standard and good construction practice shall be referred to this specification be the latest thereof.

These specifications shall be read in conjunction with the Technical Specifications for various items of work. The General Contractor shall carefully acquaint himself with the general specifications, coordinate the same with any other specifications forming a part of the Contract Document and determine his contractual obligations for the execution of various items of work in accordance with good engineering practices.

2.0 REFERENCE TO THE STANDARD CODES OF PRACTICE:

2.1 All standards, tentative specifications, specifications, code of practice referred shall be the latest editions including all applicable official amendments and revisions. The contractor shall make available at site all relevant Indian Standard Codes of Practice as applicable.

2.2 In case of discrepancy between standards, codes of practice, tentative specifications, and specifications referred to, the specifications of Indian Standard Codes of practice shall govern.

3.0 SUPREMACY OF TENDER

In case of contradiction between/among two or more clauses given separately in two or more different documents, conditions of acceptance clause will be in following preference:

General Conditions of contract. Shall prevail over Drawings

Drawings shall prevail over BOQ

BOQ shall prevail over shall prevail over technical specification

4.0 DIMENSIONS

4.1 Written dimensions on drawings shall supersede measurement by scale; and drawings to a large scale shall take precedence over those to a smaller scale. Special dimensions or directions in the specifications shall supersede all others. All dimensions shall be checked on site prior to execution.

4.2 The dimensions where stated do not allow for waste, laps, joints, etc. but the General Contractor shall provide at his own cost sufficient labour and materials to cover such waste, laps, joints, etc. and the rate quoted is inclusive of such provision and no separate payment will be made for the same.

4.3 The levels, measurements and other information concerning the existing site as shown on the drawings are believed to be correct, but the Contractor should verify them by himself and also examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any errors or omissions in the levels or the description of the ground levels or strata turning out different from what was expected or shown on the drawings.

A. WATERPROOFING

1.0 INDIAN STANDARDS:

IS : 702 – 1989 Specifications for Industrial bitumen

IS : 1322 – 1993 Bitumen Felts for Waterproofing and Damp Proofing 3 IS : 3384 – 1986 Specifications for Bitumen primer for use in waterproofing and damp-proofing (first Revision)

The above mentioned IS Codes of Practice have been given for general guidance. However, these IS Codes will be adopted only for those particular items in the contract where the detailed technical specifications are not laid down in the Tender Documents.

All waterproofing work shall be carried out by the main contractor through a specialized Waterproofing agency as specified in the tender. The work shall be carried out strictly in accordance with the instructions of the manufacturer of the waterproofing materials used in waterproofing treatment and the contractor shall be responsible for the proper production of record of ingredients used and the performance of the waterproofing work done.

The entire work shall be covered by a performance guarantee for waterproofing for the period mentioned in the description of item.

The Contractor shall promptly attend to any leakage or dampness see or communicated during the period and satisfy the Dept. that the same has been rectified; if required, by conducting a test by storing 75 mm water over the roof for 10 days. If the Contractor fails to carry out the waterproofing rectification, the dept. will, after giving 10 days notice to the Contractor, get the work carried out by another agency at the Contractor's risk and cost.

2.0 WATERPROOFING PERFORMANCE TEST:

After completion of waterproofing treatment, it shall be tested for waterproofing by storing water for 10 days, to the following depths:

75 mm over exposed horizontal surface. Upto brim in case of water tanks, lift pits

Bone dry surfaces of all underground structures shall have to be demonstrated by the contractor.

The rate for the waterproofing work to be carried out under the contract shall include all labours, materials, tools, plants, equipments, transport and all the operations required for carrying out and completing the work, whether spelt out in detail or not, but including removing all loose materials, loose scales, mortar droppings and oil, grease etc. and removing all debris / rubbish outside AI premises, curing where required and testing to the satisfaction of the EIC.

3.0 WATER PROOFING WITH BITUMEN FELT:

Waterproofing treatment shall be four course or six course as described.

1.1 MATERIALS:

The self finished felt shall be approved brand and manufacture of types 3, Graded, Hessian base felt conforming to IS :1322 -1970.

WEIGHTS:

The total weight of the finished bitumen felt in dry condition with mica dusting powder in the manufactured bitumen felts shall not be less than 22.3 kgs per 10 sqm SAMPLING:

All rolls from the same batch manufactured in one consignment shall constitute a lot.

The number of rolls to be taken from a lot shall depend upon the size of the lot as follows:

NOTE 1: All the rolls taken as per Col.2 shall be inspected for width, length and visible external defects.

These rolls shall be taken at random from the lot. From each of the rolls, one piece 3m long and full width of the felt shall be cut out for preparing test specimens. First 2 m of the roll shall not be selected for this purpose. The length of felt selected shall be free from abnormal defects and shall be truly representative of the whole consignment. In case the material has stuck together no heat shall be applied to separate the layer, but the whole roll shall be sent for testing.

NO OF ROLLS PERMISSIBLE NO. ROLLS	NO. OF ROLLS IN THE LOT	TO BE SELECTED OF DEFECTIVE
Up to 100	0	0
101 to 150	0	0
151 to 300	1	0
301 to 500	2	1
501 to 1000	3	2
1001 to 3000	5	3
3001 & Above	8	5

3.2 CRITERIA FOR CONFORMITY:

The lot shall be considered to be in conformity with the requirements of the standard, if: The number of rolls found defective with respect to width, length and visible external defects, does not exceed the corresponding number given in Col.3 of Sampling.

INDIAN BANK

3.3 BONDING MATERIALS:

This shall be blown type bitumen conforming to IS : 702 – 1988 and IS grade 85/25 of approved quality.

1st Course Kg/sq.m

3rd Course Kg/sq.m

5th Course Kg/sq.m

1 Four Course Treatment 1.45 1.45'—

2 Six Course Treatment 1.45 1.20 1.45

3.4 STONE GRIT AND PEA-SIZED GRAVEL:

Stone Grit shall be 6m and down size. Pea sized gravel shall be hard, round and free from dust, dirt, etc. Grit and gravel shall not be spread over vertical or sloping faces of flashing and at drain mouths. At these places, the surfaces should be painted with two coats of bituminous solution. Stone grit or pea sized gravel for final course of four or six course treatment shall be 0.06 cu.m. per sq.m.

PREPARATION OF SURFACES: The surfaces to be treated shall have a minimum slope of 1:120. This grading shall be carried out with cement concrete or cement plaster with coarse sand as ordered, to the average thickness required and finished smooth. Grading work shall be paid for separately.

The junction between roof and vertical faces of parapet walls, chimneys, etc. shall be cased by running triangular fillets 7.5 cm x 7.5 cm size in cement concrete. At drain mouths, fillets shall be cut back and rounded for all owing for waterproofing treatment. Cement Concrete in fillet shall be 1:2:4 {1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm (nominal size)}.

Where the parapet height is 450 mm or less, the waterproofing treatment shall be carried out over the top of the parapet wall to its full thickness.

For carrying over and tucking in the waterproofing felts into parapet wall of height

more than 450 mm, chimney stack etc. a horizontal groove of 65 mm deep, 75 mm wide, with it slower edge at minimum 150 mm above the graded roof surface shall be cut out nearly and finished smooth inside with cement mortar (1:4).

The triangular fillet 75 mm x 75 mm and the cutting & finishing of the groove shall not be measured or paid for extra. No deduction will be made, however, if the groove has already been provided in an existing building.

Where expansion joints are provided, the construction of dwarf walls and RCC slab, etc., covering the dwarf walls shall be carried out by the same agency and shall be paid separately.

The graded roof surface, concrete fillets, and faces of walls shall be thoroughly cleaned with wire brushes and all scales, mortar droppings, etc. removed. Any cracks in the roof shall be cut into "V" section and filled up flush with cement mortar 1:4 or blown up type petroleum bitumen 82/25 grade. Cleaning of surface or treating the cracks shall not be paid for separately.

4.0 PAINTING OF ROOF SLAB WITH HOT BITUMEN:

4.1 The surface to be painted should be absolutely dry sand shall be cleaned with wire brushes. All scales, mortar droppings, loose materials shall be removed.

4.2 PAINTING WITH BITUMEN:

Surface prepared shall be painted uniformly with bitumen of approved quality of 80/100 etc. after heating it to the required temperature. The cost of bitumen shall be continued at least 15 cms along vertical surface along roof slab and up to drip course in case of parapet wall.

Immediately after painting, dry clean sharp and coarse sand shall be evenly spread at 60 dm3 per 10 sqm of surface to be treated.

4.3 PRIMING COAT:

If directed the priming coat of bitumen shall be applied to the cleaned slab. This shall be paid for separately.

4.4 LAYING:

Blown type petroleum bitumen of IS grade 85/25 shall be heated to 180° C and conveyed to the roof in buckets or pouring can in weighed quantities. The roof surface shall be cleaned dry. Laying shall be commenced at the lowest level and worked up to crest. Each length of the felt laid, shall be rolled half its length.

Hot bitumen shall be poured on the roof across the full width of the rolled felt and the felt rolled out and pressed down. When the first half of felt has been bonded, the other half is rolled up and then unrolled and pressed on the hot bitumen the same way.

Subsequent strips shall be laid similarly with end laps of 10cm and side laps of 7.5 cm.

All over laps shall be firmly bonded with hot bitumen.

The third layer of bitumen in the four course treatment shall be carried out in a similar manner after flashing has been completed, followed by the final course of gravel or grit as specified in above .

4.5 SIX COURSE TREATMENT:

In six course treatment, the third and fourth layers of bitumen and self finished felt shall be laid in manner described above. The laps in fourth layer shall be staggered from those in second layer. The fifth layer of bitumen shall be carried after the flashing is done, followed by the final course of gravel or grit as specified in Waterproofing treatment shall be carried over the drain outlets and 10 cms into drain pipes or outlets.

The flashing shall consist of the same four or six course treatment except that the final course of stone grit or pea sized gravel shall be replaced by an application of additional coat of bitumen on the vertical and sloping faces of the flashing.

The upper edge of the flashing felt shall be well tucked into the flashing grooves in the parapet etc. to a depth of minimum 65 mm. The flashing treatment shall be held in place in grooves with wood edges at intervals and grooves filled up with cement mortar (1:4) and the surface finished smooth with the wall. After curing, when dry, the exposed plaster

joints of grooves shall be painted with bitumen and the vertical and sloping surface of the flashing shall be painted with two coats of bitumen.

5.0 FLAT BRICK TERRACOTA TILE WATERPROOFING TREATMENT:

The work is to be carried out on the brick bat lime concrete laid on terrace, measured and paid for separately.

The flat tiles shall be machine pressed flat earthen ware tiles, quality and make approved by EIC.. The tiles shall be 20 mm thick and of the sizes as approved by EIC..

The tiles shall be laid on 12 mm thick cement mortar (1:3) with neat cement slurry. The joints of 3 mm thickness approx. shall be properly pointed in neat cement slurry. The whole surface shall be properly watered and cured. The tiles shall be carried at an angle of 45 ° at the joints with vertical walls. Where the treatment consists of two layers, the second layer shall be laid similar to the first with joins in the two layers properly staggered. The terrace shall be tested for waterproofing by keeping 75 mm standing water on completed work for ten days. The soffit of the slab should not show any dampness or leakage.

6.0 CHINA MOSAIC WORK:(if required)

China Mosaic work shall be prepared from broken pieces of while glazed tiles or mixture of white and colour glazed tiles. No piece shall be more than 40 mm and smaller than 10 mm in any direction.

LAYING:

15 mm thick screed consisting of 1 part cement: 4 part sand shall be laid on top of roof slab. Before the screed is about to set, a floating coat, 3 mm thick of cement mortar (1 cement: 4 fine sand) shall be laid on the screed. Whilst the floating coat is green, the broken pieces of glazed tiles, thoroughly soaked in water, shall be set flat, as closely as possible. The surface shall then be rolled lightly with a wooden roller to ensure proper setting of the pieces in the floating coat and also squeezing of the mortar into joints.

The surface shall be cleaned with sawdust and kept wet for a minimum of 10 days and thoroughly cleaned on completion. Junctions with the wall shall be curved to 75 mm radium and top edge of curving carried at least 50 mm up the abutting wall. The top edge shall be finished in neat horizontal line and tucked in a groove in the wall 65 mm deep. Bell mouth around rain water pipe inlets etc. wherever required for effective drainage, shall be formed in China Mosaic finish. The surface shall be even and uniform on completion.

7.0 TREATMENT TO CRACKS:

The work shall be carried out by cutting out cracks to V section, minimum 6 mm wide on top, cleaning out with wire brush, filling with cement and sand slurry (1:1) with approved waterproofing compound mixed with cement by weight as specified by the manufacturer and curing as required.

8.0 SHALLOW SUMP FOR RAIN WATER OUTLET:

Shallow sump near rain water outlet shall be constructed before parapet is built and shall be of size specified with cement concrete 1:2:4 mix.

A PVC sheet 1 m x 1 m x 400 microns shall be laid and cement concrete of minimum thickness of 3 cms laid over it with its top surface lower than the level of adjoining roof surface by not less than 20 mm. The concrete shall be of size more than 45 cm x 45 cm to allow for waterproof terracing, to overlap its through edges by min 7.5 cm and shall be

sloping towards the outlet. The concrete shall be rendered with 12 mm thick cement plaster 1:3 while cement concrete is still green.

9.0 WATERPROOF TREATMENT WITH ACRYLIC BASED CHEMICAL OR CEMENT BASED WATRPROOF AGENT:

9.1 Preparation of Surface:

The roof surface shall be cleaned with wire brushes and gunny cloth. All scales, mortar falling, loose material etc. shall be removed to base slab surfaces. All cracks shall be made in to "V" grooves 25 mm wide at top and 12 to 20 mm deep and cleaned.

9.2 Laying:

The entire work shall be carried out as per instructions of the manufacturer of the approved waterproofing agent.

A layer of neat cement slurry mixed with waterproof agent shall be laid in convenient lengths and widths. Bricks on edge or broken brick pieces shall be laid in cement mortar1:4 (1 cement : 4 sand) with waterproof agent. The brick pieces / brick on edge shall be wetted thoroughly before use. Cement Mortar 1:4 shall be filled in the joints and a little above. Waterproofing agent of approved make shall be added at 1% weight of cement in case of acrylic based chemical waterproofing agent in slurry and mortar and properly mixed width cement specified by the Manufacturer before mixing the same with sand.

The brick on edge or brick bat work as above shall be laid to proper levels and slopes as required, directed and / or as shown on drawings. Minimum 25 mm thick joint less water proofing layers of cement mortar 1:4 (1 cement : 4 sand) with waterproof agent, shall be laid over the brick bat work and finished smooth with a layer of neat cement slurry mixed with waterproof agent. If directed, string marks showing 300 mm x 300 mm square shall be marked properly. The slope of the finished terrace shall not be less than 1 in 50, unless a flatter slope is expressly permitted by the EIC in writing. The roof surfaces shall slope from all sides towards the rain-water outlets.

The treatment shall be properly rounded at junction of walls, etc. and carried out above 300 mm above the level of waterproofing treatment. The edge of the treatment along parapet shall be tucked into a groove 65 mm deep into the parapet. The treatment shall be continued near rain water outlet etc. The entire treatment shall be properly cured for a period of 2 weeks by ponding method. Normally the proportion of acrylic based chemicals is one percent by weight of OP Cement and for other waterproofing compound 2% by weight of cement. The Contractor shall give complete details of waterproofing treatment proposed by him, including the waterproof compound he proposes to use. These details shall include roof fill materials, waterproofing compound, minimum & maximum thickness of slurry, joints thickness, mortar on top of total treatment.

The Contractor shall ensure that sufficient slope for effective drainage is provided within the average thickness of waterproofing treatment proposed by the Contractor. In case the average thickness has to exceed that specified, the fact shall be specifically brought to the notice of the EIC.

The entire work shall be covered by a guarantee for waterproofing for a period of 10 years as specified in 2.0 above.

10.0 BRICK BAT CONCRETE:

10.1 The work shall be carried out in correct line, level and slope. This shall be carried out when the thickness of cement based waterproofing treatment exceeds the specified thickness or Elsewhere in bathrooms, toilets, etc. to fill up the voids.

11.0 WATERPROOF CEMENT PLASTER:

11.1 The work shall be carried out in correct line and level in CM 1:4 (1 cement:4 sand) minimum 15 mm thick as backing coat with approved waterproofing compound, mixed with cement by weight as specified by manufacturer and finished with 6 mm thick uniform grained sand faced plaster coat including curing with 10 years performance guarantee for terrace parapet or external walls or concrete surfaces.

12.0 INJECTION / PRESSURE GROUTING WATERPROOF TREATMENT:

12.1 Surface Preparation:

The surface to be treated shall be cleaned of all scales, loose materials, and wire brushed clean. All cracks apparent and construction joints shall be made in to V grooves 25 mm at top and above 20 mm deep and treated with cement slurry 1:1 (1 cement : 1 sand) with approved waterproof compound mixed with cement by weight as specified by the manufacturer of the compound.

Holes of about 25 mm dia. to receive funnel or pipe nozzles and 25 to 40 mm deep shall be chiseled at about 1.5 m or less centre to centre as required, in the entire floor and walls to be treated. Nozzles shall then be fixed in these holes and grooves.

After the nozzles are set for minimum 24 hours, neat cement slurry mixed with waterproofing compound by weight of cement, as specified by the manufacturer of the compound, shall be injected through these nozzles, by low pressure, gravity for the slurry to run through the minutest cracks and pores in the entire structure. The process shall be continued till the surface to be treated is bond dry and shall not show any dampness at all.

The nozzles shall then be removed and the holes properly filled up.

13.0 BOX TYPE WATERPROOF TREATMENT WITH STONE SLABS:

13.1 The treatment shall be minimum 75 mm in thickness and shall be carried out entirely as per specialized waterproofing agency's manufacturer's specifications & shall be generally as follows:

13.2 For Bottom of Basement Slabs Etc.

The treatment shall be carried out before laying the raft slab, basement slab, lift pit slab, etc. This shall be laid on 1:3:6 bedding course. The bedding course shall be measured and paid for separately.

A 25 mm thick layer of cement mortar 1:4 (1cement: 4 fine sand) with waterproofing compound mixed with cement by weight as specified by manufacturer shall be evenly laid as backing course. Rough stone slabs of Shahabad Tiles minimum 20 mm thick shall be laid firmly over this with gaps of about 15 mm to 20 mm in between and properly set. The joints thus left are raked out to full depth and cement slurry admixed with waterproofing compound is grouted in these joints. A protective layer of 25 mm thick in CM 1:4 (1cement: 4 fine sand) with waterproofing compound as above is laid over this, with stone chips embedded at random. The total thickness of waterproofing treatment shall be 75 mm. The treatment shall be extended 150 mm beyond the external face of the raft or walls, and shall be properly cured at every stage and after curing is ready to receive the raft and other slabs.

13.3 For Vertical Walls Or Basement Etc.

The surface to be waterproofed shall be properly hacked and roughened. Rough stone slabs about 20 mm thick shall be placed vertically in position with the help of cement paste applied to the internal face of vertical joints leaving a gap of about 20 mm between the

external face of RCC wall and internal face of rough stone. The stones are held side by side leaving hardly any gap between the edges. In order to fix the bottom most layer of stones, a groove about 25 mm deep shall be made in the bottom and the stones fixed in it to ensure water tightness at the junction of the walls and the raft.

Maximum 2 or 3 horizontal layers of rough stones are laid at a time. A coat of rough cement plaster 1:4 (1 cement : 4 sand) with water proofing compound is applied to the external face of rough stone. After the plaster layer is set, the gap between wall and stone layer is filled with a grout made up of cement slurry with water proofing compound as per Manufacturer's specifications. The treatment shall be continued up to 300 mm above the final made up ground level.

The proportion of acrylic based waterproofing, chemicals shall be 1% by weight of cement and 2% in case of cement based waterproofing compound. Continuous pumping and bailing out water shall be ensured till RCC raft is laid and till the treatment to walls is completed. The back filling should not contain stones, boulders and such other material which will cause damage to waterproofing treatment. The internal treatment to walls shall be similar for walls and slabs and shall be laid after the raft slab or lift pit slab is laid. This shall be carried out if ordered by the EIC.

The internal treatment shall be finished smooth. The whole work shall be properly cured at every stage.

13.4 Performance Guarantee:

The Contractor shall give 10 years performance guarantee for the waterproofing work carried out by them.

14 .0 WATERPROOFING TREATMENT TO BASE OF WATER STORAGE TANKS, ETC.

Surface preparation is as per 6.0 with double layer of cement based waterproofing treatment

A layer of 25 mm thick cement mortar 1:3 (1 cement : 3 fine sand) shall be then laid with approved waterproofing compound in the proportion as per Manufacturer's specifications, nominal 25 mm size stone aggregates or gravel shall be embedded at random about half depth into the layer, while still green. After this is properly cured, a second layer 25 mm thick cement mortar 1:3 layer with waterproof compound, as above, is laid and finished smooth with neat cement also with waterproofing compound. The whole treatment shall be properly cured.

The entire treatment shall be covered with performance guarantee of 10 years.

14.1 Waterproof Patent Stone for Tank Bottom, Etc.

The patent stone in cement concrete 1:2:4 and 4 mm thick, finished smooth shall be carried out as per the specifications of the item in relevant section, except that the waterproofing compound, by weight, shall be mixed with cement as specified by the manufacturer.

Waterproof cement plaster for interior of water tank. The thickness of plaster shall be min. 20 mm. The specifications shall be same as per plaster finish smooth under relevant section. The work shall cover preparation of surface, waterproofing compound etc.

14.2 Cement Based Waterproofing To Toilet / Bathroom Slabs Etc.

The surface shall be cleaned of all loose scales, mortar, fallings, etc. by wire brushing and gunny cloth. All cracks shall be cut into V form, cleaned and filled in with cement mortar 1:1 slurry with approved waterproofing compound at 2% by weight of cement. A 20mm

thick layer of cement mortar 1:3 shall then be laid and gravel or stone aggregate of 12 m nominal size of fairly uniform size hand set in it while the cement mortar is still green with hand pressure. A final layer of 25 mm thick cement mortar 1:3 shall then be laid over it, compacted with trowels, finished smooth. In all cement based waterproofing compound, as specified by the specialized waterproofing agency shall be mixed. The whole work shall be cured properly for 10 days. The joints with walls shall be rounded 150 mm above the waterproofing treatment level. This treatment is used in bathrooms, equipment floor, office buildings, etc.

The waterproofing treatment shall carry performance guarantee of 10 years.

14.3 Expansion Joints - Polysulphide Joints:

The top 12 mm thick and 20 mm deep strip in the horizontal and vertical expansion joints in slabs, beams, columns, walls, etc. shall be filled properly with patented poly sulphide compound as per manufacturer's instructions.

For expansion joints, the joint filled shall be packed firmly to close all gaps or voids.

14.4 Application:

The resin shall be thoroughly mixed with the curing agent and shall be either directly poured or applied with special gun to fill up the joint. The joints are finished flush with the surface.

The expansion joints exposed inside the building at any floor level shall be covered with thin aluminium flat (20 gauge) or asbestos cement strip of min. available thickness or wooden beading etc. as directed by EIC. The width of such covering shall be sufficient to cover the entire joint and allowance for fixing nails / screws. The fixing of such strip shall be at one only to allow for the movement at the joint. Alternatively, the strip can be fixed from both sides but the holes on one side to be oval shape to allow unrestricted movement of structural member and to avoid shearing of the flat. Aluminium angles of suitable size, may also be provided, if the joint is at the corner, but shall be fixed on one side only.

14.5 Grading Roof:

The specification shall be for 1:2:4 cement concrete as covered under relevant section. The concrete shall be laid in level or grade as directed. The measurements shall be in cubic metres.

14.6 Cement Watta:

This is provided at the junction of horizontal and vertical surfaces to prevent entry of water. The surface, about 250 mm to 350 mm wide on both surfaces, shall be cleaned of all grease, oil, etc. The cement watta is triangular in cross section of each side averaging to 250 mm to 350 mm in cement mortar 1:3 (1 cement : 3 sand) finished neat with floating coat of neat cement, cured etc. Approved waterproofing compound shall be mixed with cement as directed by manufacturer by weight all complete as directed by Engineer-in-Charge.

ALTERNATIVE: ISOTHANE - EMB / ISOTHANE – EMA (or approved proven equivalent)

ISOTHANE EMB shall be a very high solid coating so designed to give a high build film with high elasticity, good U.V.stability and high strength. It should adhere permanently

into a flexible seamless membrane and maintain high roof integrity on any substrate i.e the hypar shell.

ISOTHANE EMA elastomeric membrane shall be a liquid applied coating based on Urethane Prepolymers which cure by reaction with atmospheric moisture to give a continuous film which is rubbery and elastic. It shall contain leafing aluminium which gives it ultra violet resistance.

ISOTHANE EMA shall cure permanently into flexible seamless membrane, by virtue of its chemical reactivity in the wet state, and shall have a good adhesion to a wide range of substrates. Isothane-EMA should not embrittle with age, exposure to ultra violet radiation or weathering.

APPLICATION SPECIFICATION

All loose materials from roof surface shall be removed by brushing. One coat of Isothane P Primer shall be applied.

Two coats of Isothane - EMB/EMA with suitable interval between two coats shall be applied to achieve a dry film thickness of 1 mm.

PRECAUTION BEFORE APPLICATION / INSPECTION

1. Thoroughly clean the roof surface by brushing (all debris, chippings, moss, etc., must be removed).

2. Inspect total roof area for defect, pay particular attention to:

a) Roof gradient

b) Upstands

c) Expansion joints

d) Dran/gully outlets

e) Roof edges

f) Roof finish

3. Any major cracks or defects noticed on the roof should be individually assessed, but the general treatment is to rake out to a firm base and fill with a non-setting mastic or ISOTHANE-EM. It is generally necessary to re-inforce these areas with scrim.

4. Allow surface to dry thoroughly and any moisture contained in the structure to evaporate.

5. Fill cracks and voids with mastic sealant:

NOTE

a) In the case of two coat application, the first coat should be touch dry in 12-48 hours and the second coat should be applied within 24 hours to ensure good adhesion.

b) Where application extends over more than a working day, an overlap of 150 mm should be done.

c) It is not normally necessary to re-inforce total roof area, but in case of high movement or regular foot traffic this is recommended. Regularly used walkways are also marked out and reinforced with scrim.

d) ISOTHANE - EM can be used for balconies and decks not subject to heavy foot traffic. In such cases at least 1.5 mm coating thickness should be applied and a reinforcing scrim embedded into the first coat is recommended. In order to improve foothold, fine

dry aggregate or silica sand should be sprinkled over the last application before it fully cures.

TYPICAL PROPERTIES

S.No.		ISOTHANE - EMA	ISOTHANE - EMB
1.	Specific Gravity	1.18	1.20
2.	Solid % min	95	92
3.	Abel closed cup flush point Deg.C	56	69
4.	Application limit Deg.C	0.70	0.70
5.	Approx.Dry time (20 C.50% RH)	12.20 hours touch dry - 7 days full cure.	12.20 hours touch dry - 7 days full cure.
6.	Elongation %	500	500
7.	Tensile Strength	300	400
8.	U/V Resistance	Excellent	Excellent
9.	Storage stability (Temperature climate)	9 months	9 months

WATER PROOFING ON FLOORS AND WALLS OF SUNKEN AREAS

Preparation of Surface:

This shall be as described for Roof Water Proofing.

Horizontal Surface

Cement slurry admixed with acrylic based chemical @ 0.5 kg/50 kg of cement shall be spread smoothly over the R.C.C roof which has been cleaned and prepared prior to laying the slurry . A 20 mm thick mortar 1:4 (1 cement : 4 coarse sand) admixed with acrylic based chemical as recommended by the manufacturer shall be spread over the bed prepared with cement slury. A

layer of graded stone aggregate shall be embedded at random. After cleaning for about 2 days, another layer of cement shall be spread evenly followed by a 20mm thick mortar 1:4 (1 cement : 4 coarse sand) admixed with acrylic based chemical which is finished smooth and corners rounded off.

Vertical Surface

These shall be 20 mm thickness in two coats. The under coat shall be 10 mm thick 1:4 (1 cement : 4 coarse sand) admixed with acrylic water proofing chemical @ 1 kg per 50 kg of cement and shall be applied on the prepared vertical surface. The top surface shall be brought to a true surface with wooden straight edge. The surface shall be finished smooth. The junction of vertical plastered surface and floor surface shall be rounded of suitable with the same materials as stated hereinbefore.

Curing

The finished surface shall be cured with flooding of water for a period of two weeks before filling sunken areas with concrete.

Precautions

While filling the areas with concrete it is to be ensured that the floor and the walls surface treated with water proofing treatment does not get damaged.

Water proofing of basements, lift pit base and sides and other similar locations shall be done as specified in the schedule and generally comprise of.

A. HORIZONTAL SURFACE:

The prepared surface of P.C.C levelling course shall be treated with three layers of waterproofing course of 20mm thick each, each layer preceded by a spread of proprietary material cement mix slurry for effective bonding of the layer.

The waterproofing course shall be of proprietary material mix cement mortar 1:3 (1 cement : 3 coarse sand) the proportion of mix of cement and proprietary material being as specified by the manufacturer and in no case it shall be less than 1% by weight of cement.

The bottom two layers of waterproofing course shall be provided with embedment of stone aggregate 12mm down by hand pack at random, the time gap between these two layers being not less than 24 hours.

The third and top layer shall be laid after curing for at least two days and top finished smooth, making the total thickness of the treatment to 60 mm.

An additional impervious layer over the waterproofing layers laid shall be formed by injecting, proprietary material cement mix grout, through a net work of nozzles of 25 mm dia M.S pipe of adequate length placed in position, at specified locations (1 to 1.5 m apart) before casting R.C.C base slab (Raft) by securing to the reinforcement of raft in such a manner that they remain in position and free from getting choked during slab casting, not earlier than 7 days of casting, by filling all voids/crevices in the concrete of the raft. The protruding part of the grouting nozzles shall be cut and the space filled with cement sand mortar (1:2) and finished smooth.

All operations of the treatment shall be as per manufacturers directions.

VERTICAL SURFACE

The waterproofing treatment shall be done after the removal of shuttering of vertical walls cast.

The prepared external surface shall be applied with proprietary material cement mix slurry. Then waterproofing plaster shall be done in two layers of 12mm thick each with proprietary cement mix mortar of 1:4 (1 mix : 4 coarse sand).

The cavities and the minutest of cracks in the concrete of the wall is then filled by injecting proprietary material cement mix grout under pressure through nozzles prefixed in a grid pattern on the other side wall surface by cutting holes about 50mm in diameter and 25mm to 40mm deep at 1.0 to 1.5 m apart and grouting nozzles fixed in these holes with cement paste which will be allowed to set for at least 24 hours before actual grouting under pressure. The nozzles are to be removed only after the grout is set. The gaps formed on removal of nozzles shall then be filled with cement sand mortar 1:2 and finished smooth. The position of the nozzles shall cover all construction joints and a continuous groove chiselled out along the joint at the junction of the floor and walls.

All the operations shall be as per manufacturer's specification and directions.

The mix of the proprietary material and cement shall be as per manufacturer's specification and in no case it shall be less than 1% by weight of cement.

The rate for the above treatment shall include drying and cleaning surface free of dust etc.

LIFT PIT

Waterproofing to lift pit, side walls, floor slab, column projected outside and around the pile cap using standard approved chemicals in box method of water proofing prior to construction below the raft and after construction of the RCC bottom and side walls of lift on the outside including necessary materials technique and labour required for effective and water tight sealing of the entire basement structure all as per IS 6494 and to the following specifications.

At the raft level / bottom of the lift well.

(a) 60mm thick standard box type (injection water proofing treatment shall be provided for all horizontal surface.

(b) At the junction of pile and raft, you shall leave four nozzles, two of which will be grouted after your horizontal surfaces treatment is completed and the balance two grout pipes shall be left in place and grouted after raft concreting is completed.

(c) Grouting nozzles should be left at 1.5 mtr centres in both direction, 2" deep into the raft slab and side walls for grouting after construction.

RAFT / RETAINING WALL

After the excavation the P.C.C for proper bonding with subsequent waterproofing treatment.

Waterproofing course of 20mm thick Chemseal or approved equivalent cement mortar 1:4 in laid over the slurry, Stone aggregate 12mm down is embedded in it by handpack at random.

Not earlier than 24 hours after above operation chemseal cement slurry is spread on the mortar and one more layer of 20mm thick Chemseal or approved equivalent cement mortar 1:4 is laid, Stone aggregate 12mm down is embedded in it by handpack at random. After curing at least for 2 days Chemseal or approved equivalent cement slurry is spread to enable bonding and final layer of 20mm thick chemseal cement mortar 1:4 is laid and finished smooth.

Polysulphide epoxy coating should be given.

The total thickness of the above treatment is about 60mm.

After the reinforcement of raft is placed in position grouting nozzles of adequate length are fixed at the specified locations (1 to 1.5m apart). These nozzles are of 25mm diameter M.S.pipes. The nozzles are placed in such a manner that they remain free from getting choked. The tip of these nozzles protrudes above the raft concrete to allow grouting hose to be connected to them for grouting.

Not earlier than 7 days after the concreting has been done, Chemseal cement grout or approved equivalent is injected through these network of nozzles. This will help to form an additional impervious layer over the waterproofing layers laid at the bottom by filling all voids/crevices in the concrete of the raft.

The protruding part of the grouting nozzles is cut and the space filled with cement sand mortar (1:2) and finished smooth. After the vertical walls have been cast and shuttering removed, the waterproofing treatment is done as follows.

The external surface is prepared and Chemseal or approved equivalent cement, slurry is applied and then waterproofing plaster with Chemseal or approved equivalent cement mortar (1:4) applied in two layers of 12mm each.

Polysulphide epoxy coating will be given.

Holes about 50 mm in diameter and 25 to 40 mm deep are made on the wall surface about 1.00 to 1.5 m apart in a grid pattern, Grouting nozzles are fixed in these holes with cement paste. These nozzles are allowed to set for at least 24 hours. The positioning of the holes is such as to cover all construction joints. The joint at the junction of the floor and walls is chiselled to make a continuous groove and nozzles fixed in this groove.

Chemseal or approved equivalent cement grout is injected through the above nozzles under pressure so as to fill in the minutest of cracks and cavities in the concrete.

After the grout is set, the nozzles are removed and the space filled with cement sand mortar (1:2) and finished smooth.

EXTERNAL IMPREGNATION (BOX) TREATMENT:

FLOOR RAFT: Actual area over which the treatment is laid i.e. total area of raft/floor plus the projections of treatment beyond edge of raft / floor shall be measured and charged accordingly.

WALLS: The external surfaces of the walls actually provided with the treatment shall be measured and charged for.

E. In case of pile Foundations, the treatment shall be laid below pile caps and also to the vertical walls of each pile cap and the same shall be measured and charged for. No deductions shall be made for the piles as grouting shall be done to take care of piles.

GUARANTEE for the watertight performance of the structure for a minimum period of 10 years from the date of completion shall be given in the prescribed form given below. This guarantee shall be in legal paper in an acceptable form. The guarantee shall be enforceable either by the Architects or by clients. If, during the guarantee period, water leaks are noticed in the structure from the portions treated by you, the same shall be rectified when called upon immediately, all at no extra cost to the entire satisfaction of the Architect/Employer.

MODE OF MEASUREMENTS

A. TERRACE

It shall be over all plan area between the walls. The Vattas (Golas) shall be measured separately in Running Meter and as a separate item. Usually the Vattas (Golas) shall be of 300 mm height from the finished surface.

B. TOILET BLOCKS

FLOOR: Area of the Toilet Blocks shall be measured by length x breadth between walls.

VERTICAL SIDES

The actual area treated by us above the finished floor level shall be measured by length x height.

B. BRICK MASONRY

BRICK MASONRY

1.0 DESCRIPTION

This work shall consist of construction of structures with bricks jointed together by cement mortar in accordance with the details shown on drawings or as approved by the Engineer.

2.0 MATERIALS

All materials to be used in the work shall conform to the requirements laid down in chapter Materials under Civil

3.0 PERSONNEL

Only trained personnel shall be employed for construction and supervision.

4.0 CEMENT MORTAR

Cement and sand shall be mixed in specified proportions given in the drawings. Cement shall be proportioned by weight, taking the unit weight of cement as 1.44 tonne per cubic metre. Sand shall be pro-portioned by volume taking into account due allowance for bulking. All mortar shall be mixed with a minimum quantity of water to produce desired workability consistent with maximum density of mortar. The mix shall be clean and free from injurious type of soil/acid/alkali/ organic matter or deleterious substances.

The mixing shall preferably be done in a mechanical mixer operated manually or by power. Hand mixing can be resorted to as long as uniform density of the mix and its strength are assured subject to prior approval of the Engineer. Where permitted, specific permission is to be given by the Engineer. Hand mixing operation shall be carried out on a clean water-tight platform, where cement and sand shall be first mixed dry in the required proportion by being turned over and over, backwards and forwards several times till the mixture is of uniform colour. Thereafter, minimum quantity of water shall be added to bring the mortar to the consistency of a stiff paste. The mortar shall be mixed for at least two minutes after addition of water.

Mortar shall be mixed only in such quantity as required for immediate use. The mix which has developed initial set shall not be used. Initial set of mortar with ordinary Portland Cement shall normally be considered to have taken place in 30 minutes after mixing.

In case the mortar has stiffened during initial setting time because of evaporation of water, the same can be re-tempered by adding water as frequently as needed to restore the requisite consistency, but this re-tempering shall not be permitted after 30 minutes. Mortar unused for more than 30 minutes shall be rejected and removed from site of work.

5.0 SOAKING OF BRICKS

All bricks shall be thoroughly soaked in a tank filled with water for a minimum period of one hour prior to being laid. Soaked bricks shall be removed from the tank sufficiently in advance so that they are skin dry at the time of actual laying. Such soaked bricks shall be stacked on a clean place where they are not contaminated with dirt, earth, etc.

6.0 JOINTS

The thickness of joints shall not exceed 10mm. All joints on exposed faces shall be tooled to give concave finish.

7.0 LAYING

All brickwork shall be laid in an English bond, even and true to line, in accordance with the drawing or as directed by the Engineer, plumb and level and all joints accurately kept. Half and cut bricks shall not be used, except when necessary to complete the bond. Closer in such cases shall be cut to the required size and used near the ends of the walls. The bricks used at the face and also at all angles forming the junction of any two walls shall be selected whole bricks of uniform size, with true and rectangular faces.

All bricks shall be laid with frogs up on a full bed of mortar except in the case of tile bricks. Each brick shall be properly bedded and set in position by slightly pressing while laying, so that the mortar gets into all their surface pores to ensure proper adhesion. All head and side joints shall be completely filled by applying sufficient mortar to brick already placed and on brick to be placed. All joints shall be properly flushed and packed with mortar so that no hollow spaces are left. No bats or cut bricks shall be used except to obtain dimensions of the different courses for specified bonds or wherever a desired shape so requires.

The brick work shall be built in uniform layers, and for this purpose wooden straight edge with graduations indicating thickness of each course including joint shall be used. Corners and other advanced work shall be raked back. Brickwork shall be done true to plumb or in specified batter. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. Vertical joints in alternate courses shall come directly one over the other. During construction, no part of work shall rise more than one metre above the general construction level, to avoid unequal settlement and improper jointing. Where this is not possible in the opinion of the Engineer, the works shall be raked back according to the bond (and not toothed) at an angle not steeper than 45 degrees with prior approval of the Engineer. Toothing may also be permitted where future extension is contemplated. Before laying bricks in foundation, the foundation slab shall be thoroughly hacked, swept clean and wetted. A layer of mortar not less than 12 mm thick shall be spread on the surface of the foundation slab and the first course of bricks shall be laid.

8.0 JOINTING OLD AND NEW WORK

Where fresh masonry is to join with masonry that is partially/entirely set, the exposed jointing surface of the set masonry shall be cleaned, roughened and wetted, so as to effect the best possible bond with the new work. All loose bricks and mortar or other material shall be removed.

In, the case of vertical or inclined joints, it shall be further ensured that proper bond between the old and new masonry is obtained by interlocking the bricks. Any portion of the brickwork that has been completed shall remain undisturbed until thoroughly set.

In case of sharp corners specially in skew bridges, a flat cutback of 100 mm shall be provided so as to have proper and bonded laying of bricks.

9.0 CURING

Green work shall be protected from rain by suitable covering and shall be kept constantly moist on all faces for a minimum period of seven days. Brick work carried out during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period. The top of the masonry work shall be left flooded with water at the close of the day. Watering may be done carefully so as not to disturb or wash out the green mortar.

During hot weather, all finished or partly completed work shall be covered or wetted in such a manner as will prevent rapid drying of the brickwork.

During the period of curing of brick work, it shall be suitably protected from all damages. At the close of day's work or for other period of cessation, watering and curing shall have to be maintained.

Should the mortar perish i.e. become dry, white or powdery through neglect of curing, work shall be pulled down and rebuilt as directed by the Engineer. If any stains appear during watering, the same shall be removed from the face.

10.0 SCAFFOLDING

The scaffolding shall be sound, strong and safe to withstand all loads likely to come upon it. The holes which provide resting space for horizontal members shall not be left in masonry under one metre in width or immediately near the skew backs of arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good. Scaffolding shall be got approved by the Engineer. However, the Contractor shall be responsible for its safety.

11.0 EQUIPMENT

All tools and equipment used for mixing, transporting and laying of mortar and bricks shall be clean and free from set mortar, dirt or other injurious foreign substances.

12.0 FINISHING OF SURFACES

12.1 General

All brickwork shall be finished in a workmanlike manner with the thickness of joints, manner of striking or tooling as described in these above specifications.

The surfaces can be finished by "jointing" or "pointing" or by "plastering" as given in the drawings.

For a surface which is to be subsequently plastered or pointed, the joints shall be squarely raked out to a depth of 15 mm. while the mortar is still green. The raked joints shall be well brushed to remove dust and loose particles and the surface shall be thoroughly washed with water, cleaned and wetted.

The mortar for finishing shall be prepared as approved.

12.2 Jointing

In jointing, the face of the mortar shall be worked out while still green to give a finished surface flush with the face of the brick work. The faces of brick work shall be cleaned to remove any splashes of mortar during the course of raising the brick work.

12.3 Pointing

Pointing shall be carried out using mortar not leaner than 1:3 by volume of cement and sand or as shown on the drawing. The mortar shall be -filled and pressed into the raked joints before giving the required finish. The pointing shall be ruled type for which it shall, while still green, be ruled along the centre with half round tools of such width as may be specified by the Engineer. The super flush mortar shall then be taken off from the edges of

the lines and the surface of the masonry shall be cleaned of all mortar. The work shall conform to IS:2212.

12.4 Plastering

Plastering shall be done where shown on the drawing.

Plastering shall be started from top and worked down. All putlog holes shall be properly filled in advance of the plastering while the scaffolding is being taken down. Wooden screeds 75 mm wide and of the thickness of the plaster shall be fixed vertically 2.5 to 4 metres apart, to act as gauges and guides in applying the plaster. The mortar shall be laid on the wall between the screeds using the plaster's float and pressing the mortar so that the raked joints are properly filled. The plaster shall then be finished off with a wooden straight edge reaching across the screeds. The straight edge shall be worked on the screeds with a small upward and sideways motion 50 mm to 75 mm at a time. Finally, the surface shall be finished off with a plasterer's wooden float. Metal floats shall not be used.

When recommencing the plastering beyond the work suspended earlier, the edges of the old plaster shall be scrapped, cleaned and wetted before plaster is applied to the adjacent areas. No portion of the surface shall be left unfinished for patching up at a later period.

The plaster shall be finished true to plumb surface and to the proper degree of smoothness as directed by the Engineer.

The average thickness of plaster shall not be less than the specified thickness. The minimum thickness over any portion of the surface shall not be less than the specified thickness by more than 3 mm.

Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut in rectangular shape and re-done as directed by the Engineer.

12.5 Curing of Finishes

Curing shall be commenced as soon as the mortar used for finishing has hardened sufficiently not to be damaged during curing. It shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages.

12.6 Scaffolding for Finishes

Stage scaffolding shall be provided for the work. This shall be independent of the structure.

13.0 ARCHITECTURAL COPING FOR WING/RETURN / PARAPET WALL

This work shall consist of providing an Architectural coping for wing / retum / parapet walls.

The material used shall be cement mortar 1:3 or as shown on the drawings prepared in accordance as approved.

The cement mortar shall be laid evenly to an average thickness of 15 mm to the full width of the top of the wall and in continuation a band of 15 mm thickness and 150 mm depth shall be made out of the mortar along the top outer face of the walls.

14.0 ACCEPTANCE OF WORK

All work shall be true to the lines and levels as indicated on the drawing or as directed by the Engineer, subject to tolerances as indicated in these specifications.

Mortar cubes shall be tested in accordance with IS:2250 for compressive strength, consistency of mortar and its water retentivity. The frequency of testing shall be one sample for every 2 cubic metres of mortar, subject to a minimum 3 samples for a day's work.

In case of plaster finish, the minimum surface thickness shall not be less than the specified thickness by more than 3mm.

AUTOCLAVED CELLULAR CONCRETE BLOCK MASONRY

SPECIFICATION FOR CONCRETE BLOCK MASONRY

1.0 SCOPE

These specifications cover the use of Autoclaved Cellular Concrete Block Masonry for the structural / non structural purposes.

2.0 GENERAL

The provision of the latest Indian Standards listed below form part of these specifications:

All relevant Standards as specified elsewhere in this Volume are also applicable.

IS 269	Specification for ordinary and low heat portland cement
IS 383	Specification for coarse and fine aggregates from natural sources for concrete.
IS 455	Specification for portland slag cement
IS 456	Code of Practice for plain and reinforced concrete.
IS: 1200	Measurement for Building works
IS: 1725	Specifications for solid cement blocks used in general building construction.
IS: 1905	Code of practice for structural safety of buildings Masonry walls.
IS:2116	Sand for masonry mortars.
IS:2185 (Part 1)	Specification for concrete masonry units: Hollow and solid concrete blocks.
IS 2185 (Part 3)	Specifications for Autoclaved Cellular concrete Blocks.
IS:2250	Code of practice for preparation and use of masonry mortar.
IS 2572	Code of practice for construction of hollow concrete block masonry.
IS 2645	Specification for integral waterproofing compound.
IS:3115	Specification for lime based blocks.
IS:3414	Code of practice for design and installation of joints in buildings.
IS:3466	Specification for masonry cement.
IS:3952	Specification for burnt clay hollow blocks for walls and partitions.
IS 3809	Fire resistance Test for Structure.
IS:4098	Specification for lime-pozzolana mixture

IS:4441	Code of practice for use of silicate type chemical resistant mortars.
IS:4442	Code of practice for use of sulphur type chemical resistant mortars.
IS 6041	Construction of Autoclaved Cellular Concrete Block Masonry.
IS 6441(Part 1to 8)	Methods of test for autoclaved cellular concrete products. (Determination of unit weight or bulk density & moisture content).
IS 8112	Specification for 43 Grade ordinary Portland cement
IS 9103	Specification for admixtures for concrete.

3.0 MATERIAL

3.1 Cement: Ordinary Portland cement complying with IS 269 shall be used unless specified.

3.2 Aggregates: Aggregates shall conform to IS 383. Grading shall be as indicated in IS 383. Fineness modules of the combined aggregates shall be between 3.6 and 4.

3.3 Water: Water conforming to IS 456 and as approved by the EIC shall be used.

3.4 Admixtures: Additives or admixtures may be added to the cement or concrete mix conforming to the IS specifications. Admixtures shall be chloride free and melamine polymer based. Other additives or admixtures not being governed by Indian Standards shall be tested and checked that the same are not detrimental to durability. However any addition shall only be after approval of the EIC.

4.0 MANUFACTURE:

4.1 Autoclaved Cellular Concrete blocks may be hollow (open or closed cavity) or solid and shall be referred to by its nominal dimension. The term nominal dimension includes the thickness of the mortar joint. All specifications of solid concrete blocks including specifications for actual dimensions, tolerances, sizes, shapes and webs, grades of blocks etc. shall conform to IS : 2185.

4.2 Concreting: Concrete mix used for blocks shall be pre-designed to give a minimum crushing strength of 30 Kg/Cm2. Concrete shall be mixed in the mechanical mixer. Blocks shall be moulded, laid and compacted with automatic machines table vibrator. Care shall be taken to see that the mix mould is properly filled up. Block shall be protected until they are sufficiently hardened to permit handling without damage.

4.3 Curing & Drying: Blocks shall be cured in the curing yard by keeping them continuously moist for at least 14 days. Steam-cured blocks shall be preferred. Cured blocks shall be allowed to dry for a period of 4 weeks before being used. The blocks shall be allowed to complete their initial shrinkage before they are laid in the wall.

4.4 Physical requirements: All blocks shall be sound and free of cracks or other defects. For exposed construction face or faces shall be free of chips or other imperfections, and the overall dimensions of the blocks shall be in accordance to tolerance as specified. Minimum compressive strength shall be 30 Kg/Cm2 or as specified in the Schedule of Quantity, maximum permissible water absorption shall not exceed the limit specified in I.S. : 2185, dimensional variations shall conform to I.S. 2185.

4.5 Testing: Tests as indicated in Appendices A to F of IS 2185 shall be conducted on samples of units selected according to the sampling procedure given here under to ensure conformity with the physical requirements as specified.

4.6 Sampling: A sample of 20 blocks shall be taken from every consignment of 5000 blocks or part thereof of the same size and same batch of manufacture. From these samples, the blocks shall be taken at random for conducting the test. The blocks shall be taken at regular intervals during the course of work, preferably while being loaded or unloaded. In case samples are to be taken from the stacks, blocks shall be taken at random from across the top of the stacks, the sides accessible and from the interior of the stacks.

4.7 The blocks shall be kept under cover and protected from extreme conditions of temperature, relative humidity and wind until they are required for test. The test shall be conducted as soon as the sample has been taken.

4.8 Number of Tests: All the 20 blocks shall be checked for dimensions and inspected for visual defects. Out of the 20 blocks, 3 blocks shall be subjected to the test for block density, 8 blocks to the test for compressive strength, 3 blocks to the test for water absorption and 3 blocks to the test for drying shrinkage and later to the test for moisture movement. The remaining 3 blocks shall be reserved for retest for drying shrinkage and moisture movement if a need arises.

4.9 Blocks shall be approved if requirements of conditions mentioned in 11.2 to 11.5 of IS 2185 (Part I) (as given below) are satisfied. The number of blocks with dimensions outside the tolerance limit and / or with visual defects, among those inspected shall not be more than two. For Block density and compressive strength, the mean value determined shall be greater than or equal to the minimum limit specified in Table 2 of IS 2185 (Part I).

For drying shrinkage and moisture movement, all the test specimens shall satisfy the requirements of the test. If one or more specimens fail to satisfy the requirements, the remaining 3 blocks shall be subjected to these tests. All blocks shall satisfy the requirements. Drying shrinkage shall not exceed 0.1 percent.

For water absorption, the mean value determined shall not be more than 10 percent by mass.

5.0 PRECAUTIONS:

5.1 ACC blocks should be stacked in dry, well ventilated areas on a level ground. Block should be placed on edges (in direction of 240mm height) not on flat. Different stacks should be maintained for different sizes of blocks.

5.2 Damp-proof course should be provided beneath the ACC block masonry.

5.3 Unsupported height of ACC block masonry should not exceed 18 times the thickness of wall and length 20 times the thickness of wall.

6.0 WORKMANSHIP:

6.1 In total dry climate top and sides may be slightly moistened to avoid absorption of water from mortar. Joints shall not be bigger than 10mm and will be perfectly horizontal and vertical. Joints shall be raked 10mm deep while mortar is wet.

6.3 Cut blocks shall not be used. Special solid / hollow pre-cast blocks at site shall be cast well in advance to be used as spacers and to adjust breaking of vertical joints.

6.4 Cracks in block masonry are due to shrinkage or expansion of blocks or due to settlement, thermal expansion or changes in moisture content in the structural members enclosing the block walls.

The following measures are recommended to prevent formation of cracks.

a) While curing, the block masonry should be lightly sprinkled with water and not made excessively wet.

b) Expansion joints shall be provided in walls exceeding 4.8 m in length.

c) Reinforcement should be provided in the bed joints in block work, one course above and course below windows and above doors in order to distribute the shrinkage/ temperature stresses occurring at the corners of openings, more uniformly throughout the walls.

d) R.C.C. band (Patli) 100 mm thick and width equal to block masonry and having 10mm dia. two bars with 6 mm dia links @ 200 mm c/c shall be provided at every 1000mm interval in the block masonry. The gap between the topmost layer of block and the soffit of the beam shall be packed by lightly hammering flat pieces of approved stone / tiles and then the gaps will be covered by weld mesh before closing them by cement plaster. The weld mesh will be extended at least 150 mm on the R.C.C. beam and 150 mm on block masonry and nailed to them with strong nails.

e) All block walls abutting concrete columns or walls shall be bonded to the same with approved 6mm dia 250 mm long galvanized M.S. dowels or approved G.I. butterfly ties left from the concrete columns while casting, at every alternate course of block.

7.0 SCAFFOLDING

Scaffolding shall be erected with steel sections or pipes of adequate strength so as to be safe for construction operations. The contractor shall take all measures to ensure the safety of the work and working people. Any instructions of the Engineer in this respect shall also be complied with. The contractor shall be entirely responsible for any damage to properly or injury to persons resulting from ill erected scaffolding, defective ladders and materials or otherwise arising out of his default in this respect. Proper scaffolding shall be provided to allow easy approach to every part of the work. Overhead work shall not be allowed. Block work shall be carried out with double scaffolding only. Making holes of any kind for the purpose of supporting the scaffolding shall not be permitted.

Raking out of joints.Preparation of the tops and sides.

Forming and preparing expansion, contraction or construction joints as detailed above or specified in the BOQ or drawings.

Making holes, openings, outlets, etc. embedding pipes, ends of beams, joints, slabs, trusses, sills, etc. whatever required during construction and neatly finishing the exposed surfaces and opening as per instructions of the EIC.

Curing and protection as specified.

C. PLASTERING & POINTING

1.0 SCOPE

These specifications cover the use of plastering for brick, block masonry and RCC work, pointing for brick, block and stone masonry work.

2.0 APPLICABLE INDIAN STANDARDS

The provision of the latest revisions of the following IS codes shall form a part of this specification to the extent they are relevant.

IS: 269	Specification for ordinary rapid hardening and low heat Portland cement
IS – 383	Specification for coarse and fine aggregate
IS: 712	Building Limes
IS: 1200 (Part XII)	Method of measurement of building and Civil Engg. Works - Plastering & Pointing
IS: 1542	Specification for sand for plaster
IS: 1630	Mason's Tools for Plaster work and pointing work.
IS: 1661	Code of practice for application of cement lime plaster finishes
IS 2645	Specification for integral waterproofing compound.
IS: 10067	Material Constants for Building Works

Other IS Codes, not specifically mentioned here, but pertaining to plastering work, form part of these specifications.

3.0 GENERAL

3.1 Cement Mortar

Cement mortar shall have the proportion of cement to sand as specified and shall comply with relevant clauses of concrete specifications.

3.2 Scaffolding

Scaffolding independent of masonry / RCC work i.e. double scaffolding shall be erected having two sets of vertical supports with steel sections or pipes of adequate strength so as to be safe for construction operations. The contractor shall take all measures to ensure the safety of the work and working people. Any instructions of the Engineer in this respect shall also be complied with.

The contractor shall be entirely responsible for any damage to properly or injury to persons resulting from ill erected scaffolding, defective ladders and materials or otherwise arising out of his default in this respect. Proper scaffolding shall be provided to allow easy approach to every part of the work. Overhead work shall not be allowed. Making holes of any kind for the purpose of supporting the scaffolding shall not be permitted.

3.3 Tools and Accessories

Tools and accessories used in plaster work shall conform to IS: 1630. All tools shall be cleaned by scrapping and washing at the end of each day's work or after use. Metal tools shall be cleaned after each operation. All tools shall be examined to see that they are thoroughly cleaned before plastering is begun.

3.4 Programme of work in relation to plastering

The programme of other building operations before, during and after plastering shall be according to the instructions contained in clause 9 of IS: 1661.

3.5 General Precaution in plastering

All general precautions as specified in IS.. 1661, Clause 9, shall be taken and preparation of the background shall be done as laid down in IS: 1661, Clause 13. Care shall be taken to see that other parts of the work or adjacent works are not damaged while plastering.

3.6 Preparatory work

All joints in the face work that is to be plastered shall be raked out to depth equal to not less than the width of the joints or as directed by the Engineer. The raking shall be done taking care not to allow by chipping of masonry. In new work the raking out shall be done when the mortar in the joints is still green. Efflorescence if any shall be removed by brushing and scrapping. Smooth surfaces of concrete, old plaster, etc. must be suitably roughened to provide necessary bond for the plaster. All dirt, soot, oil paint or any other material that might interfere with satisfactory bond shall be removed. In the case of stone masonry, scrubbing on the walls to receive the plaster shall not be more than 12 mm. The surface to be plastered shall be cleaned and scrubbed with fresh water and kept wet for 6 hours prior to plastering. It shall be kept damp during the progress of the work. The plastering shall not be commenced unless the preparatory work is passed in writing by the Engineer.

3.7 Chicken wire Mesh at Junction

All junctions of Masonry wall with R.C. structure e.g. column, beam, etc. which are to be plastered, shall be reinforced by fixing strips of approved G.I. Chicken wire mesh of minimum 300mm wide centrally over the length of junction. G.I. Chicken wire mesh of required width shall also be fixed over chasing for conduits, pipes, etc. on masonry walls before plastering is commenced. The mesh shall be nailed rigidly to the structure / masonry with G.I. nails of suitable type at approx. 400mm centers. The finished mesh shall be straight, rigid and laid without sagging. The payment shall be made for the area covered by wire mesh in Sq. mtrs including overlaps.

3.8 Gauges

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

3.9 Workmanship Plastering:

In all plaster work the mortar shall be firmly applied with somewhat more than the required thickness and well pressed into the joints and on the surface and rubbed and levelled with a flat wooden rule to give required thickness. Long straight edges shall be freely used to give perfectly plane and even surface. All corners must be finished to their true angles or rounded as directed by the Engineer. The surface shall be finished to plane or curved surface as shown on the plan or directed by the Engineer, and shall present a neat appearance. The mortar shall adhere to the masonry surface intimately when set and there should be no hollow sound when struck. Cement plastering should be done in squares or strips as directed. Plastering shall be done from top downward.

First or Backing Coat: The first coat of the specified thickness shall be applied as described above. The subsequent coat shall be applied after this coat has been allowed to sufficiently set but not dried depending upon weather conditions. The surface shall not be allowed to dry during this period and shall be kept wet.

3.10 Plastering to Ceiling

Ceiling plaster shall be 6to 12 mm thick in 1:3 cement sand mortar (1 cement : 3 sand).

Projecting burrs of mortar formed due to the gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brushes. In addition concrete surface shall be poke marked with a pointed tool at spacing of not more than 50 mm centres, the pokes being made not less than 3 mm deep, to ensure a proper key for the plaster. The mortar shall be washed off and surface cleaned of all oil, grease etc., and well wetted before the plaster is applied.

4.0 PLASTERING IN TWO COATS

4.1 Base Coat

The base coat plaster shall be of cement mortar 1:4. Waterproofing compound of approved make shall be added according to the manufacturer's' instructions to make the mortar waterproof.

The plaster with this mortar shall be laid as specified above with a thickness of not more than 15 mm for brick work and concrete surfaces. Keys shall be formed on the surface by thoroughly combing it with wavy horizontal lines about 12 mm apart and about 3 mm deep when the mortar is still pastic. The base coat shall be sufficiently cured not allow to dried.

4.2 Final Coat / Finishing Coat

A reasonable time (not more than 48 hours) shall be allowed after the application of the base coat for thorough drying before the application of the second coat. After soaking base coat thoroughly with water the mortar for second coat shall be applied .

The cement mortar for sand faced plaster shall have washed Kharasalis or similar type of approved sand with slightly larger proportion of coarse material. The proportion of cement to sand shall be 1:4. The approved quality of waterproofing compound shall be added as specified by manufacturer and approved by Engineer – In- Charge in external surface plastering. The water is added gradually to make the mixture homogeneous. The thickness of finishing coat shall not exceed 10mm. After application, the surface should be finished with a wooden flat, lined with cork and tapped gently to retain a coarse surface texture. When the finishing coat has hardened, the surface shall be kept moist continuously for 14 days.

The item includes providing rigid P. V. C. pipes of length aprox. 9" and fixing the same at interval of not more than 60cm c/c at the junctions of beam bottom and brick / block masonry work, prior backing coat plaster from outside.

Cement grout shall be poured through the pipes by attaching flexible PVC pipes with minimum head of 3000 mm till the entire gap under the beam is filled up with grout and set. The rigid PVC pipes should be removed the next day of grouting and cavities shall be immediately plugged with 1:3 cement mortar mixed with required water proofing compound.

5.0 POINTING

5.1 General

When the type of pointing is not mentioned in the item, sunk pointing is described below shall be carried out.

5.2 Raking Out Joints

Where the joints have not been raked out when the mortar is green, the joint shall be chipped (without damaging the masonry) to such a depth that the minimum depth of new mortar measured from either the sunk surface of the finished surface of the finished pointing or from the edge of the brick shall not be less than 12 mm, thoroughly cleaned off all loose particles with a stiff brush and thoroughly wetted.

5.3 Pointing

The mortar shall be pressed into the raked out joints with a pointing trowel. The mortar shall not spread over the corners, edges or the surface of the masonry. With a pointing tool, the mortar shall be neatly pressed back to about 3 mm or as directed. The vertical 'joints shall be pressed back similarly to match the horizontal joints. The surface of masonry shall be cleaned of all mortar.

6.0 CURING

Curing shall be started after 24 hours after finishing the plaster. The plaster shall be kept wet for a period of seven days. During this period it shall be suitably protected from all damages as directed by the Engineer-in-Charge. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be monitored.

Construction Safety

IS:3696 Safety Code For Scaffolds And Ladders. (Part I& II)

Measurement

IS:1200 Method Of Measurement Of Building Works.

IS:3385 Code Of Practice For Measurement Of Civil Engineering Works.

In the event that state, city or other governmental bodies have requirements more stringent than those set forth in this Specification, such requirement shall be considered part of this Specification and shall supersede this Specification where applicable.

6.1 General

The quality of materials and method and control of manufacture and transportation of all concrete work irrespective of mix, whether reinforced or otherwise, shall conform to the applicable portions of this Specification.

Engineer shall have the right to inspect the source(s) of material(s), the layout and operation of procurement and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and Engineer's approval obtained, prior to starting of concrete work.

6.2 Materials

All materials shall conform to the requirements laid in relevant Indian Standard Specification related to them.

6.3 Admixtures:

Admixtures may be used in concrete only with the approval of Engineer based upon evidence that, with the passage of time, neither the compressive strength nor its durability will reduce. 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 to be used, such as in mass-concrete works, it shall be dissolved in water and added to the mixing water in an amount not to exceed 1½ percent of the weight of the cement in each batch of concrete. When admixtures are used, the designed concrete mix shall be corrected accordingly. Admixtures shall be used as per manufacturer's instructions and in the manner and with the control specified by Engineer.

6.4 Water proofing agent

Where specified and approved by Engineer, water proofing agent confirming to IS:2645, shall be added in quantities specified by Engineer.

6.5 Tests

All materials shall satisfy the relevant Indian Standards. It is the Contractor's obligation to carry out the tests at his cost at Laboratories approved by the Engineer and produce the necessary certificates in proof of the compliance of the material with the specification.

- Tests on cement shall include:
- Fineness test
- Test for normal consistency
- Test for setting time
- Test for soundness
- Test for tensile strength
- Test for compressive strength
- Test for heat of hydration (by experiment and by calculations) in accordance with IS:269.
- Tests on sand shall include :
- Sieve test
- Test for organic impurities
- Decantation test for determining clay and silt content
- Specific gravity test
- Test for unit weight and bulkage factor
- Test for sieve analysis and fineness modulus.
- Tests on coarse aggregate shall include
- Sieve analysis
- Specific gravity and unit weight of dry, loose and rodded aggregate
- Soundness and alkali aggregate reactivity
- Petrographic examination
- Deleterious materials and organic impurities
- Test for aggregate crushing value.

The Engineer, if he so desires, may order further tests to be carried out on cement, sand, coarse aggregate, water in accordance with the relevant Indian Standards.

Any or all these tests would normally be ordered to be carried out if Engineer feels the materials are not in accordance with the Specifications or if the specified concrete strengths are not obtained and shall be performed by Contractor at an approved test laboratory.

6.6 Standard Finish for Exposed Concrete

Exposed concrete shall mean any concrete, other than floors or slabs, exposed to view upon completion of the job.

Unless otherwise specified on the Drawings, the standard finish for exposed concrete shall be a smooth finish.

A smooth finish shall be obtained with the use of lined or plywood forms having smooth and even surfaces and edges. Panels and form linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms the joint marks shall be smoothened off and all blemishes, projections, etc. removed leaving the surfaces reasonably smooth and unmarred.

6.7 Integral Cement concrete Finish

When specified on the Drawings an integral cement concrete finish of specified thickness for floors and slabs shall be applied either monolithic or bonded, as specified on the Drawings, as per IS: 2571. The surface shall be compacted and then floated with a wood float or power floating machine. The surface shall be tested with a straight edge and any high and low spots eliminated. Floating or trowelling of the finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of dry cement and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.

6.8 Rubbed Finish

A rubbed finish shall be provided only on exposed concrete surfaces as specified on the Drawings. Upon removal of forms, all fins and other projections on the surfaces shall be carefully removed, offsets leveled and voids and / or damaged sections immediately saturated with water and repaired by filling with a concrete or mortar of the same composition as was used in the surface. The surfaces shall then be thoroughly wetted and rubbed with carborundum or other abrasive. Cement mortar may be used in the rubbing, but the finished surfaces shall not be brush coated with either cement or grout after rubbing. The finished surfaces shall present a uniform and smooth appearance.

6.9 Protection

All concrete shall be protected against damage until final acceptance by Engineer / Owner.

Preparation of concrete surfaces

The preparation of concrete surfaces upon which additional concrete is to be placed later, shall preferably be done by scarifying and cleaning while the concrete is between its initial and final set. This method shall be used wherever practicable and shall consist of cutting the surface with picks and stiff brooms and by use of an approved combination of air and water jet as directed by Engineer. Great care shall be taken in performing this work to avoid removal of too much mortar and the weakening of the surface by loosening of aggregate.

When it is not practicable to follow the above method, it will be necessary to employ air tools to remove laitance and roughen the surface.

The final required result shall be a pitted surface from which all dirt, unsound concrete, laitance and glazed mortar have been removed.

6.10 Bonding Treatment (Mortar)

After rock or concrete surfaces upon which new concrete is to be placed have been scarified, cleaned and wetted as specified herein, they shall receive a bonding treatment, immediately before placement of the concrete.

The bonding medium shall be a coat of cement-sand mortar. The mortar shall have the same cement-sand proportions as the concrete which shall be placed on it. The water-cement ratio shall be determined by placing conditions and as approved by Engineer.

Bonding mortar shall be placed in sufficient quantity to completely cover the surface about 10 mm thick for rock surface and about 5 mm thick for concrete surfaces. It shall be brushed or broomed over the surface and worked thoroughly into all cracks, crevices and depressions. Accumulations or puddles of mortar shall not be allowed to settle in depressions and shall be brushed out to a satisfactory degree, as determined by Engineer.

Mortar shall be placed at such a rate that it can be brushed over the surface just in advance of placement of concrete. Only as much area shall be covered with mortar as can be covered with concrete before initial set in the mortar takes place. The amount of mortar that will be permitted to be placed at any one time, on the area which it is to cover, shall be in accordance with Engineer's directions.

Cleaning and bonding formed construction joints

Vertical construction joints shall be cleaned as specified above or by other methods approved by Engineer. In placing concrete against formed construction joints, the surface of the joints, where accessible, shall be coated thoroughly with the specified bed-joint bonding mortar immediately before they are covered with concrete or by scrubbing with wire brooms dipped into the fresh concrete. Where it is impracticable to apply such a mortar coating, special precautions shall be taken to ensure that the new concrete is brought into intimate contact with the surface of the joint by careful puddling and spading with aid of vibrators and suitable tools.

6.11 Expansion and contraction joints

Provision shall be made for expansion and contraction in concrete by use of special type joints at locations shown on the Drawing. Contraction joint surfaces shall be treated as per the Specifications on the Drawings or as directed by Engineer.

6.12 Preparation of Mortars and Its Grade

Grade of Masonry Mortar

The grade of masonry mortar will be defined by its compressive strength in N/mm2 at the age of 28 days as determined by the standard procedure detailed in IS:2250-1981.

For proportioning the ingredients by volume, the conversion of weight into volume shall be made on the following basis:

Dry hydrated lime	700 kg/cum
Burnt Clay Pozzolana	860 kg/cum
Lime Pozzolana mixture	770 kg/cum

Coarse Sand (dry) 1280 kg/cum

Fine sand (dry) 1600 kg/cum

fly Ash 590 kg/cum

Cement Mortar: This shall be prepared by mixing cement and sand with or without the addition of Pozzolana as specified.

Proportioning: Cement bag weighting 50 kg shall be taken as 0.035 cubic metre. Other ingredients in specified proportion shall be measured using boxes of size 40 X 35 X 25 cm. Sand shall be measured on the basis of its dry volume.

Mixing: The mixing of mortar shall be done in mechanical mixers operated manually or by power as decide by Engineer. The Engineer may, however, permit hand mixing at his discretion taking into account the nature, magnitude and location of the work and practicability of the use of mechanical mixers or where item involving small quantities are to be done or if in his opinion the used of mechanical mixer is not to be used, the Contractor shall take permission of the Engineer in writing before the commencement of the work.

Mechanical Mixing: Cement and sand in the specified proportions shall be mixed dry thoroughly in a mixer. Water shall then be added gradually and wet mixing continued for at least three minutes. Only the required quantity of water shall be added which will produce mortar of workable consistency but not stiff paste. Only the quantity of mortar, which can be used within 30 minutes of its mixing shall be prepared at a time. Mixer shall be cleaned with water each time before suspending the work.

Hand Mixing: The measured quantity of sand shall be leveled on a clean masonry platform and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by being turned over and over, backwards and forwards, several times till the mixture is of a uniform colour. The quantity of dry mix which can be used within 30 minutes shall then be mixed in a masonry trough with just sufficient quantity of water to bring the mortar to a stiff plaster of necessary working consistency.

Precautions: Mortar shall be used as soon as possible after mixing and before it begins to set, and in any case within half hour, after the water is added to the dry mixture.

Exposed Aggregate Plaster

The base plaster of cement mortar of specified mix and thickness is to be done with surface true to plumb and floated hard. Necessary grooves of 20 mm x 15 mm shall be provided as shown in the drawing or as directed, in the base plaster. The plastered surface shall be properly ranked, cement paste shall be applied on a limited area at a time so that it would not become hard before granite chips are applied. The granite chips to be used shall be 6mm gauge of hard approved variety screened, washed and dried properly and shall be applied by means of floats or trowels, dashing them against the still fresh cement paste already applied. Where uniform texture is not obtained chips shall be stuck suitably by hand. care should be taken that application of cement paste shall be done uninterruptedly within one panel so that joints and patches are avoided. precautionary steps should be taken to protect the surface already done during the process of finishing adjoining areas so that the areas completed shall not get stained.

D. STRUCTURAL STEEL (Ornamental)

1.0 SCOPE:

This specification covers Preparation of fabrication drawings, Providing all materials, fabricating, transporting, erection in position to proper lines and levels, fixing, steelwork for various structures and painting / other protection of steelwork for structures including fixtures, fittings, temporary works and supports, and ancillaries. The steelwork may have to be fabricated out of steel shapes, plates, hollow sections, pipes, cast steel, forgings etc and may involve any or combination of two or more of these in sizes, quantity and quality as specified in the drawings or as directed by the Engineer. The steelwork may consist of all types such as columns, beams, trusses, wall beams, girders, brackets, base-plates, floorings, anchors, stairs bracings or of any other kind as shown in the drawings or as required by the Engineer. Painting would involve cleaning by sand blasting to appropriate degree and specifications as given and painting with various combinations of primary and intermediate and final coats of specified thickness.

The Contractor shall furnish all the materials, skilled staff and labour, transportation, equipment, tools, tackles, temporary work and all other things that may be required for carrying out the work described above as per drawings, specifications and the instructions of the Engineer.

CODES AND STANDARDS:

Codes and standards applicable are given in the list below, which however shall not limit the applicable standards or codes or directions of the Engineer.

Table – Codes of Practice and Standards

Specification	Description
IS: 800	Code of practice for general construction in steel
IS: 808	Dimensions of hot rolled steel beam, column channel and angle sections
IS: 813	Scheme of symbols for welding
IS: 814	Covered electrodes for manual metal arc welding of Carbon and carbon-manganese steel
IS: 816	Code of practice for use of metal arc welding in general mild steel construction
IS: 817	Code of practice for training and testing of metal arc welders
IS: 818	Code of Practice for safety and health requirements in electric and gas welding and cutting operations
IS: 822	Code of procedure for inspection of welds
IS: 823	Code of procedure for manual metal arc welding of mild steel
IS: 1030	Carbon Steel castings for general engineering purposes
IS: 1161	Steel tubes for structural purposes
IS: 1181	Qualifying tests for metal arc welders

IS: 1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates
IS: 1363 (1&2)	Hexagon head bolts and nuts of product grade C
IS: 1364 (1-5)	Hexagon head bolts and nuts of product grade A and B
IS: 1367 (1-20)	Technical supply conditions for threaded steel fasteners
IS: 1387	General requirements for the supply of metallurgical materials
IS: 1477 (1 & 2)	Code of Practice for painting ferrous metals in buildings
IS: 1599	Method for bent test
IS: 1608	Mechanical testing of metals – tensile testing
IS: 1730	Steel plates, sheets and strips and flats for general engineering purposes – dimensions
IS: 1852	Rolling and cutting tolerances for hot rolled steel products
IS: 2004	Carbon Steel forgings for general engineering purposes
IS: 2016	Plain washers
IS: 2062	Steel for general structural purposes – (supersedes IS: 226)
IS: 2595	Code or practice for radiographic testing
IS: 3502	Steel chequered plates
IS: 3613	Acceptance test for wire flux combination for submerged arc welding
IS: 3640	Hexagon fit bolts
IS: 3658	Code of practice for liquid penetrant flaw detection
IS: 3664	Code of practice for ultrasonic pulse echo testing by contact and immersion methods
IS: 3696	Safety codes for scaffolds and ladders
IS: 3757	High strength structural bolts
IS: 4353	Submerged arc welding of mild steel and low alloy steels – recommendations
IS: 4923	Hollow steel sections for structural use
IS: 5334	Code of practice for magnetic particle flaw detection of welds
IS: 5372	Taper washers for channel
IS: 5624	Foundation bolts
IS: 6610	Heavy washers for steel structures
IS: 6639	Hexagon bolts for steel structures
IS: 7205	Safety code for erection of structural steelwork

IS: 7215	Tolerances for fabrication of steel structures
IS: 7293	Safety code for working with construction machinery
IS: 9595	Metal arc welding of carbon and carbon manganese steels – recommendations
IS: 12843	Tolerances for erection of steel structures
SP: 34	Handbook of concrete reinforcement and detailing

2.0 INSPECTION

It is presumed that the site has been inspected and all site conditions noted that might affect the selection of erection method, plant requirements and such details. The method and units of transportation of structures from fabrication yards to site would also depend on the location of fabrication yards, the dimensions and grades of the connecting roads and the approach to the erection location. It is necessary that during the work the existing structures (where there are some) are not damaged or affected anyway by the present work.

3.0 STRUCTURAL STEEL

3.1 General

3.1.1 General requirements relating to the supply of material shall conform to the specifications of IS: 1387, for the purpose of which the supplier shall be the Contractor and the purchaser shall be the Engineer.

3.1.2 Finished rolled material shall be free from cracks, flaws, injurious seams, laps, blisters, ragged and imperfect edges and other defects. It shall have a smooth and uniform finish, and shall be straightened in the mill before shipment. They shall also be free from loose mill scale, rust, pits or other defects affecting its strength and durability.

The acceptance of any material on inspection at the mill i.e. rolling mills, foundry or fabricating plant where material for the work is manufactured, shall not be a bar to its subsequent rejection, if found defective.

3.1.3 In general, steelwork connections shall be by bolting and welding. Mild steel or high tensile bolts shall be used as indicated in the drawings.

4.0 OTHER MATERIALS

4.1 All materials shall conform to Special requirements as given below:

4.2 Mild steel for bolts and nuts shall conform to IS: 2062 but have a minimum tensile strength of 44 kg/sq. mm. and minimum percentage elongation of 14. High tensile steel for bolts and nuts shall conform to IS: 8500 but with a minimum tensile strength of 58 kg/sq. mm.

4.3 For cast steel, the yield stress shall be determined and shall not be less than 50 percent of the minimum tensile strength.

4.4 Plain washers shall be of steel. Tapered or other specially shaped washers shall be of steel, or malleable cast iron.

4.5 Parallel barrel drifts shall have a tensile strength not less than 55 kg/sq. mm, with elongation of not less than 20 percent measured on a gauge length of 4 So (So = cross sectional area).

4.6 Materials for castings and forgings, fasteners and welding consumables shall be as under:

i) Castings and Forgings: Steel castings and forgings shall comply with the requirements of the following Indian Standards, as appropriate:

IS: 1030 Carbon Steel Castings for General Engineering purposes

IS: 1875 Carbon Steel Billets, blooms, slabs, bars for forgings

IS: 2004 Carbon Steel Forgings for General Engineer purposes

IS: 2644 High Tensile Steel Casings

IS: 4367 Alloy & tool steel forgings for general industrial use

5.0 STEEL PROTECTION SYSTEM

Generally all steelwork shall be sand / shot blasted to SA – 2-1/2 (SIS 055900) and given the following coats of paint.

One coat of zinc anode epoxy primer (or equivalent of similar properties) with a minimum dry film thickness of 75 microns per coat

An intermediate coat of epilux 950 super high build coating (or equivalent of similar properties) with a dry film thickness of 200 microns

Two coats of acrylic polyurethane enamel minimum dry film thickness of 30/35 microns per coat

Unless otherwise specified, paints shall conform to the relevant IS specifications. The paints that have been tested as per specifications only shall be used. Where there are no specifications, manufacturer's recommendation shall be followed.

6.0 FABRICATION

6.1 General

All work shall be in accordance with the drawings approved and released by the Engineer for construction, as per these specifications and as instructed by the Engineer. Care should be exercised by the Contractor to ensure that all parts of an assembly are so well fabricated to fit accurately together. All members shall carry a mark number and an item number and, if required, serial no.

Unless specifically required under the contract, corresponding parts for identical units need not be interchangeable, but the parts shall be match marked.

Templates and other appliances used for ensuring the accuracy of the work shall be of mild steel. All measurements for fabrication shall be made by means of accurate steel tapes or other devices properly calibrated.

All structural steel members and parts shall have straight edges and blunt surfaces. If necessary they shall be straightened or flattened by pressure unless they are required to be of curvilinear forms. They shall also be free from twist. Pressure applied for straightening or flattening shall be such that would not injure the materials. Hammering shall not be permitted. Adjacent surface or edges shall be in close contact or at uniform distance throughout.

The contractor shall submit his program of work to the Engineer for his approval at least 15 days before commencement of fabrication. This program shall include the proposed system of identification and erection marks together with complete details of fabrication and welding procedures.

The Contractor shall prepare shop drawings for fabricating the components of steelwork and obtain approval of the Engineer a week before the start of work on the components. Complete information regarding the location, type, size and extent of all welds shall be clearly shown on the shop drawings. The drawings shall distinguish between shop and field welds.

6.2 Preparation of Edges and Ends

All structural steel parts, where required, shall be sheared, cropped, sawn or flame cut and ground accurately to the required dimension and shape.

End/edge planning and cutting shall be done by any one of the following prescribed methods or left as rolled:

Shearing, cropping, sawing, machining, machine flame cutting.

Hand flame cutting with subsequent grinding to a smooth edge.

Sheared edges of plate not more than 16mm thick with subsequent grinding to smooth profile, which are of secondary use such as stiffeners and gussets.

If the ends of stiffeners are required to be fitted, they shall be ground, so that the maximum gap over 60% of the contact area does not exceed 0.25 mm.

Where the flame cutting or shearing is used, at least one of the following requirements shall be satisfied.

The cut edge is not subject to applied stress.

The edge is incorporated in weld.

The hardness of cut edge does not exceed 350 HV 30.

The material is removed from the edge to the extent of 2 mm or minimum necessary, so that the hardness is less than 350 HV 30.

Edge is suitably heat treated by approved method to the satisfaction of the Engineer and shown that crack had not developed by dye penetrant or magnetic particle test.

Thickness of plate is less than 40 mm for machine flame cutting for materials conforming to IS: 2062. The requirement of hardness below 350 HV 30 of flame cut edges should be specified by the Engineer.

Where machining for edge preparation in butt joint is specified, the end shall be machined after the members have been fabricated. Outside edges of plate and section, which are prone to corrosion shall be smoothed by grinding or filing. In the case of high tensile steel at least 6 mm of the material from the flame cut edge shall be removed by machining. Longitudinal edges of all plate and cover plates in plate girders and built-up members shall be ground to correct dimensions except in the following cases:

Covers to single flange plates may be left un-machined.

Machine flame cutting instead of machining is acceptable for edges of single plates, 25 mm or less thick, in tension.

Edges of single shaped plates over 25 mm thick may be machine flame cut and the end surface ground.

Edges of plates or flats of the same nominal width in tiers may be left un-machined, if so authorised by the Engineer.

All edges of splice and gusset plates may be sheared and ground. The ends of plates and sections forming the main components of plate girders or of built-up members may be machine flame cut, sawn or hand flame cut and ground. Where ends of stiffeners are required to be fitted, they shall be machined, machine flame cut, swan, sheared and ground, or hand flame cut and ground. The ends of lacing bar shall be rounded unless otherwise required. Other edges and ends of mild steel parts may be sheared and any burrs at edges shall be removed.

6.3 Preparation of Holes

6.3.1 Drilling and Punching: Holes for black bolts, high strength bolts and counter sunk bolts (excluding close tolerance and turn fitted bolts) shall be either punched or drilled. The diameter of holes shall be 1.5 mm larger for bolts less than 25 m. dia and 2.0 mm for more than or equal to 25 mm.

All the holes shall be drilled except for secondary members such as, floor plate, handrails etc. Members which do not carry the main load can be punched subject to the thickness of member not exceeding 12 mm for material conforming to IS: 226.

Holes through one thickness of material or when any of the thickness exceeds 20 mm for steel conforming to IS: 2062 or 16 mm for conforming to IS: 8500, shall either be sub-drilled or sub-punched to a diameter of 3 mm less than the required size and then reamed to the required size. The reaming of material more than one thickness shall be done after assembly.

Where several plates or sections form a compound member, they shall where practicable, be firmly connected together by clamps or tacking bolts, and the holes be drilled through the group in one operation. Alternatively, and in the case of repetition work, the plates and sections may be drilled separately from templates that shall be checked periodically. All burrs shall be removed.

Shop erection / assembly shall be done wherever so required by the engineer.

6.3.2 Where block drilling is done, care shall be taken to check that the holes are not out of position or are dimensionally correct

6.3.3 Size of Holes: The sizes of holes in millimeters are given in table 1 below:

Table-1: Diameter of holes for bolts

Nominal dia of Bolts (mm)	Dia of Holes (mm)
12	13.5
14	15.5
16	17.5
18	19.5
20	21.5
24	25.5
27	29.0
30	31.0
31	33.0

Close tolerance bolts and barrel bolts: Holes for close tolerance and turn fitted bolts. The diameter of the holes shall be equal to the nominal diameter of the bolt shank minus 0.15 mm to 0.0 mm. The member to be connected with close tolerance or turn fitted bolts shall be firmly held together by service bolts or clamped and drilled through all thickness in one operation and subsequently reamed to required size within specified limit of accuracy as specified in IS: 919 tolerance grade H8.The holes not drilled through all thickness at one operation shall be drilled to smaller size and reamed after assembly.

Holes for high strength friction grip bolts: All holes shall be drilled after removal of burrs. Where the number of plies in the grip does not exceed three, the diameters of holes shall be 1.6 mm larger than those of bolts and for more than three plies in grip, the diameter of hole in outer plies shall be as above and dia of holes in inner plies shall not be less than 1.6 mm and not more than 3.2 mm larger than those in bolts, unless otherwise specified by the Engineer.

6.3.4 Removal of Burrs: The work shall be taken apart after drilling and all burs left by drilling and the sharp edges of all rivet holes completely removed.

7.0 BOLTS, NUTS AND WASHERS:

7.1 Black bolts (black all over): Black bolts are forged bolts in which the shanks, heads and nuts do not receive any further treatment except cutting of screw threads. They shall be true to shape and size and shall have the standard dimensions as shown on the drawings.

7.2 Close tolerance bolts: Close tolerance bolts shall be faced under the head and turned on the shank.

7.3 Turned barrel bolts: The diameter of the screwed portion of turned barrel bolts shall be 1.5 mm smaller than the diameter of the barrel unless otherwise specified by the Engineer. The diameter of the bolts as given on the drawing shall be the nominal diameter of the barrel. The length of the barrel shall be such that it bears fully on all the parts connected. The threaded portion of each bolt shall project through the nut by at least one thread. Faces of heads and nuts bearing on steel work shall be machined.

7.4 Washers:

In all cases where the full bearing area of the bolt is to be developed, the bolt shall be provided with a steel washer under the nut of sufficient thickness of the parts bolted together and to prevent the nut when screwed up, from bearing of the bolt.

For close tolerance or turned barrel bolts, steel washers whose faces give a true bearing shall be provided under the nut. The washer shall have a whole diameter not less than 1.5 mm larger than the barrel and a thickness of not less than 6 mm so that the nut when screwed up will not bear on the shoulder of the bolt.

Taper washers with correct angle of taper shall be provided under all heads and nuts bearing on beveled surfaces. Spring washers may be used under nuts to prevent slackening of the nuts when excessive vibrations occur. Where the heads or nuts bear on timber, square washers having a length of each side not less than three times the diameter of bolts or round washers having a diameter of 3½ times the diameter of bolts and with a thickness not less than one quarter of diameter shall be provided.

7.5 Studs

Ordinary studs may be used for holding parts together, the holes in one of the parts being tapped to take the thread of the stud. Counter-sunk studs may be used for making the connections where the surfaces are required to be cleared of all obstruction, such as

protruding heads of bolts, studs may also be welded on the steel work in the positions required.

7.6 Service bolts:

Service bolts shall have the same clearance as black bolts and where it is required that there should be no movement prior to final riveting, sufficient drifts or close tolerance bolts shall be used to locate the work.

7.7 Tightening bolts:

Bolted connection joints with black bolts and high strength bolts shall be inspected for compliance of Code requirements.

The Engineer shall observe the installation and tightening of bolts to ensure that correct tightening procedure is used and shall determine that all bolts are tightened. Regardless of tightening method used, tightening of bolts in a joint should commence at the most rigidly fixed or stiffest point and progress towards the free edges, both in initial and in final tightening. The tightness of bolts in connection shall be checked by inspection wrench, which can be torque wrench, power wrench or calibrated wrench.

Tightness of 10% bolts, but not less than two bolts, selected at random in each connection shall be checked by applying inspection torque. If no nut or bolt head is turned by this application, connection can be accepted as properly tightened, but if any nut or head has turned all bolts shall be checked and, if necessary, re-tightened.

7.8 Drifts-

The barrel shall be drawn or machined to the required diameter for a length of not less than one diameter over the combined thickness of the metal through which the drifts have to pass. The diameter of the parallel barrel shall be equal to the nominal diameter of the hole subject to a tolerance of +0 mm and –0.125 mm. Both ends of the drift for a length equal to 1½ times the diameter of the parallel portion of the bar shall be turned down with a taper to a diameter at the end equal to one-half that of parallel portion.

7.9 Pins and pin holes

7.9.1 Pins: The pins shall be parallel throughout and shall have a smooth surface free from flaws. They shall be of sufficient length to ensure that all parts connected thereby shall have a full bearing on them. Where the ends are threaded, they shall be turned to a smaller diameter at the ends for the thread and shall be provided with a pilot nut, where necessary, to protect the thread when being drawn to place. Where the ends are not threaded suitable cotter arrangements shall be made to prevent pin from working loose. Pins more than 175 mm in length or diameter shall be forged and annealed.

Pinholes: Pinholes shall be bored true to gauge, smooth, straight at right angles to the axis of the member and parallel with each other, unless otherwise required. The tolerance in the length of tension members from outside to outside of pinholes and of compression members from inside to inside of pinholes shall be as specified in the drawings. In built up members, the boring shall be done after the members have been riveted or welded. Where specified proper brass / gunmetal bushes shall be provided in the pinholes. The specified diameter of the pinhole shall be its minimum diameter. The resulting clearance between the pin and the hole shall be not less than 0.5 mm and not more than 1.0 mm or otherwise as specified in the drawings.

8.0 SHOP ERECTION AND MATCH MARKING

Sub-sections of the steelwork, if so required by the Engineer, shall be temporarily erected in the fabrication shop before dispatch to site, for the Engineer's inspection. The quality of fabrication, and the alignment and fit of all connections would be checked. For this purpose a sufficient number of parallel drifts and service bolts that tightly screw up, shall be employed. All parts shall fit accurately and be in accordance with drawings and specifications. After the Engineer's approval, any sub-size holes left shall be reamed to size and materials match marked and dispatched to site. The Engineer shall be the sole authority to decide the extent of shop erection required

After the work has been approved by the Engineer and before it is dismantled, each part shall be carefully marked for erection with distinguished marks and stamped with durable markings. Drawings showing these markings correctly shall be supplied to the Engineer.

Unloading, handling and storage of steel work as per these specifications shall be the responsibility of the Contractor. The cost of repairs or rejected material, its removal and the cost of transporting replacement material to the site shall be borne by the Contractor.

9.0 WELDING

All welding shall be done with prior approval of the Engineer and the workmanship shall conform to the specifications of IS: 823 or other relevant Indian Standards as appropriate.

When material thickness is 20 mm or more, special precaution like preheating shall be taken as laid down in IS: 823. Surfaces and edges to be welded shall be welded smooth, uniform and free from fins, tears, cracks and other discontinuities. Surfaces shall also be free from loose or thick scale, slug rust, moisture, oil and other foreign materials. Surfaces within 50 mm of any weld location shall be free from any paint or other material that may prevent proper welding or cause objectionable fumes during welding.

The general welding procedures including particulars of the preparation of fusion faces for metal arc welding shall be carried out in accordance with IS: 9595.

The welding procedures for shop and site welds including edge preparation of fusion faces shall be submitted in writing in accordance with Clause 22 of IS: 9595 for the approval of the Engineer before commencing fabrication and shall also be as per details shown on the drawings. Any deviation from above has to be approved by the Engineer. Preparation of edges shall, wherever practicable done by machine methods.

Machine flame cut edges shall be substantially as smooth and regular as those produced by edge planning and shall be left free of slag. The Engineer shall permit manual flame cutting only where machine cutting is not practicable.

Electrodes to be used for metal arc welding shall comply with relevant IS specifications. Test shall be carried forward as per IS: 8613 to find out suitable wire flux combination for welded joint.

Assembly of parts for welding shall be in accordance with provisions of IS: 9595.

The welded temporary attachments should be avoided as far as possible, otherwise the method of making any temporary attachments shall be removed by cutting, and chipping and surface shall be finished smooth by grinding to the satisfaction of the Engineer.

Welding shall not be done when the air temperature is less than 10 degrees Celsius. Welding shall not be done when the surfaces are moist, during periods of strong winds or snowy weather unless the work and the welding operators are adequately protected.

For welding of any particular type of joint, welders shall qualify to the satisfaction of the Engineer in accordance with appropriate welders qualification tests as prescribed in any of the Indian Standards IS: 817, IS: 1393, IS: 7307(PART I), IS: 7310(PART I) and IS: 7318(PART I) as relevant.

In assembling and joining parts of a structure or of built up members, the procedure and sequence of welding shall be such as to avoid distortion and minimise shrinkage stress.

All requirements regarding pre heating of parent material and inter pass temperature shall be in accordance with provision of IS: 9595

Peening of weld shall be carried out wherever specified by the Engineer:

If specified peening may be employed to be effective on each weld layer except first.

The peening shall be carried out after weld has cooled out by light blows from a power hammer using a round nose tool. Care shall be taken to prevent scaling or flaking of weld and base metal from over peening.

Where the Engineer has specified the butt welds are to be ground flush, the loss of parent metal shall not be greater than that allowed for minor surface defects. The end of butt joints shall be welded so as to provide full throat thickness. This may be done by use of extension pieces, cross runs or other means approved by the Engineer. Extension pieces shall be removed after the joint has cooled and the ends of the welds shall be finished smooth and flush with the faces of the abutting parts.

The joints and welds listed below are prohibited type, which do not perform well under cyclic loading.

i) Butt joints not fully welded throughout their cross section

ii) Groove welds made from one side only without any backing grip

iii) Intermittent groove welds

iv) Bevel grooves and J grooves in butt joints for other than horizontal position

v) Plug and slot welds

The run on and run off plate extension shall be used providing full throat thickness at the end of butt-welded joints. These plates shall comply with the following requirements.

One pair of run on and one pair of run off plates prepared from same thickness and profile as the parent metal shall be attached to start and finish of all butt welds preferably by clamps. When run on and run off plates shall be removed by flame cutting, it should be cut at more than 3 mm from parent metal and remaining metal shall be removed by grinding or by any other method approved by the Engineer.

10.0 TOLERANCES:

The tolerances in fabrications shall be governed by IS: 7215. Tolerances in dimensions of components of fabricated structural steel work shall be specified on the drawings and shall be subject to the approval of the Engineer before fabrication. Unless specified all parts of an assembly shall fit together accurately within tolerances specified in Table –2. A machine bearing surface, where specified by the Engineer, shall be machined with a deviation of 0.25mm for surfaces that can be inscribed within a square of side 0.5 m.

TABLE -2 FABRICATION TOLERANCES

SNO	DESCRIPTION OF WORK / ITEM	TOLERANCE
	INDIVIDUAL COMPONENTS	
1	LENGTH	
	a) Member with both ends finished for contact bearing	± 1mm
	b) individual components of members with end plate connection	+ 0 mm,-2 mm
	c) Other members i) up to and including 12 m	± 2 mm
	Other members ii) over 12 m	± 3.5 mm
2	WIDTH	
	a) width of built-up girders	± 3 mm
	b) Deviation in the width of members required to be inserted in other members	+ 0 mm - 3 mm
3	DEPTH	
	Deviation in the depth of the solid web and open web girder	+3 mm, -2 mm
4	STRAIGHTNESS	
	a) Deviation from straightness of columns (L – length of member)	L/3000 with max of 15 mm
	i) in elevation	+5 mm,- 0 mm
	ii) in plan	L/1000 with max. of 10 mm
5	Deviation of centre line of web from centre line of flanges in built up members at contact surfaces	3mm
6	Deviation from flatness of plate of webs of built members in a length equal to depth of member (d- depth of member)	0.005 d with max of 2 mm
7	Tilt of flange of plate girders (b – width of the member)	
	i) At splices and stiffeners, at supports, at the top flanges of plate girders and at bearings	0.005 b with a max of 2 mm
	ii) at other places	0.015 b with a max of 4 mm
8	Deviation from square ness of the flange to web of columns and box girders (L is nominal length of the diagonal)	L/1000
9	Deviation from squareness of fixed base plate (not machined) to axis of column. This dimension shall be measured parallel to the longitudinal axis of the column at points where the outer surfaces of the column sections make contact with the base plate (D- the distance from the column axis to the point under consideration on the base plate)	D/500
10	Deviation from square ness of machined ends to axes of columns (D- same as in 9 above)	D/1000
11	Deviation from square ness of machined ends to axes of beams of girder (D- same as in 9 above)	D/1000
12	Ends of member abutting at joints through cleats or end plates, permissible deviation from the square ness of ends	1/600 of depth of member subject to a max of 1.5 mm

11.0 PACKING AND TRANSPORT

All projecting plates and bars and all ends of members at joints shall be stiffened, all straight bars and plates shall be bundled, all screwed ends and machined surfaces shall be suitably packed and all bolts, nuts, washers and small loose parts shall be packed separately in cases, so as to prevent damage or distortion. Care shall be taken during loading and unloading so that no material sustains damage and materials are not mixed up.

The materials shall be carefully transported and unloaded at site of erection, exercising great care not to damage the materials in any manner. They shall be stored as per erection marks and sizes with small materials being stored in sheds to prevent loss or mixing up.

12.0 ERECTION

12.1 General

The provisions of this item shall apply of erection of steelwork in the various structures either in the roof or elsewhere. The contractor shall transport the fabricated steel to the erection site. This should be done without damaging the steelwork in any manner. Even so the steelwork shall be subject to the Engineer's inspection and minor rectification if needed shall be carried out as directed by the Engineer.

The steelwork shall be erected in position to lines and levels as shown in the drawings with or without enabling works. It will be welded or bolted in final position all as shown in the drawings. The contractor shall take all safety precautions to prevent any damage to the work or any accident. After erection and necessary welding / bolting is approved by the Engineer, the Contractor shall touch up the shop paints as necessary and shall apply the required coats of paint as shown in the drawings. After approval of painting, further work on the structure such as sheeting etc shall be carried and do all the work required to complete the construction included in the contract in accordance with the drawings and the specification and to the entire satisfaction of the Engineer.

12.2 Organization and Equipment

The contractor shall submit a complete erection scheme for the approval of the Engineer showing the equipment that he would be a method and procedure of erection, compatible with details of fabrication. As time is of the very essence, the means to achieve fast and accurate work shall be employed. The approval of the Engineer shall not relieve the contractor of his responsibility for the safety of his method or equipment or from carrying out the work fully in accordance with the drawings of the specifications.

A detailed scheme must be prepared showing stage-wise activities, with complete drawings and phase-wise working instructions. This should be based on detailed stage-wise calculation and take into account specifications and capacity of erection machinery, tools, tackles to be used and temporary working loads as per Code provisions. Temporary work where used shall be supported by design and calculations.

The scheme should be based on site conditions, erection machinery employed, available working space, length and weight of members to be handled. The accent of the scheme shall be safe working and avoidance of any risk of accident.

The scheme should indicate precisely the type of temporary fasteners to be used as also the minimum percentage of permanent fasteners to be fitted during the stage erection. The working drawings should give clearly the temporary, fixtures, clamps, spacer supports, etc

Unless otherwise provided in the contract, the contractor shall supply and erect all necessary false work and staging and shall supply all labour, tools, erection plant and other materials necessary to carry out the work complete in all aspects.

The contractor shall supply all types, bolts, nuts, washers, etc. required to complete erection at site with allowance for wastage, etc., of 10% of the net number of field bolts, washers required, or a minimum of five number of each item.

Service bolts and nuts, ordinary plate washers and drifts for use in the erection of works shall be supplied at 25% of the number of the permanent bolts in the work.

Prior to actual commencement of erection all equipment, machinery, tools, tackles, ropes, etc. need to be tested to ensure their safe and efficient working. Frequent visual inspection is essential in vulnerable areas to detect displacements, distress etc.

For welded structure, welders' qualifications and skill are to be checked as per standard norms. Safety requirements should conform to IS: 7205, IS: 7273 and IS: 7269 as applicable. Safety shall be the paramount consideration in erection work.

Erection work should start with complete resources mobilized as per latest approved drawings and after a thorough survey of foundations and other related structural work. The structure should be divided into erectable modules as per the scheme.

This should be pre-assembled in a suitable yard/platform and its matching with members of the adjacent module checked by trial assembly before erection.

The structure shall be set out to the required lines and levels. The steelwork should be erected, adjusted and completed in the required position to the specified line and level s with sufficient drifts and bolts. Packing materials are to be available to maintain this condition. Organised "Quality Surveillance" checks need to be exercised frequently.

During the progress of work, the Contractor shall have a competent Engineer and a skilled Foreman in charge of the work, who shall be adequately experienced in steel erection and acceptable to the Engineer.

12.3 Handling and storing Materials

Suitable area for storage of structures and components shall be located near the site of work. The access road should be free from water logging during the working period and the storage area should be on leveled and firm ground.

The store should be provided with adequate handling equipments e.g. road mobile crane, gantries, derricks, chain pulley blocks, winch of capacity as required. Stacking area should be planned and have racks, stands sleeper, access tracks, etc., and properly lighted.

Storage should be planned to suit work sequence and avoid damage or distortion. Rusted, bent or damaged steel shall be rejected. Methods of storage and handling steel, whether fabricated or not shall be subject to the approval of Engineer and should be accessible to handling equipment.

Small fitting hand tools are to be kept in containers in covered stores.

All materials, consumables, including raw steel or fabricated material shall be stored specification-wise and size-wise above the ground upon platforms, skids or other supports. It shall be kept free from dirt and other foreign matter and shall be protected as far as possible from corrosion and distortion. The electrodes shall be stored specification-wise and shall be kept in dry warm condition in properly designed racks. The bolts, nuts, washers and other fasteners shall be stored on racks above the ground with protective oil

coating in gunny bags and suitably marked. It is essential to ensure that bolts of different strengths / sizes are not mixed up. The paint shall be stored under cover in airtight containers.

IS: 7293 and IS: 7969 dealing with handling of materials and equipments for safe working should be followed. Safety nuts and bolts as directed are to be used while working. The Contractor shall be held responsible for loss or damage to any material paid for by the Department while in his care or for any damage to such material resulting from his work.

12.4 Straightening Bent Material

The straightening of plates, angles and other shapes shall be done with prior approval of the Engineer by methods not likely to produce fracture or any injury. The metal shall not be heated unless permitted by the Engineer for special cases, when the heating shall not be to a temperature higher than that producing a dark "cherry red" colour, followed by as slow cooling as possible.

Following the straightening of a bend or buckle the surface shall be carefully investigated for evidence of fracture. Sharp kinks and bends may be the cause for rejection of material.

12.5 Assembling Steel

The parts shall be accurately assembled as shown on the drawings and match marks shall be followed. The material shall be carefully handled so that no parts will be bent, broken or otherwise damaged. Hammering which will injure or distort the members shall not be done. Bearing surface or surfaces to be in permanent contact shall be cleaned, given a coat of contact paint before the members are assembled. All joint surface for bolted connections including bolts, nuts, washers shall be free from scale, dirt, burrs, other foreign materials and defects that would prevent solid seating of parts. The slope of surface of bolted parts in contact with bolt head and nut shall not exceed 1 in 20, plane normal to bolt axis, otherwise suitable tapered washer shall be used.

All fasteners shall have a washer under nut or bolt head whichever is turned in tightening. Any connection to be bolted shall be secured in close contact with service bolts or before the connections are finally bolted. Joints shall normally be made by filling not less than 50 percent of holes with service bolts and barrel drifts in the ratio 4:1. The service bolts are to be fully tightened up as soon as the joint is assembled. Connections to be made by close tolerance or barrel bolts shall be completed as soon as practicable after assembly.

Any Connection to be site welded shall be securely held in position by approved methods to ensure accurate alignment, camber and elevation before welding is commenced. The field welding, bolted and pin connection shall conform to the Code requirements. The correction of minor misfits involving harmless amounts of reaming, cutting and chipping will be considered a legitimate part of erection. However, any error in the shop fabrication or deformation resulting from handling and transportation which prevents proper assembling and fitting up of parts by moderate use of drifts or by a moderate amount of reaming and slight chipping or cutting shall be reported immediately to the Engineer and his approval of the method of correction obtained. The correction shall be made in the presence of the Engineer.

Erection tolerance: The unloaded steel structure, as erected shall satisfy the criteria specified in the following table within specified tolerance limits. Each criterion given in the table shall be considered as a separate requirement, to be satisfied independently of any other tolerance criterion.

The erection tolerances specified in the table apply to the following reference points:

❖ For a column, the actual centre point of the column at each floor level and at the base, excluding any base-plate or cap-plate. The level of the base plate on pedestal shall be so as to avoid contact with the soil and corrosion environment. For a beam the actual centre point of the top surface at each end of the beam, excluding any end plate.

Permissible tolerances after erection

Criterion	Permitted deviation
Deviation of distance between adjacent columns	5 mm
Inclination of a column in a multi-storey building between adjacent floor levels	0.002 h where h is the storey height
Deviation of location of a column in a multi-storey building at any floor level from a vertical line through the intended location of the column base	.0035 □ hb / n 0.5 where □hb is the total height from the base to the floor level concerned and n is the number of storeys from the base to the floor level concerned
Inclination of a column in a single storey building, (not supporting a crane gantry) other than a portal frame	0.0035 h c where h c is the height of the column
Inclination of the column of a portal frame (not supporting a crane gantry)	Mean 0.002 h c Individual 0.010 h c Where h c is the height of the column

A tension member shall not deviate from its correct position relative to the members to which it is connected by more than 3 mm along any setting axis.

Setting Column bases and grouting: Column bases shall be set so that the column load is uniformly transmitted to the foundation with column centre line aligned with the foundation as shown in the drawings. The location and layout of anchor bolts are to be correctly set to ensure that the structures are erected as shown in the drawings.

The Contractor shall be responsible for the correct alignment and leveling of all steelwork at site to ensure that the columns are plumb. Before erection of columns on foundations, the top surface of the base concrete shall be thoroughly cleaned with wire brushes and by chipping to remove all laitance and loose material. The Contractor shall be responsible to provide all packing and shim plates that may be required for the proper erection and bedding of the columns with base plates. No steel structure shall be erected on the foundation unless the foundation has been certified fit for erection of steel, by the Engineer. Adequate number of air releases and inspection holes shall be provided in the base plate.

After the column is erected and alignment is checked and accepted, the column with base shall be held firmly in position by shims and pickings. The space between the column base and the base concrete shall be grouted with non-shrink grout.

The grout shall be of the type Sika grout 214 / Conb extra GP 2 / Shrinkomp 40 or equivalent. The substrate surface must be free of contaminants and all dirt and dust blown clean. The surface shall be thoroughly cleaned with water and all free water removed after cleaning. A containing formwork or other arrangement shall be made to hold the grout without leaks.

The (grout) powder shall be mixed with recommended quantity of water and stirred till a grout of smooth consistency is obtained. It shall be poured as soon as possible in order

that the expanding properties are fully availed of. Where a thicker section is encountered, 10 mm chips may be added to the grout. This may slightly affect the flow properties of the grout and additional powder may be needed to restore the same. Bolt holes shall be filled in first and then the gap between the column base and base concrete grouted. It is essential that the grout flow is continuous. For larger grouts suitable pumps shall be employed. The air must escape and shall not be trapped inside. Grouting shall not be done in extreme hot or cold weather.

13.0 FIELD INSPECTION:

13.1 General

All materials, equipment and work of erection shall be subject to the inspection of the Engineer who shall be provided with all facilities including labour and tools required at all reasonable times. Any work found defective is liable to be rejected.

No protective treatment shall be applied to the work until the appropriate inspection and testing has been carried out. The stage inspection shall be carried out for all operations so as to ensure the correctness of fabrication and good quality. Girder dimensions and camber shall not be finally checked until all welding and heating operations are completed and the member has cooled to a uniform temperature.

14.0 TESTING OF MATERIALS:

Structural steel shall be tested for mechanical and chemical properties as per various IS codes as may be applicable and shall conform to requirements specified in IS: 226, IS: 2062, IS: 11587,IS: 1977, IS: 8500 and IS: 961, etc.

Bolts, nuts, washers, welding consumables, steel forging, casting and stainless steel be tested for mechanical and chemical properties in the appropriate IS Code. Measurements for the plate and rolled sections shall be taken at not less than 15 mm from edge.

Lamination tests for plates shall be carried out by ultra-sonic testing or any other specified methods. Steel work shall be inspected for surface defects and exposed edge laminations during fabrication and cleaning. Significant edge laminations found shall be reported to the Engineer for his decision.

Chipping, grinding, machining or ultrasonic testing shall be used to determine depth of imperfection.

14.1 Bolted connections:

Bolts and bolted connection joints with high strength bolts shall be inspected and tested according to IS: 4000.

The firmness of joint shall be checked by 0.2 mm filler gauge, which shall not go inside under the bolt head by more than 3 mm. The alignment of plates at all bolted splice joints and welded butt joints shall be checked for compliance with Code requirements.

Testing of flame cut and sheared edges is to be done, where the hardness criteria given in the code are adopted. Hardness testing shall be carried out on six specimens.

14.2 Welding and welding consumables:

Welding procedure, welded connection and testing shall be in compliance with Code requirements.

All facilities necessary for stage inspection during welding and on completion shall be provided to the Engineer or their inspecting Authority by manufacturer.

Adequate means of identification either by identification mark or other record shall be provided to enable each weld to be traced to the welder(s) by whom it was carried out.

All metal arc welding shall be in compliance with IS: 9595 provisions.

The method of inspection shall be in accordance with IS: 822 and extent of inspection and testing shall be in accordance with the relevant standards or in the absence of such a standard, as agreed with the Engineer.

Procedure tests -The Destructive and Non-Destructive test of weld shall be carried out according to IS: 7307 (Part I).

14.3 Non-Destructive Testing of Welds

One or more of the following methods may be applied for inspection or testing of weld:

Visual Inspection: All welds shall be visually inspected, which should cover all defects of weld such as size, porosity, crack in the weld or in the HAZ (Heat Affected Zone) etc. Suitable magnifying glass may be used for visual inspection. A weld shall be acceptable by visual inspection if it shows that:

The weld has no cracks.

Through fusion exists between weld and base metal and between adjacent layers of weld metal.

Weld profiles are in accordance with requisite clauses of IS: 9595 or as agreed with the Engineer.

The weld shall be of full cross section, except for the ends of intermittent fillet welds outside their effective length.

When weld is transverse to the primary stress, undercut shall not be more than 0.8 mm deep when the weld is parallel to the primary stress in the part that is undercut.

The fillet weld in any single continuous weld shall be permitted to under run the nominal fillet weld size specified by 1.6 mm without correction provided that undersize portion of the weld does not exceed 10 percent of the length of the weld. On the web-to-flange welds on girders, no under run is permitted at the ends for a length equal to twice the width of the flange.

The piping porosity in fillet welds shall not exceed one in each 100 mm of weld length and the maximum diameter shall not exceed 2.4 mm, except for fillet welds connecting stiffeners to web where the sum of diameters of piping porosity shall not exceed 9.5 mm in any 25 mm length of weld and shall not exceed 19 mm in any 300 mm length of weld.

The full penetration groove weld in butt joints transverse to the direction of computed tensile stress shall have no piping porosity. For all other groove welds, the piping porosity shall not exceed one in 100 mm of length and the maximum diameter shall not exceed 2.4 mm.

Magnetic Particle and Radiographic Inspection:

Welds that are subject to radiographic or magnetic particle testing in addition to visual inspection shall have no crack.

Magnetic particle test shall be carried out for detection of crack and other discontinuity in the weld according to IS: 5334.

Radiographic test shall be carried out for detection of internal flaws in the weld such as crack, piping porosity inclusion, lack of fusion, incomplete penetration, etc. This test may be carried out as per IS: 1182 and IS: 4853.

Acceptance Criteria:

The weld shall be unacceptable if radiographic or magnetic particle testing shows any of the type of discontinuities indicated in the code.

Ultrasonic Inspection:

The Ultrasonic testing in addition to visual inspection shall be carried out for detection of internal flaws in the weld such as cracks, ping porosity inclusion, lack of fusion, incomplete penetration, etc. Acceptance criteria shall be as per IS: 4260 or any other relevant IS Specification and as agreed to by the Engineer.

Liquid Penetration Inspection:

The liquid penetrant test shall be carried out for detection of surface defect in the weld, as per IS: 3658, in addition to visual inspection.

The non-destructive testing of following welds be carried out using one of the method or methods described at (ii), (iii) and (iv) above, as may be agreed to by the Engineer.

All transverse butt welds in tension flange.

10 percent of the length of longitudinal and transverse butt welds in tension flanges.

5 percent of the length of longitudinal and transverse butt welds in compression flanges.

All transverse butt welds in webs adjacent to tension flanges as specified by the Engineer.

The particular length of welds in webs to be tested shall be agreed with the Engineer, in case of (b) or (c).

Where specified by the Engineer, bearing stiffeners or bearing diaphragms adjacent to welds, plates in box girder construction adjacent to plates at cruciform welds, plates in box girder construction adjacent to corner welds or other details shall be ultrasonically tested after fabrication.

Any lamination, lamellar tearing or other defect found shall be recorded and reported to Engineer for his decision.

14.4 Testing of welding for Cast Steel: The testing of weld for cast steel shall be carried out as may be agreed to by the Engineer.

14.5 Stud Shear Connectors (where applicable)

Stud shear connectors shall be subjected to the following tests:

The fixing of studs after being welded in position shall be tested by striking the side of the head of the stud with a 2 kg hammer to the satisfaction of the Engineer.

The selected stud head stroked with 6 kg hammer shall be capable of lateral displacement of approximately 0.25 the height of the stud from its original position. The stud weld shall not show any sign of crack or lack of fusion.

The studs whose welds have failed the tests given in (a) and (b) shall be replaced.

14.6 Inspection requirement:

The fabricated member/component made out of rolled and built-up section shall be checked for compliance of the tolerances given in Table-2. Inspection of member/components for compliance with tolerances, and the check for deviations shall be made over the full length.

During checking, the inspection requirement shall be placed in such a manner that local surface irregularities do not influence the results.

For plate, out-of-plane deviation shall be checked at right angle to the surface over the full area of plate.

The relative cross frame deviation shall be checked over the middle third of length of the girder or frame between each pair of webs and for cantilever at the end of member.

The web of rolled beam or channel section shall be checked for out-of-plane deviation in longitudinal direction equal to the depth of the section.

During inspection, the component/member shall not have any load or external restraint.

14.7 Inspection Stages:

The inspection to be carried out for compliance of tolerances shall include but not be limited to the following stages:

For completed parts, component/members on completion of fabrication and before any subsequent operation such as surface preparation, painting, transportation, and erection.

For webs of plate and box girder, longitudinal compression flange stiffeners in box girders and orthotropic decks and all web stiffeners at site joints, on completion of site joint.

For girders and frames, cantilevers and other parts in which deviations have apparently increased on completion of site assembly.

Where, on checking member/component for the deviations in respect of out-of-plane or out-of-straightness at right angles to the plate surface, and any other instances, exceed tolerance, the maximum deviation shall be measured any recorded. The recorded measurements shall be submitted to the Engineer who will determine whether the component/member may be accepted without rectification, with rectification or rejected.

15.0 PAINTING

15.1 General Scope

Unless otherwise specified, all steelwork shall be given approved primer and top coats of painting. The work shall include sand / grit blasting of steel to Swedish specification 2-1/2 and other preparation of metal surfaces as required, providing and applying the paint in the specified number of coats and thickness (with repair / touching of the shop / first coat / other coats as necessary) including supply of all materials, equipment, tools and tackles, scaffolding, labour, supervision, thickness testing instruments, all testing, materials and all and other work to complete the painting as per specifications and to the satisfaction of the Engineer.

15.2 Quality of paint

Only the paints which have been tested for the following qualities as per the specification given in the relevant IS codes should be used:

- Weight test (weight per 10 litre of paint thoroughly mixed)

- ❖ Drying time
- ❖ Flexibility and adhesion
- ❖ Consistency
- ❖ Dry thickness and rate of consumption

Unless otherwise specified all painting and protective coating work shall be done in accordance with IS: 1477 (Part 1)

15.3 Preparation of Steelwork

The steelwork shall be thoroughly cleaned and all grease, oil and all other surface contaminants shall be removed by application of solvents, wire brushing and other tools. The steelwork shall be grit / sand blasted to degree defined as 2-1/2 as per Swedish Standard SI S 05 5900 with a surface profile not exceeding 65 microns. It must be ensured that the steel is clean and free of all contaminants. The longevity of the coating and protection will depend on the extent to which the steel is clean. All dust is removed and the steelwork.

The steel after grit / sand blast cleaning is very susceptible to atmospheric action and as such within as short a time as possible (not more than 15 to 20 mins) the first coat of primer shall be applied.

15.4 Paint preparation and application procedure

The primer shall be an inorganic Zinc silicate solvent based paint normally of the two pack self curing type. The liquid part is thoroughly stirred to uniform consistency and then the solid part (zinc dust) shall be added with constant mechanical stirring till the powder is thoroughly dispersed. The mixture is strained through a 80 mesh sieve and allowed to mature for 20 minutes with stirring. It is then applied by airless spraying with a pump ratio of 30 : 1, a tip size of 0.40 mm and a pressure of 120 kg / sq.cm The wet film thickness shall be not less than 125 microns and the dry film thickness 75 microns. One coat of primer shall be applied with a DFT of not less than 75 microns.

The intermediate coat shall be of a super high-build epoxy coating with a composition of catalysed epoxy resin suitably pigmented. This is in two packs. The separate packs are stirred properly and mixed in the recommended ratio. The mixture shall be applied to the clean primer surface by airless spray (pump ration 45:1) with a fluid tip of about 0.55 mm and air supply of 100 psi. The pot life of the mixture is an hour. At approximately 4.25 sq.m per litre, a 200 micron DFT should be available.

The topcoats shall be two coats of an acrylic polyurethane enamel for a high gloss coating to provide protection against the atmosphere at site.. The steelwork which has already been primed with one coat and given an intermediate coat shall be carefully cleaned of adhering contaminant without damaging the coats.

The top coat paint also comes in two packs, base is stirred thoroughly and the catalyst is added in the ration of four parts of base to one part of catalyst. The mixture is stirred to uniform consistency and after a maturing period of 30 minutes, the top coats shall be applied by air less spray with pump ratio of 30:1, a tip between 0.40 and 0.45 mm at a tip pressure of 140 kg / esq. There shall be two topcoats each of DFT of 30 microns.

The prime and top coats shall be compatible with each other.

The surface of the steelwork shall be clean dry before the application of any paint.

The painting equipment shall be kept scrupulously clean and for this purpose, a thinner shall be used for cleaning the equipment before and after use.

It must be ensured that all paints are fresh and whenever the contents of two pack paints are mixed the paint must be used up before the time recommended by the manufacturers.

The colour of the topcoats shall be selected by the Engineer. Two slightly different shades may be chosen to ensure that two topcoats are given without missing out any area of the steel work.

15.5 Curing: The painted materials shall not be handled till it is dry. The painted components shall be allowed to air-dry for at least 24 hours after which it should be gradually subjected to working temperature range.

15.6 Ambient conditions and painting: Painting work shall not be done if the ambient temperature is below 10 0 C or if it is above 50 0 C, nor shall it be done if the relative humidity is above 90 %. No painting work shall be done during rain or misty or foggy conditions. As far as possible coated surface shall not be exposed to rain or forest before they are dry.

15.7 Other requirements

The coatings shall be applied to all surfaces excluding inner surfaces of fully sealed hollow sections. Surfaces that would be inaccessible for cleaning and painting after fabrication shall be painted as specified before being assembled.

All bolts, nuts, washers etc. are to be thoroughly cleaned and dipped into boiling linseed oil conforming to IS: 77.

All machined surfaces are to be well coated with a mixture of white lead conforming to IS: 234 and Mutton Tallow conforming IS: 887.

The work shall be done inside a properly covered area by workmen who are properly attired and protected for the work.

All fabricated steel shall be painted in the shops after inspection and acceptance with at least one priming coat, unless the exposed surfaces are subsequently to be cleaned at site or are metal coated. No primer shall be applied to galvanised surfaces.

Field contact surfaces and surfaces to be in contact with cement shall be painted with primer only. No paint shall be applied within 50 mm of designed location of field welds.

E. WOOD WORK & JOINERY INCLUDING DOORS & WINDOWS

1.0 SCOPE

The specifications refer to wood work in general including carpentry and joinery work in the building.

2.0 GENERAL

The provision of the latest revisions of the following I.S. codes shall form a part of these specifications.

IS	205	Specifications for non-ferrous metal butt hinges.
IS	287	Recommendation for maximum permissible moisture content of timber used for different purpose.
IS	303	Specification for plywood for general purpose.

IS 362	Specification for parliamentary hinges
IS 419	Specification for putty for the use on window frames
IS 883	Code of practice for design of structural timber in building.
IS 1003	Specification for Timber panelled and glazed shutters Part II - Window and ventilator shutters.
IS1200	Method of measurement of building and Civil Part XXI Engineering Works – Wood Work and Joinery.
IS:1341	Specification for steel butt hinges
IS:1658	Specification for Fibre Hard Boards
IS: 1761	Specification for transparent sheet glass for glazing and framing purposes.
IS: 3087	Specification for wood particle boards (medium density for structural timber in building)

Other I.S. codes not specifically mentioned here, but pertaining to wood work and joinery form part of these specifications.

3.0 MATERIALS

3.1 Sawn Timber

Teak wood of good quality and class as specified in the item shall be used. The timber shall be of high quality and well seasoned. It shall have uniform colour free from defects such as cracks, dead knots, shakes, sapwood etc. No individual hard and wound knot shall be more than 6 sq.cm in size and the aggregate area of such knots shall not be more than 1% of the area of the piece. The timber shall be close grained having not less than 2 growth rings per cm. width in cross section.

The maximum permissible percentage of moisture content for well seasoned timber used in building work shall be as specified in the IS : 287.

3.2 Glazing materials - Glass Panels:

Unless otherwise specified, glass panes used in glazed or panelled and glazed shutters, shall be of good quality glass of thickness not less than 4 mm for panes upto 0.1 sq.m in area not less than 5 mm for glass panes of area larger than 0.1 sq.m with a tolerance of 0.2 mm in both cases. The glass shall be free from flaws such as specks, bubbles, smoke waves, air holes, etc. and shall conform to the relevant IS : 1761.

Unless otherwise specified, glass panes used in shutters of bath room and lavatories shall be frosted and of thickness as mentioned above and shall be free from any flaws.

Where so specified, special quality glass such as plate glass, pin heads glass, wired glass, float glass etc. shall be used. They shall conform to relevant IS standards as regards quality. Putty for glazing in wooden frames of doors and windows. Putty shall be prepared by mixing one part of white lead with three parts of finely powdered chalk and then adding boiled linseed oil and mixing the whole thing into a homogeneous stiff paste. It shall be free from impurities like dust, grit, etc. and shall conform to IS : 419.

3.3 Fittings

The item of wood work of joinery generally includes fittings such as hinges and screws for fixing of door shutters and is explicitly so mentioned in the item.

Hinges - Hinges shall be of iron, brass, aluminium or any other material as specified. They shall present a neat appearance and shall operate smoothly. All hinges shall be of steel and their riveted heads shall be well formed and smooth. Hinges shall be of the type specified and shall conform to the relevant Indian Standard Specifications.

4.0 WORKMANSHIP

4.1 Wood Work, Wrought, Framed and Fixed

General

The work shall be carried out as per detailed drawings and/or as directed by the Engineer-in-charge. The wooden members of the frame shall be planed smooth and accurate to the full dimensions. Rebates, rounding, mouldings, etc. as shown in the drawing shall be done before the members are joined into frames. Where wood work is not exposed to view as in the case of frames for false ceiling, however, no planing is required to be done unless specified expressly as rough timber work.

Note: The work wrought shall mean 'planed'.

Jointing in timber frames must be made carefully and accurately. They shall be strong, neat and shall fit without edging or filling. The joints shall be pinned with hard wood or bamboo pins of 10 to 15 - dia after the members of the frame are pressed together in a suitable vice-mechanism

The door and window frame shall have rebate to house the shutters and the depth of such rebate shall be 1.25 cm.

Wood work shall be painted, oiled, polished or otherwise treated as specified. All portions of timber abutting against masonry or concrete portion of building shall be coated with boiling coal tar or other type of approved wood preservatives primer, before placing them in final position.

Before any surface treatment is applied in the wood work shall be got approved by the Engineer-in-Charge

Fixing in Position:

The frames shall be fixed only after acceptance by the Engineer-in-Charge. In case of door frames without sills, the vertical members shall be buried in floor for the full thickness of the floor and the door frame shall be temporarily braced at the sill level so as to prevent warping or distortion of frame during construction.

All Carpenter's work shall be accurately set out and framed together and securely fixed in the best possible manner and with properly made joints. All joints must fit accurately without wedging or filling. All nails screws, plugs, pins etc. shall be provided as necessary and as directed and approved. After the woodwork has been erected, if any undue shrinkage or bad workmanship is discovered, the Contractor shall forthwith amend the same without any extra charge.

All expose woodwork in country teak shall be painted with one coat of primer and two coats of paint of type; make and shade as indicated and approved. All woodwork coming in contact or embedded in masonry work shall be treated with two coats of solignum or coal tar as directed by the Engineer prior to installation.

4.2 Panelled, Glazed or Panelled and Glazed Shutters:

General: The work shall be carried out as per detailed drawing. The wooden members shall be planed smooth and accurate. They shall be cut to the exact shape and sizes

without patching or plugging of any kind. Mouldings, rebates, rounding, etc. shall be done, as shown in the drawing, before the pieces are assembled into the shutter.

Joinery work: The thickness of the styles and rails shall be as specified in the item of work. The minimum thickness of panels shall normally be 15 mm where the clear width of panel is not more than 300 mm and 20 mm where the clear width of the panel is more than 300 mm. However, where the Engineer-in-Charge so considers, lesser thickness upto 12 mm and 15 mm respectively may be allowed by him instead of 15 mm and 20 mm specified above. Solid wood panel for door and window shutters shall be made out of one or more strips of timber planks of not less than 125 mm width. it is preferable to use strips of not more than 200 mm width to reduce chances of warping, splitting or other defects. The timber strips shall be joined together with continuous tongued and grooved joints, glued together and reinforced with metal dowels. The grooving of the solid panel shall normally run along the longer dimensions of the panel unless otherwise directed. The corners and edges of panels shall be finished as shown in the drawing and these shall be feather tongued into styles and rails. Sash bars shall have mitres joints with the styles.

Styles and rails of shutters shall be made out of single piece. Lock and intermediate rails exceeding 200 mm in width if permitted by the Engineer-in-charge may be made out of one or more pieces of timber but the width of each piece shall not be less than 125 mm. Where more than one piece of timber is used, they shall be joined with a continuous tongued and grooved joint glued together and reinforced with metal dowels (rust proof) at regular intervals of 20 cm or pinned with not less than three 40 mm rust proof pins of the lost head type.

The tenons shall pass clear through styles. The styles and rails shall have a 12 mm groove to receive the panel.

In case the double shutters the rebate at the closing junction of the two shutters shall be of depth not less than 2 cm.

Shutters shall not be painted or otherwise treated before these are passed by the Engineer-in-Charge and fixed in position.

4.3 Glazing: The glazing work shall be done in accordance with the specification given separately elsewhere.

4.4 Hold Fasts: Hold fasts used for fixing doors and window frames shall be made of 40 x 3 mm flat iron and 40 cm long. It shall have two holes on one end for fixing to frame with long screws, and at the other end, the flat iron shall be split and bent at right angles in the opposite direction. The hold fast shall be tightly fixed to the frame by means of bolts, the bolt hole in frame being plugged suitably and finished neat. The hold fast shall be embedded into masonry by concrete block of 200 x 250 x 400 mm size.

5.0 FLUSH DOOR SHUTTERS

5.1 General:

The door shall be of flush type solid core with single or double shutter as the case may be.

5.2 Shutters

The shutters shall be decorative or non-decorative type of the exterior or interior grade as described in the item and as shown in the drawings. It shall conform to the relevant specifications for the type and grade given in I.S. 2202/1983, Specifications for Wooden Flush door shutters (solid core type). The face panel shall be of BWP grade ply conforming to IS-2191 (Part-I).

The finished thickness shall be as mentioned in the item. Face veneers used shall be of the pattern and colour approved by the Engineer. Solid teakwood lipping of thickness not less than 12mm shall be provided on all edges. The lipping shall be fixed using adhesive as specified and shall be factory pressed. Nothing extra shall be payable on this account.

All necessary rebates, recesses, holes etc., if any, for fixtures or otherwise shall also be provided and the visible surface finished with teak veneering to match.

The solid core shall be of wood laminate prepared from battens of well-seasoned and good quality wood, having straight grains. Battens shall be properly glued and machine pressed together.

Edges of the core shall be lipped with good quality teakwood battens of minimum 25mm depth and 35mm width glued and machine pressed along with the core and shall stand 72 hours boiling water test for de-lamination and strength. The flush doors shall be truly plain, well finished and shall be free from detects like warping etc.

Only phenol formaldehyde resin glue shall be used for door manufacture and a certificate to this effect from manufacturers shall be furnished.

5.3 Inspection:

The Contractor shall give intimation to the Engineer-in-Charge who shall arrange for the visual inspection of the samples at the factory premises, accompanied by the Contractor. The samples inspected by the EIC or his representative shall be signed as a mark of identification. These inspected samples of each type will be delivered by Contractor at site.

The final approval of the door and window shutters is subject to testing.

Flush doors shall be tested as per IS-4020.

The cost of sample, packaging, sealing and transportation of samples to the laboratory, shall be borne by the Contractor. Testing charges shall be reimbursed to Contractor, provided that the shutters fulfill the requirement of relevant specification. If the shutters fail to fulfill the requirements, testing charges shall be borne by the Contractor.

5.4 Fixtures and Fastenings

These shall be as shown in a table on the drawings or as indicated in the specifications. Where it is not specified they shall be of oxidised brass and shall be of good workmanship. All fixtures and fastenings shall be sound and strong. They shall be sectional and of the best quality. The size, shape, design and finish shall be as shown on drawings and approved by the Engineer.

Unless otherwise specified each leaf shall be hung with three brass parliamentary hinges for back flap with brass screws. Each door shall be furnished with aldrop and latch, brass flush bolts, etc. The fixtures shall comply with the relevant Indian Standards. Samples of all fixtures and fastening shall be got approved by the Engineer and deposited in his office for reference.

All the fixtures shall be fixed to the joinery in a secure and efficient manner. Metal sockets shall be provided to all bolts where the shoots enter, stone, concrete, etc.

F. FLOORING, SKIRTING, DADO OR CLADDINGWORKS

1.0 SCOPE

These Specifications covers flooring, skirting, dado or cladding works using different types of stone/ slabs/ tiles as detailed hereunder:

2.0 GENERAL

The provision of the latest revisions of the following IS Codes shall form a part of this specification to the extent they are relevant.

IS: 269		Specification for ordinary, rapid hardening and low beat Portland cement.
IS: 383		Specification for coarse and fine aggregate from natural sources for concrete
IS: 657		Specification for material for use in the manufacturer of magnesium oxychloride flooring compositions.
IS: 1130		Specification for marble (Blocks, slabs & Tiles).
IS: 1200	Part XI	Method of measurements for Building and Civil Engg. Works, paving, floor finishes, dado & skirting.
IS: 1237		Specification for cement concrete flooring tiles.
IS: 1443		Code of practice for laying and finishing of cement concrete flooring tiles.
IS. 2541		Code of practice for use of lime concrete' in buildings.
IS: 2571		Code of practice for laying in situ cement concrete flooring
IS: 4082		Recommendation on stacking and storage of construction materials at site.
IS: 4457		Specification for Ceramic unglazed vitreous acid resistant tile.
IS: 8042		Specification for white port land cement
IS 8112		Specification for high strength ordinary portland cement
IS: 10067		Material Constants in Building Work
IS: 13711		Ceramic Tiles : Sampling & basis of acceptance
IS: 13712		Ceramic Tiles : Definitions, classifications, characteristics and making
IS: 13753		Dust Pressed ceramic tiles with water absorption of E > 10% (Group - B III)
IS: 13754		Dust Pressed ceramic tiles with water absorption of 6% < E < 10% (Group - B IIb)
IS: 13755		Dust Pressed ceramic tiles with water absorption of 3% < E < 10% (Group - B IIa)
IS: 13756		Dust Pressed ceramic tiles with water absorption of E < 3% (Group - B I)

Other I.S Codes not specifically mentioned here, but pertaining to Floor Finishes form part of these specifications.

3.0 MATERIAL

3.1 Cement, sand, aggregate, water shall conform to the specifications for Cement concrete of this volume. Stone shall be hard, sound, durable and free from defects like cavities, cracks, sand-holes, flaws, injurious veins, patches of loose or soft materials and weathered portions etc.

4.0 SUB-BASE

4.1 Sub-base for all flooring shall be prepared and kept ready for further applications. All items shall be defined and detailed on the drawing.

Preparation of sub-base may be carried out by excavation or back filling in plinth. Back filling shall be with the selected earth in layer of 150mm to 200mm maximum and adequately watered and well-compacted to achieve at least 90% compaction at optimum moisture content.

In case of excavation, the base shall be well-dressed to the desired level and inspected. All loose spots shall be excavated till the hard surface is reached and then filled as directed by the Engineer-in-Charge. Surface shall be watered with just sufficient water and rolled and compacted with vibratory compactor.

4.2 Dry Brick Flooring

4.2.1 Spreading Sand:- After the plinth has been prepared as detailed above, 225mm of sand shall be spread, evenly over the surface and well watered and the wet sand brought to a true under surface formation.

4.2.2 Laying bricks:- Over the sand, thoroughly well burnt bricks of uniform shape shall be laid on edge breaking bonds in straight lines. After laying each two or three lines of bricks, they shall be cramped together as tightly as possible. When the last line of bricks has been cramped into position no movement of the bricks should be possible and if any such exists, the flooring must be removed and railed.

4.2.3 Blinding the surface:- After the bricks are satisfactory laid, sand will be spread over the surface so as to fill all joints. This sand will be well watered and more sand and water added as necessary and until all joints are filled flush and solid.

4.2.4 Pointing:- The joints shall thereafter be raked out to a depth of half an inch and level pointed with cement mortar.

4.2.5 Curing:- The complete work shall be kept covered with wet straw for ten days after pointing.

4.3 Rubble soling

Good quality 150mm to 230mm thick rubble soling shall be carried out depending upon the grade of soil. Rubble used shall be at least 100mm for 150mm thick soling and 150mm for 230mm thick soling. Stone shall be hand packed as close as possible and bedded firmly with the broadest face downwards and the greatest length across, voids filled with chips and small stones. These shall be hammered down to achieve packing and the complete filling of interstices. To achieve the desired levels and slopes, pegs at suitable intervals (about 12m) shall be fixed.

Soling shall be watered and again packed with sand or stone dust to fill interstices created by watering. Then it shall be rolled by power driven roller of 10MT capacity wherever possible or with vibratory compactor. Filling sand or stone dust, watering and compaction shall continue till full compactness is achieved to the satisfaction of the Engineer-in-Charge.

4.4 Base floor

This shall be regular reinforced concrete floor or plain cement concrete floor as specified. All specifications of concreting shall be the same as per Plain & Reinforced Concrete section of this volume.

5.0 CEMENT CONCRETE FLOORING

5.1 Materials

Cement concrete: The cement concrete shall generally conform to specifications for ordinary concrete. The coarse aggregates shall be carefully selected, sufficiently tough and hard stone pieces broken in a manner that will provide particles of approximately cubical shape affording good interlocking. The maximum size of coarse aggregate shall be 12 mm. The fine aggregate shall consist of properly graded particles. The proportion of mix shall not be of the grade below M15 {1: 2: 4 (1 cement: 2 coarse sand: 4 stone aggregate)}. The least amount of mixing water that will produce a workable mix and will allow finishing without excessive trowelling shall be used. Generally a water cement ratio of 0.5 should suffice.

5.2 Workmanship:

The sub-grade in all cases shall be formed to proper levels and slopes, well compacted and cured. The top surface shall be kept slightly rough.

The surface of the sub-grade shall be cleaned off all loose materials and moistened immediately before laying the concrete floor. The concrete flooring shall be laid in alternate bays not exceeding 6.25 sq.m (about 64 sf.ft) each. The edge of each panel into which the floor is divided should be supported by aluminium dividing strips of adequate size to prevent sticking. Their depth shall be the same as that proposed for the finished floor as mentioned in the item. At least 48 hours shall elapse before the concreting in the adjacent bays is commenced.

The concrete shall be laid immediately after mixing. While being placed the concrete shall be vigorously sliced and spaded with suitable tools to prevent formation of voids or honey comb pockets. The concrete shall be brought to the specified levels by means of a heavy straight edge resting on the side forms and drawn ahead with a sawing motion in combination with a series of lifts and drops alternating with small lateral shifts. While concreting the adjacent bays care shall be taken to ensure that the edges of previously laid bays are not broken by careless or hard tamping.

Immediately after laying the concrete, the surface shall be inspected for high or low spots and any needed correction made up by adding or removing the concrete. After striking off the surfaces to the required grade concrete shall be compacted with a wooden float. The blows shall be fairly heavy in the beginning but as consolidation takes place, light rapid strokes shall be given to complete the ramming.

The floating shall be followed by steel trowelling after the concrete has hardened sufficiently to prevent excess of fine material from working to the surface, The finish shall be brought to a smooth and even surface free from defects and blemishes and tested with straight edges. No dry cement or mixture of dry cement and sand shall be sprinkled directly on the surface of the concrete to absorb moisture or to stiffen the mix. After the concrete has been thoroughly rammed and has dried sufficiently to allow rendering to be worked up, surface shall be rendered with a thin coat of 1:1 cement mortar with fine sand and uniformly floated. If so directed by the Engineer-in-Charge, approved mineral colour pigment conforming to appendix-B of IS 657 shall be added to the cement mortar to give the required colour and shade to the flooring. When the cement mortar rendering is sufficiently stiff, lines shall be marked on it with strings or by any other device to give the

appearance of tiles 30 x 30 cm or of any other size laid diagonally or square as directed by the Engineer-in-Charge. The junctions of floor and walls shall be rounded off if so directed, without any extra payment.

After the concrete in the bays has set, the joints of the panels shall be filled with cement cream or with suitable bitumastic compound as shown on the drawings or directed by the Engineer-in-Charge. Vertical edge of the bays shall be neatly marked on the surface of the concrete with a pointed trowel after filling the joints.

Finishing: When the rendering is somewhat stiff, neat cement may be sprinkled on sparingly through a paper pot on the surface and rubbed lightly to give smooth polished ordinary cement coloured surface. If coloured flooring is required by the Engineer-in-Charge the approved coloured cement shall be used. Surface shall be protected from direct sun when it is green.

Curing: Curing shall start on the next day after finishing and shall be continued for 14 days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies shall be avoided as the colour of the flooring is likely to be bleached due to the remnants of cement dust from the bags.

6.0 GLAZED / ANTISKID CERAMIC / VITRIFIED TILES IN FLOORING

6.1 Material:

The tiles including specials shall be of the approved make and quality and shall conform to BIS Specifications in all respects. Glazed tiles / Ceramic tiles shall conform to IS : 13711-1993, IS : 13712-1993, IS : 13753-1993, IS : 13754-1993, IS : 13755-1993, and IS : 13756-1993. Samples of tiles shall be got approved by the Engineer-in-Charge, who will keep them in his office for verification as to whether the material brought for use conform to the approved samples.

The tiles shall be square or rectangular of size as specified in the item description or as directed by the Engineer-in-charge. The thickness of the tiles shall be as specified. The length of all four sides shall be measured correct to 0.1mm and average length breadth shall not vary more than ± 0.8mm from specified dimension. The variation of individual dimension from average value of length / breadth shall not exceed ± 0.5mm. Tolerance in thickness shall be ± 0.4mm.Cement Mortar 1:4 to be used along with White Cement of approved quality and make.

6.2 Workmanship

6.2.1 Mortar Bedding

The amount of water added while preparing mortar shall be the minimum necessary to give sufficient plasticity for laying. Care shall be taken in the preparation of mortar to ensure that there are no hard lumps that would interfere with even bedding of the tiles. Before spreading the mortar bed, the base shall be cleaned of all dirt, scum or laitance and loose materials and then well wetted without forming any pools of water on the surface. The mortar shall then be evenly and smoothly spread over the base by the use of screed battens to proper level or slope. The thickness of the bedding shall not be less than 12 mm (about ½") or more than 20 mm (about ¾") in any one place. The tiles shall be laid on bedding mortar when it is still plastic but has become sufficiently stiff to offer a fairly firm cushion for the tiles.

6.2.2 Fixing Tiles

The tiles before laying shall be soaked in water for at least 2 hours. Tiles, which are fixed in the floor adjoining the wall, shall be so arranged that the surface of the round edge tiles

shall correspond to the skirting or dado. Neat cement grout of honey like consistency shall be spread over the bedding mortar just to cover so many areas as can be tiled within half an hour. The edges of the tiles shall be smeared with neat white cement slurry and fixed in this grout one after the other, each tile being well pressed and gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. There shall be no hollows in bed or joints. The joints shall be kept as close as possible and in straight lines. The joints between the tiles shall not exceed 1.5 mm (about 1/ 1 6") wide. The joints shall be grouted with a slurry of white cement. When hairline joints are specified the same shall be followed. After fixing the tiles finally in an even plane, the flooring laid shall be kept moist and allowed to mature undisturbed for 10 days to allow the bedding and flooring to set properly.

6.2.3 Cleaning

After the tiles have been laid in a room or the day's fixing work is completed, the surplus cement grout that may have come out of the joints shall be cleaned off before it sets. Once the floor has set, the floor shall be carefully washed clean and dried. When dry, the floor shall be covered with oil free dry saw dust which shall be removed only after completion of the construction work and just before the floor is occupied.

7.0 GLAZED/CERAMIC TILES IN DADO/ SKIRTING

7.1 Materials

The tiles including specials shall be of the approved make and quality and shall conform to BIS standards in all respects. Samples of tiles shall be got approved by the Engineer-in-Charge. Materials brought for use shall conform to the approved samples.

7.2 Workmanship

7.2.1 Plastering

Cement plaster of about 15 mm thickness shall be applied to the part of the wall where dado or skirting is to be fixed. The proportion of mortar shall be as mentioned in the item.

7.2.2 Fixing of Tiles

Dado or skirting work shall be done only after fixing tiles on the floor is completed. The tiles shall be soaked in water for at least 2 hours before being used for skirting or dado work. Tiles shall be fixed when the cushioning mortar is still plastic and before it gets very stiff. The back of tiles shall be covered with a thin layer of neat cement paste and the tile shall then be pressed in the mortar and gently tapped against the wall with a wooden mallet. The fixing shall be done from the bottom of wall upwards without any hollows in the bed or joints. Each tile shall be fixed as close as possible to the one adjoining. The tiles shall be joined with white cement and matching coloured pigment slurry. Any difference in the thickness of tiles shall be evened out in cushioning mortar so that all tile faces are in one vertical plane. The joints between the tiles shall not exceed 1.5 mm in width and they shall be uniform. After fixing the dado, they shall be kept continuously wet for 14 days.

7.2.3 Cleaning

After the tiles have been fixed the surplus cement grout that may have come out of the joints shall be cleaned off before it sets. After the complete curing, the dado or skirting work shall be washed thoroughly clean.

8.0 CUDDAPAH / KOTA STONE FLOORING (local available sand stone for flooring)

8.1 Cuddapah / Kota Stone Slabs

The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness. They shall be of the colour indicated in the drawings or as instructed by the Engineer-in-Charge.

The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required. Before starting the work the contractor shall get the samples of slabs approved by the Engineer-in-Charge.

8.2 Dressing

Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane.

The thickness of the slab after it is dressed shall be 20, 25, 30 or 40mm as specified in the description of the item. Tolerance of + 2mm shall be allowed for the thickness. In respect of length and breadth of slabs Tolerance of + 5mm for hand cut slabs and + 2mm for machine cut slabs shall be allowed.

8.3 Laying

Base concrete or the RCC slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1:6 (1 cement: 6 coarse sand) or with lime mortar (1 lime putty: 1 surkhi: 1 coarse sand) as given in the description of the item.

The average thickness of the bedding mortar under the slab shall be 20mm and the thickness at any place under the slab shall be not less than 12mm.

The slabs shall be laid in the following manner:-

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar is allowed to harden a bit and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg. of cement per sqm. The edges of the slab already paved shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the stone slabs as given in the description of the item.

The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible. Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the Engineer-in-Charge.

8.4 Curing, Polishing and Finishing:

The day after the tiles are laid all joints shall be cleaned of the grey cement grout with a wire brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with grey or white cement mixed with our without pigment to match the shape of the topping of the wearing layer of the tiles.

The floor shall then be kept wet for a minimum period of 7 days. The surface shall thereafter be grinded evenly with machine fitted with medium grade grit block (No.80). Water shall be used profusely during grinding. After grinding the surface shall be thoroughly washed to remove all grinding mud, cleaned and mopped. It shall then be covered with a thin coat of grey or white cement, mixed with or without pigment to match the colour of the topping of the wearing surface in order to fill any pin hole that appear. The surface shall be again cured. The second grinding shall then be carried out with machine fitted with fine grade grit block (No.120).

The final grinding with machine fitted with the finest grade grit blocks (No.320) shall be carried out the day after the second grinding described in the preceding Para or before handing over the floor, as ordered by the Engineer-in-Charge.

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

First Grinding : Medium grade (No.80)

Final Grinding : Fine grade (No.120)

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

After the final polish, oxalic acid shall be dusted over the surface at the rate of 33 gm per square metre sprinkled with water and rubbed hard with a 'namdah' block (pad of woolen rags).

The following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

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

9.0 CUDDAPAH / KOTA STONE IN RISERS OF STEPS, SKIRTING AND DADO

9.1 Kota Stone Slabs and Dressing shall be as specified above, for clause 8.0 for Kota Stone flooring, except that the thickness of the slabs which shall be as specified in the description of the item. The slabs may be of uniform size, as specified.

9.2 Preparation of surface shall be as specified above in clause 8.0 for Kota Stone flooring.

9.3 Laying shall be as specified above in clause 8.0 for Kota Stone flooring for flooring, except that the joints of the slabs shall be set in grey cement mixed with pigment to match the shade of the slabs and the backing coat shall be 15mm thick cement mortar 1: 4 (1 cement : 4 Coarse sand).

9.4 Curing, Polishing and Finishing shall be as specified above in clause 8.0 for Kota Stone flooring.

10.0 MARBLE / GRANITE STONE SLAB FLOORING

10.1 General

The item refers to provision of flooring of Indian Marble / Granite stone slabs of approved colour / pattern and shall conform to the specification as given below :-

10.2 Materials

10.2.1 Stone Slabs

The stone slab specified in the item shall be got approved by the Engineer . At its thinnest part, no stone shall be thinner than the specified thickness. The stone slab shall be hard, sound, durable, and resistant to wear, rectangular in shape or square if directed by the Engineer and of the specified width. The stone slab shall be of the type mentioned in the item and of the colour and quality approved by the Engineer. Slabs shall be hard, dense, uniform and homogenous 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 plane surface and edges machine cut true and square. The rear face shall be rough enough to provide a key for the mortar. Uniformity of size shall generally be maintained for the stone slab used in any room. The stone shall be without any soft veins; cracks of floors and shall have a uniform colour. The edges shall be quite straight. The stone in slabs in external and internal wall veneer work shall be mirror polished where required, in the factory with silicon carbide abrasive starting from no. "00" up to no. 5 and then using buff/lead strip rolls with tin oxide for final mirror polish. For flooring and counter top the final tin oxide polish shall not be used. Samples of stone slabs to be used shall be got approved by the Engineer and the slabs to be used shall conform to the approved sample.

The dimensions of the slab shall be as specified in the item.

10.2.2 Bedding

Cement mortar for the bedding shall be of the proportions as specified in the item. The proportions will be by volume on the basis of 50 Kg. bag of cement. The mortar may be hand mixed or machine mixed.

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 or more till a homogeneous mixture of uniform colour is obtained. Fresh & clean water shall be added gradually and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. 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. The mortar remaining unused after that period or mortar which has partially hardened or is otherwise damaged shall not be re-tempered or remixed. It shall be destroyed or thrown away.

10.3 Construction

10.3.1 Bedding

The base of cement concrete shall be laid and compacted to a reasonably true plain surface and to the required slopes and below the level of the finished floor to the extent of the thickness of the slabs and mortar bedding. Cement concrete bedding if provided shall be paid under a separate item. Cement mortar for bedding may be mixed manually or by a mechanical mixer. The amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and satisfactory bedding. Care shall be taken in preparing the mortar to ensure that there are no hard lumps that would interfere with the even bedding of the stones. Before spreading the mortar, the sub-floor or base shall be cleaned of all dirt, scum or laitance and of loose material 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 paving surface shall be marked out. The mortar shall then be evenly and smoothly spread over the base by the use of screed battens only over so much area as will be covered with slabs within half and hour. The thickness of the mortar bedding shall not be less than 12mm, not more than 25mm. The required slope shall be given to the bed.

10.3.2 Fixing stone slab

Before laying, the stone slabs shall be thoroughly wetted with clean water. Neat cement grout of honey like consistency shall be spread on the mortar bed over as much area as could be covered with the slabs within half an hour. The specified type of stone slabs shall be laid on the neat cement float and shall be evenly and firmly bedded to the required level and slope in the mortar bed. Each stone slab shall be gently tapped with a wooden mallet till it is firmly and properly bedded. There shall be no hollows left. If there is a hollow sound on gentle tapping of the slabs, such slabs shall be removed and reset properly. The Mason shall make the joints of uniform thickness and in straight lines. The joints shall be filled solidly with pigmented grout for their full depth. The stone slabs shall be laid so as to give continuous parallel long joints with cross joints at right angles to them. The edges of the adjoining slabs shall be in one plane. Where the slabs cover open edges, of floor or window sills the edges shall be neatly rounded off. This shall be included in the rate.

When diamond pattern paving is provided in the item, the slabs shall be square and laid to the diamond pattern with triangular shaped slabs to make up the edges. In plain pattern stones on each course shall break joints with those in the next. The pattern joints etc. shall be as per drawings or as directed by Engineer-In-Charge, to the entire satisfaction of Engineer –In- Charge.

10.3.4 Curing

The flooring shall be kept well wetted with damp sand or water for fourteen days. It shall be kept undisturbed for at least seven days.

10.3.5 Cleaning

All flooring shall be thoroughly cleaned and handed over clean and free from any mortar stains etc.

All labour, materials and equipment, cleaning the sub-base, laying mortar bed and cement grout, fixing stone slabs specified above and making up the joints.

Any cutting and waste if required.

Pointing when included in the item.

Cleaning the floor from all stains, etc.

Polishing wherever required.

11.0 MARBLE / GRANITE STONE IN RISERS OF STEPS AND SKIRTING

11.1 Marble Stone Slabs and Dressing of Slabs shall be as specified above in clause 10.0 of Marble / Granite Stone Slab Flooring except that the thickness of slabs shall be as specified in the item description. A tolerance of + 3mm shall be allowed, unless otherwise specified in the description of the item.

11.2 Preparation of Surface

It shall be as specified above in clause 10.0 of Marble / Granite Stone Slab Flooring except where necessary the wall surface shall be cut uniformly to the requisite depth so that the skirting face shall have the projection from the finished face of wall as shown in drawings or as required by the Engineer-in-Charge.

11.3 The risers of steps and skirting shall be in grey or white cement admixed with or without pigment to match the shade of the stone, as specified in the description of the item, with the line of the slab at such a distance from the wall that the average width of the gap shall be 12mm and at no place the width shall be less than 10mm. The skirting or riser face

shall be checked for plane and plumb and corrected. The joints shall thus be left to harden then the rear of the skirting or riser slab shall be packed with cement mortar 1:3 (1 cement: 3 coarse sand) or other mix as specified in the description of the item. The fixing hooks shall be removed after the mortar filling the gap has acquired sufficient strength.

The joints shall be as fine as possible. The top line of skirting and risers shall be truly horizontal and joints truly vertical, except where otherwise indicated.The risers and skirting slab shall be matched as shown in drawings or as instructed by the Engineer-in-Charge.

11.4 Curing, Polishing and Finishing

The face shall be kept cured with water for at least seven days.

The face and top of skirting shall be polished. The stone in slabs in external and internal wall veneer work shall be mirror polished where required, in the factory with silicon carbide abrasive starting from no. "00" up to no. 5 and then using buff/lead strip rolls with tin oxide for final mirror polish. For flooring and counter top the final tin oxide polish shall not be used.

12.0 MARBLE / GRANITE STONE SLAB CLADDING

Marble / Granite tiles and slabs shall be mirror polished, eggshell polished, flame finished or given any other surface treatment as specified. All exposed edges shall be similarly treated.The Marble / Granite stone in slabs in external and internal wall veneer work shall be mirror polished where required, in the factory with silicon carbide abrasive starting from no. "00" up to no. 5 and then using buff/lead strip rolls with tin oxide for final mirror polish. For flooring and counter top the final tin oxide polish shall not be used Machine polishing and sizing shall be done with only water as lubricant. Sawing also shall be preferably done with water as lubricant but as a special case, oil or kerosene may be permitted subject to the oil or kerosene being thoroughly dried in ovens. Tiles / slabs with stains or patches due to the use of oil or otherwise shall be rejected. Any tiles / slabs showing patches or stains after installation shall also be rejected and replaced.

Tiles shall be transported to site well-packed in boxes. Slabs will be individually packed in cardboard paper. Tiles / slabs shall not be waxed or touched up with dyes / colours.

The entire supply for each type of marble / granite, unless specifically permitted by the Architect/ EIC, shall be procured from one location in one quarry to keep variations to the minimum. The Contractor shall segregate and sort the tiles / slabs according to colour, texture and size to keep variations in the same in any one floor, wall or isolated area to the minimum. The Contractor shall, before fixing the marble / granite on floors or walls, lay whole areas of marble / granite loose on ground to select and match the marble / granite. Any tiles / slabs with a variation not acceptable to Architect / PMC/ EICof shall not be used, and if used shall be removed and replaced.

Tight tolerances shall be checked and maintained throughout. Maximum variations shall be as follows:-

Sides	±	0.5 mm
Thickness	±	0.5 mm slabs
	±	0.3 mm tiles
Angularity	±	0.2 %
	±	2 mm

Linear items such as treads, skirting, sills etc. shall be of uniform thickness throughout. All visible edges shall be machine polished unless otherwise specified.

Marble / granite shall be laid or fixed to the highest standard by highly trained masons to the entire approval of Architect / PMC/EIC. Any tiles / slabs broken, stained or damaged shall be removed / replaced.

External wall cladding shall be fixed with approved stainless steel 316 grade serrated cramps and dowels. Marble / granite slabs for external cladding shall be minimum 30mm thick. The Contractor shall prepare shop drawings and get them approved by the Architect before proceeding with any work.

The Contractor shall put a mock-up of typical and non-typical panels and get it approved well before he commences fixing on site.

The Contractor shall coordinate his site activities with other contractors working on site through PMC/ EIC and shall take particular care, in coordination with the PMC/ EIC , in ensuring that his methods of fixing do not damage or endanger the building structure, finishes and services in any way.

The Contractor shall get his system of anchorage approved by the Architect/ EIC of . No reinforcement bar in concrete shall be cut through during drilling or anchorage.

The anchorage in solid concrete blockwork shall be specially designed taking into consideration the actual compactness and crushing strength of the blocks. 2 nos. pullout tests in blockwork shall be carried out prior to commencing work to prove the strength of anchorage with ample margin of safety.

Prior to commencing work, the Contractor shall obtain approval of the Architect for material and workmanship after submitting the following details:-

a. 3 representative samples for each type of marble / granite specified.
b. Physical characteristics:- Dimensional tolerances, water absorption (polished or unpolished as applicable) by weight, compression strength, Mohs hardness, unit weight.
c. Source of supply and availability in full quantity and uniformity of colour, tone and texture.
d. Company profiles of suppliers and labour sub contractor if any.
e. Procedure for fixing and samples of fixtures such as cramps, pins, dowels etc.

If required the Contractor shall arrange visits to the quarries and to the works carried out by the proposed Sub Contractor.

Marble / Granite stone slab / tiles delivered on Site, including wastage and breakage, polishing, chamfering, rounding, grooves, drip moulds and other linear works as per drawings and specifications.

Stainless steel cramps, pins and dowels as per approved shop drawings and as specified.

Backing mortar and pigmented cement grout where specified.

Labour in transporting materials on site, fixing, carefully cutting, hand polishing, and touching up where required etc.

Protecting Marble / Granite stone slab / tiles during construction until virtual completion of works.

Temporary supports, templates, straight edges etc.

Alignment and leveling in coordination with EIC / PMC and Main Contractor.

Joints with plastered and other surfaces.

Cleaning on completion.

Scaffolding and safety precautions.

Submissions of Samples.

Mock-up (total area approx. 15 sqm.)

Working to specified tolerances

Shop drawings

Pull out tests – 2 nos. – On anchors in blockwork.

Provisions for adequate anchorage.

13.0 INTERLOCKING BLOCK PAVEMENTS

13.1 Scope

Scope of work consisting of manufacturing of concrete paver blocks of required size, shape and colour, as per the specification given below and providing and fixing of interlocking paver blocks.

13.2 Dimension and Tolerances:

Concrete interlocking paver blocks shall be made in size and shall be as specified in the tender documents.

Maximum variation in dimension of interlocking paver block shall not be more than 2mm.

13.3 Materials

13.3.1 Water

The water used in the manufacture of concrete masonry units shall be free from matter harmful to concrete or reinforcement, or matter likely to cause efflorescence in the units and shall conform to the requirement of IS 456-1978 (Third Revision).

13.3.2 Additives or admixtures

Additives or admixtures may be added as admixtures to the concrete mix. Additives or admixtures used in the manufacture of concrete paver blocks may be:

Accelerating, water reducing and air entraining admixtures conforming to IS-9103 – 1979.

Fly ash conforming to IS-3812 (Part II) 1955.

Waterproofing agents conforming to IS: 2645-1975.

Colouring pigments.

Where no India Standards apply, the additives or admixtures shall be shown by test or experience, to be not detrimental to the durability of the concrete and as approved by the Engineer-In-Charge

13.4.1 Mix

The concrete mix must be prepared and approval of the Engineer-in-charge of should e taken before proceeding with actual manufacturing of the block. Before commencing the manufacturing of blocks the supplier shall submit to the Engineer for approval full details of all preliminary trial mixes and tests.

When the proportions of a concrete mix have been approved by Engineer, the contractor shall not vary the quality or source of materials or the mix without written approval of the Engineer.

In case of blocks, where compaction is done by external vibrator, concrete mix of very low consistency (Zero slump) shall be used in order to vibrate and compact the concrete under pressure.

13.4.2 Mixing

Concrete shall normally be mixed in a mechanical mixer. Mixing shall be continued until there is a uniform distribution of materials and the mass is uniform in colour and consistency.

13.4.3 Placing and Compaction

Concrete placed in the mould will be compacted by means of mechanical compaction the mould shall be filled upto overflow vibrated or mechanically tamped and struck off level.

After demoulding the blocks shall be protected until they are sufficiently hardened to permit handling without damage.

13.4.4 Curing

The block hardened as above shall then be cured in a curing water tank or in a curing yard and shall be kept moist for at least 14 days. When the blocks are cured in immersion tank, the water of the tank shall be changed at least every 4 days.

13.4.5 Drying

After curing the blocks shall be dried for a period of 4 weeks before being used on the work, they shall be stacked with voids horizontal to facilitate through passage of air, the blocks shall be allowed to complete their initial shrinkage before they are laid at site.

13.4.6 Surface Texture and Finish

The finished concrete paver blocks shall have uniform texture and finish. The colour of pigment shall be approved by the Engineer-In-Charge The colour pigment shall be non fading and shall not have any deleterious effect on concrete.

13.5 Physical Requirement

13.5.1 General

All blocks shall be sound and free of cracks or other defects which interfere with the proper placing of the blocks or impair the strength or performance.

The blocks shall be free of chips, cracks or other imperfections.

13.5.2 Dimensions

Overall dimensions of the block shall be in accordance with the specifications and the maximum tolerance in dimension will be + 2mm.

13.5.3 Block Density

The blocks density shall conform to manufacturer's specifications or approved by the Engineer-in-charge .

13.5.4 Compressive Strength

The minimum compressive strength at 28 days shall be 400 kg/cm2 for 100mm thick concrete blocks and 350 kg/cm2 for 60mm thick concrete paver blocks.

13.5.5 Water Absorption

The water absorption shall not be more than 1% of the total mass.

13.5.6 Testing & Sampling

The testing and sampling shall be carried out as specified in IS: 2185 (Part I) 1979, for concrete masonry units.

13.5.7 Manufacturer's Certificate

The manufacturer shall satisfy that the paver blocks conform to the requirement of this specification and shall produce certificate to this effect along with each consignment.

13.5.8 Independent Testing

If the Engineer-In-Charge desires to carry out independent test, same shall be carried out in accordance with the specifications by selecting random sample from any batch. The manufacturer shall supply free of charge required number of paver blocks for testing. Cost of testing shall be borne by the manufacturer.

13.6 Laying & Fixing Paver Blocks

The interlocking Concrete Paver Block is to be fixed as explained. The sub base / ground should be levelled taking into consideration the thickness of the paver block by part excavation and part filling and properly compacting using a plate compactor. Sand bed of 50mm thick should be provided underneath the paver blocks for fixing the interlocking blocks. The interlocking blocks should be placed interlocking them as per the design and shape, as directed by the Engineer-in-charge. After laying the concrete blocks, fine sand should be spread over the paver blocks. The surface should be compacted using plate compactor, so that the fine sand will get filled up in the gaps between blocks and the blocks will be interlocked.

Providing & fixing the interlocking pavement blocks in sand bedding to the required pattern and compacting, including cost of independent testing, leveling of sub base etc. Cleaning the floor.

14. TREMIX FLOORING

Scope: These specifications covers, providing & laying concrete flooring with tremix treatment by dewatering of concrete by vacuum, as detailed hereunder. The tremix treatment shall be carried out by specialized agency only. These specification shall be read in conjunction with the item No.5 Concrete Flooring, above.

14.1 General

The Contractor shall submit the plan of work going to be followed by him, well in advance (at least a week). A sketch shall be accompanied giving details of the construction joint locations, sequence of floor casting, etc. The work shall be planned and executed so that there is no delay between the placement, screeding, de-watering and floating of concrete.

14.2 Screeding:

After poring concrete in place, as detailed in 5.2 above, it shall be compacted, in wet condition, by screed vibrator run over the steel channel shuttering pressing concrete surface matched with the top of steel channel shuttering spaced not more than 4.0 meters

apart. Poker vibrators will be used to vibrate the laid concrete thoroughly with minimum 40 mm dia needles. On completion of laying of approximate 2m to 2.5m length the surface vibrator then be run over the concrete surface to achieve better over all compaction of concrete. Water cement ratio shall be just sufficient to make concrete workable. Screed shall be run at least twice to achieve well compacted & level surface.

Undulations on the concrete surface shall be rectified immediately by local patching, in wet state of concrete.

14.3 Vacuum Dewatering:

After screeding the vacuum mat be placed on this leveled concrete and the excess water from the concrete is sucked off. It should be done in accordance with the manufacturer's recommendation, paying special attention over the edges. A time of approximate 1.5 to 2.0 minutes per centimeter thickness of concrete slab is normally adopted for Vacuum treatment. As a result of which the water cement ratio shall be reduced to in the order of 0.42 to 0.43, thereby reducing the total water content in the concrete by 20 to 25%. Care should be taken at this stage to avoid curling at the ends due to excess use of vacuum mats.

14.4 Floating & Troweling:

The hardened concrete surface after vacuum dewatering shall be leveled to achieve true horizontal surface, with the help of mechanical power floater.

Final smooth finish shall be achieved by mechanical power troweling. To give the surface metallic finish Metallic Dry shake IRONITE No. 3 (non coloured) @ 3.0 kg / sqm sprinkled over green concrete in such a way that 2/3rd of the dry shake shall be broadcasted in first pass and same shall be floated with power floater, remaining 1/3rd of dry shake shall be sprinkled in the next pass to acquire a smooth finish by floating and trowelling.

The floating shall be followed by steel trowelling after the concrete has hardened sufficiently to prevent excess of fine material from working to the surface, The finish shall be brought to a smooth and even surface free from defects and blemishes and tested with straight edges. No dry cement or mixture of dry cement and sand shall be sprinkled directly on the surface of the concrete to absorb moisture or to stiffen the mix. After the concrete has been thoroughly rammed and has dried sufficiently to allow rendering to be worked up, surface shall be rendered with a thin coat of 1:1 cement mortar with fine sand and uniformly floated. If so directed by the Engineer-in-Charge, approved mineral colour pigment conforming to appendix-B of IS 657 shall be added to the cement mortar to give the required colour and shade to the flooring.

After the concrete in the bays has set, the joints of the panels shall be filled with cement cream or with suitable bitumastic compound as shown on the drawings or directed by the Engineer-in-Charge . Vertical edge of the bays shall be neatly marked on the surface of the concrete with a pointed trowel after filling the joints.

14.5 Finishing:

The top shall be polished to give an even & smooth surface. Surface shall be protected from direct sun when it is green.

14.6 Curing:

Curing shall start on the next day after finishing and shall be continued for 14 days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies shall be avoided as the colour of the flooring is likely to be bleached due to the remnants of cement dust from the bags.

15.0 GROOVE CUTTING:

The grooves shall be cut to form the panels of floor as per architectural drawings or as directed by the Engineer-in-charge . The grooves shall be cut 6mm wide & 20mm deep, with mechanical saw and shall be filled upto10 mm deep with joint sealing compound like Polysulphide or (conforming to grade B of IS:1834 or equivalent) of approved make as directed by the Engineer-in-Charge .

15.1 Expansion Joint:

The Expansion joints shall be spaced at approximately 120 sqm. area and/or as specified and shall constitute formation of 12/20/25 mm clear joint between the two concretes. This joint be formed by placing the Shalitex board in position against the old concrete leaving 12/20/25mm x 10mm deep joint at top, which shall be filled in by Polysulphide joint sealant. The 16/20mm dia. MS dowel bars shall be so placed that the half length of bar be bonded in to concrete on one side of the joint and the other half shall be prevented from bonding with concrete. In addition, a recess at its slip end shall be provided to accommodate the movement of the slab during expansion of the concrete. The unbonded portion of the dowel bar shall be covered with an expansion cap using 25mm dia. PVC pipe, 305mm long (unless otherwise specified).

15.2 Construction Joint:

The side construction joints shall be buttered against each other and later on a joint groove shall be cut as specified in 'a)' above.

16.0 STEEL REINFORCEMENT:

Reinforcement as specified shall be placed in concrete, 50mm below the top surface of concrete. This mesh shall be for individual panels, formed by side construction joint and expansion joint.

Tie bars, 600 mm long, shall be provided at construction joints using specified dia. and at specified spacing and / or as directed by EIC.

Dowel bars, 600 mm long, shall be provided at expansion joints using specified dia. and at specified spacing and / or as directed by EIC .

G. PAINTING

1.0 SCOPE

These specifications cover the use of paints for the plastered and concrete surfaces. It also includes the painting of wood and metal surfaces.

2.0 GENERAL

The provisions of the latest revisions of the following IS Codes shall form a part of this specification.

IS: 63	Whiting for Paint & putty.
IS: 75	Specification for Linseed oil, raw & refined.
IS: 159	Specification for ready mixed paint, brushing, acid resistant.

IS: 345	Specification wood filler, transparent, liquid.
IS: 426	Specification for paste filler for colour coats.
IS: 427	Specification for Distemper, dry colour, as required.
IS: 428	Specification for Distemper, Oil Emulsion, colour as required.
IS: 533	Specification for Gum spirit of Turpentine (Oil of Turpentine)
IS: 710	Marine Plywood
IS: 1200 (Part XIII)	Method of Measurement of Building & Civil Engg Works - White Washing, colour washing, distempering & other finishes.
IS: 1477 (Part 1)	Code of practice for painting of ferrous metals in buildings Pre-treatment
IS: 1477 (Part 11)	Code of practice for finishing of ferrous metals in buildings. Painting
IS: 2338 (Part 1)	Code of practice for finishing of wood and wood based materials Operations and workmanship for finishing.
IS: 2338 (Part 11) :	Code of practice for finishing of wood and wood based materials, Schedule
IS: 2395 (Part 1) :	Code of practice for painting concrete masonry and plaster surfaces. Operation & workmanship
IS: 2395 (Part 11)	Code of practice for painting concrete, masonry and plaster surfaces. Schedule.
IS: 2524 (Part 1)	Code of practice for painting of non-ferrous metal in buildings Pre-treatment
IS: 2524 (Part II)	Code of practice for painting of non-ferrous metal in buildings Painting
IS: 3140	Code of practice for painting asbestos cement buildings:
IS: 3537	Specification for ready mixed paint, finishing, interior for general purposes to IS colour.
IS: 5410	Specification for cement paints, colour as required.
IS : 6278	Code of practice for white washing & colour washing.

Other IS Codes not specifically mentioned here, but pertaining to painting form part of these specifications.

3.0 MATERIALS

Materials shall strictly conform to the relevant IS Specifications.

4.0 PAINTING PLASTERED OR CONCRETE SURFACES

4.1 General

Wherever scaffolding is necessary, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be painted. A properly secured and well tied suspended platform ("JHOOLA") may be used for painting. Where ladders are used, pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the walls and floors. For painting of ceilings, proper stage scaffolding shall be erected, where necessary.

4.2 Preparation of surfaces:

The surface shall be thoroughly cleaned off all dirt, dust, mortar dropping and other foreign matter, before paint is to be applied. New plaster surfaces and wet patches shall be allowed to sufficiently dry, before applying paint. All unnecessary nails shall be removed. Pitting in plaster shall be made good with putty. The surface shall then be rubbed down again with a fine grade sand paper and made smooth.

The surface shall be allowed to dry thoroughly before the regular coat of paint is allowed.

The surface affected by moulds moss, fungi, algaelicnens, efflorescence shall be treated in accordance with IS 2395 (Part 1) before applying paint.

5.0 OIL-BOUND DISTEMPER

5.1 Preparation of Surfaces:

Any unevenness shall be made good by applying putty, made of plaster of Paris mixed with water on the entire surface including filling up the undulation and then sand papering the same after it is dry.

5.2 Primer Coat

The primer where used as on undercoated surfaces shall be alkali resistance primer or distemper primer as specified in the item. These shall be of the same manufacture as of oil bound distemper. If the wall surface plaster has not dried completely alkali resistance primer shall be applied before distempering the walls. But if the distempering is done after the wall surface is dried completely, distemper primer shall be applied.

5.3 Application

Primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished uniformly leaving no brush marks. It shall be allowed to dry for at least 48 hours, before application of oil bound distemper or any other paint.

5.4 Preparation of oil bound distemper:

The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for days work shall be prepared.

5.5 Application of distemper coat:

After the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. Minimum two coats of distemper shall be applied with brushes in horizontal strokes followed to immediately by vertical which together shall constitute one coat. The subsequent coats shall be applied after a time interval of at least 24 hours between consecutive coats to permit the proper drying of the preceding coat.

The finished surface shall be even and uniform without patches, brush marks, distemper, drops, etc.

Sufficient quantity of distemper shall be mixed to finish one room at a time. The application of a coat in each room shall be finished in one operation and no work shall be started in any room, which cannot be completed the same day.

15 cm double bristled distemper brushes shall be used. After each days work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes, which are dirty and caked with distemper, shall not be used on the work.

6.0 WATER PROOF CEMENT PAINT

6.1 Preparation of Surfaces

The surfaces shall be thoroughly wetted with clean water before the water proof cement paint is applied.

6.2 Preparation of Paint

Portland cement paints are made readily by adding paint powder to water and stirring to obtain a thick paste which shall then be diluted to a brushable consistency. Generally equal volumes of paint powder and water make a satisfactory paint. In all cases the manufacturer's instructions shall be followed. The paint shall be mixed in such quantities as can be used up within an hour of mixing as otherwise the mixture will set and thicken, affecting flow and finish.

The lids of cement paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hydroscopic qualities.

6.3 Application of Paint

No painting shall be done when the paint is likely to be exposed to a temperature of below 7˚C within 48 hours after application.

When weather conditions are such as to cause the paint to dry rapidly, work shall be carried out in the shed as far as possible. This helps the proper hardening of the paint film by keeping the surface moist for a longer period.

To maintain a uniform mixture and to prevent segregation the paint shall be stirred frequently in the bucket. For undecorated surfaces, the surface shall be treated with minimum two coats of water-proof cement paint. Not less than 24 hours shall be allowed between two coats and the second or subsequent coat shall not be started until the preceding coat has become sufficiently hard to resist marking by the brush being used. In hot dry weather the preceding coat shall be slightly moistened before applying the subsequent coat.

The finished surface shall be even and uniform in shade without patches, brush marks, paint drops, etc.

Cement paints shall be applied with a brush with relatively short stiff hog or fibre bristles. The paint shall be brushed in uniform thickness and shall be free of excessively heavy brush marks. The laps shall be well brushed out.

6.4 Curing

Painted surfaces shall be sprinkled with water two or three times a day. This shall be done between coats and for at least three days following the final coat. The curing shall be started as soon as the paint has hardened so as not to be damaged by the sprinkling of water say about 12 hours after its application.

6.5 Rate

The rate shall include the cost of all labour, materials, equipments, scaffolding necessary in all the above operations (including priming coat) as described above.

7.0 PAINTING WOOD AND METAL SURFACES

7.1 General Requirement

The materials required for the execution of painting work shall be obtained directly from approved manufacturers and brought to the site in maker's drums, with seals unbroken. All paints shall conform to relevant Indian Standards as mentioned under sub-head "Material".

All materials not in actual use shall be kept properly protected. Lids of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. Materials which have become stale or fat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in the smaller container. No left over paint shall be put back into stock tins. When not in use, the containers shall be kept properly closed.

If for any reason thinning is necessary, in case of ready mixed paint, the brand of thinner recommended by manufacturer shall be used.

Painting except the priming coat shall generally be taken in hand after all other construction work is practically finished. The rooms shall be thoroughly swept out and the entire building cleaned up at least one day in advance of the paint work being started. The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt scales, smoke and grease shall be thoroughly removed before painting is started.

No painting on exterior or other exposed parts of the work shall be carried out in wet, humid or otherwise unfavourable weather and all the surfaces must be thoroughly dry before painting work is started.

7.2 Brushing of Paint

The brushing operations are to be adjusted to the spreading capacity advised by the manufacturers of the particular paint. The painting shall be applied evenly and smoothly by means of crossing and laying off, the later in the direction of the grain of wood. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternatively in the 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.

During painting, every time after the paint has been worked out of the brush bristles or after the brush has been unloaded, the bristles of the brush, (which are drawn together due to the high surface tension) shall be opened up by striking the brush against a portion of the unpainted surface with the end of the bristles held at right angles to the surface, so that bristles thereafter will collect the correct amount of paint when dipped again into the paint container.

7.3 Spraying

Where so stipulated, the painting shall be done with spray. Spray machine used may be (a) high pressure (small air aperture) type or (b) a low pressure (large air gap) type, depending on the nature and location of work to be carried out. 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 should be done only when dry conditions prevail. During spraying the spray gun shall be held perpendicular to the surface to be coated and shall be passed over the surface in a uniform sweeping motion. Different air pressures and fan adjustment shall be tried so as to obtain the best application with the minimum wastage of paint. The air pressure shall not be kept too high as otherwise the paint will clog up and will be wasted.

Spots that are inaccessible to the spray pattern shall be touched up by brush after spraying.

At the end of the job, the spray-gun shall be cleaned thoroughly so as to be free from dirt. Incorrect adjustments shall be set right, as otherwise they will result in variable spray patterns, runs, sags and uneven coats.

Each coat shall be allowed to dry completely and lightly rubbed with very fine grade of sand paper and loose particles brushed off before next coat is applied. Each coat shall vary slightly in shade and shall be got approved 'from the Engineer-in-charge of before next coat is started.

Each coat except the last coat shall be lightly rubbed down with sand paper or fine pumice stone and cleaned off dust before the next coat is applied.

No hair marks from the brush or clogging of paint puddles in the corner panels, angles of moulding, etc. shall be left on the works. In painting doors and windows, the putty round the glass panes shall also be painted but care shall be taken to see that no paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out in painting.

In painting steel work, special care shall be taken while painting over bolts, nuts, rivets, overlaps etc.

The additional specifications for primer and other coats of paints shall be according to the detailed specifications under the respective headings.

7.4 Brushes and containers

After work, the brushes shall be completely cleaned off paint and linseed oil by rinsing with turpentine. After cleaning, the brushes are wrapped in heavy paper or water proof paper for storage. It is to be used the next day it shall be hung in a thinner or linseed oil in a container. On no account shall brushes to be made to stand on bristles. A brush in which paint has dried up is ruined and shall on no account be used for painting work.

The containers, when not in use, shall be kept closed and free from air so that paint does not thicken and also shall be kept guarded from dust. When the paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth, before they can be used again.

7.5 Wood and wood Based Materials

7.5.1 Preparation of Surface

All wood works shall be dry and free from any foreign matter, incidental to building operation. Nails shall be punched well below the surface to provide a firm key for stopping. Moulding shall be carefully smoothened with abrasive paper and projecting fibres shall be removed. Flat portions shall be smoothened off with abrasive paper used across the grain prior to painting. Any knots, resinous, streaks or bluish sap wood that are large not enough to justify cutting out shall be treated with two coats of pure shellac knotting, applied thinly and extended about 25 mm beyond the actual area requiring treatment.

7.5.2 Plywood and Block Board: This shall be treated as for solid wood, described above.

7.5.3 Hard Boards The surface shall be dusted off and painted with a coat of plastic emulsion paint thinned with water or with a coat of shellac varnish as specified. The surface shall then be rubbed down with fine grade abrasive paper and followed with required under coating and finishing coat as for solid wood.

7.5.4 Particle Board: The surface shall be filled with thin brushable filler and finished as for solid wood.

7.5.5 Insulation Boards: Two thin coats of water based paints shall be applied by spraying.

7.6 Priming Coat: The dirt or any other extraneous material shall be removed from the surface to be painted. In case he surface is already finished with printer coat but unsatisfactory, it shall be rubbed down to bare wood and surface reprimed. Primer shall be applied by brushing.

7.7 Application for transparent wood filler: The filler shall be applied with brush or rag in such a way that it fills up all the pores and indentations and levels up the surface. It shall be allowed to dry for 24 hours and it shall then be cut and rubbed with emery paper so that the surface of the wood is laid bare, with, the filler only in the pores and crevices of the wood.

7.8 Stopping: All holes, cracks, crevices, etc. shall be stopped carefully to true and level surface with putty before the main undercoat is applied and after the application of the priming coat, stopping shall be prepared as below:

Bees wax, resin and lac (orange in colour) in the proportion of 1: 1: 16 by weight shall be melted down together in a suitable pot using slow heat, the mix being kept well stirred. Colouring materials to produce the required shade shall be added into molten mixture and stirred. Stopping shall on cooling be rolled into stick forms for use.

7.9 Application of Paints: This shall conform to specifications under Para 7.1

7.10 Applying wood preservatives:

The preservatives of specified quality shall be applied in two coats. On new wood work, it shall be applied liberally with a stout brush and not doubled with rags or cotton waste, The first coat shall be allowed at least 24 hours to soak in before the second coat is applied. The excess of preservative which does not soak into the wood shall be wiped off with a clean dry piece of cloth.

8.0 WHITE WASHING

8.1 General

The item refers to white-washing over old and new concrete, stone masonry brick plastered surfaces and asbestos cement sheets.

White wash shall be prepared from fresh burnt white stone lime or shell lime. This lime shall be of class C type as per IS: 712. Surkhi lime or lime of equivalent quality may be used. The lime shall be dissolved in a tub with sufficient quality of water (about 4.5 litres/Kg. of lime) and the whole shall be thoroughly mixed and stirred until it attains the consistency of thin cream. The white wash shall be taken out in small quantities and strained through a clear course cloth. Alternatively whiting for paints and putty as per IS: 63 may also be used. Clean gum dissolved in hot water shall then be added in suitable proportion of 2 gm of gum Arabic to a litre of lime or whiting to prevent the white- wash coming off easily when rubbed. Rice may be used instead of gum.

8.2 Scaffolding

This may be double or single according to requirements. If ladders are used, pieces of old gunny bags or cloth rags shall be tied on their tops to avoid damage or scratches to the wall. Proper stage scaffolding shall be created when white-washing ceiling. The contractor shall be responsible for accidents if any taken place.

8.3 Preparation of Surface

The surface shall be prepared by removing all mortar dropping and foreign matter and thoroughly cleaned with wire or fibre brush or other means as may be ordered by the Engineer to produce an approved clean and even surface. All loose pieces and the scales shall be scraped off and holes stopped with mortar. In case where the surface have been previously coloured-washed, the old colour wash must be entirely removed before the white-wash is applied. In the case of surface which have once been white-washed, the old loose white-wash shall be broomed down. In case, the loose white-wash cannot be removed by brooming, the Engineer of may order scraping of the surface.

After cleaning the surface as specified above, the unwanted nails shall be removed and all nail holes, cracks and crevices stopped with mortar similar in composition to the surface to be stopped. The mortar should be cured.

8.4 Application of white-wash

On the surface so prepared, the white-wash shall be laid. Each coat shall be laid on with a brush. The first stroke of the brush shall be from the top downwards, another from bottom upwards over the first stroke, and similarly, one stroke from the right and another from the left over the first brush before it dries. This will form one coat. Each coat must be allowed to dry and shall be subject to inspection before the next coat is applied. When dry, the surface shall show no signs of cracking. It shall present a smooth and uniform finish free from brush marks and it should not come off easily when rubbed with a finger.

No portion in the surface shall be left out initially, to be patched up later on.

For new work, the white washed surface shall present a smooth and uniform finish.

For old work, patches and repairs shall be white washed first. Thereafter, the whole surface shall be white washed with the required number of coats.

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

Preparing the surface for white wash including the scaffolding.

Applying the white wash in required number of coats as specified above and prior white washing of repaired patched.

9.0 PLASTIC EMULSION PAINTING ON WALL & CEILING

9.1 General

Plastic emulsion paints are not suitable for application on external wood and iron surfaces and surfaces which are liable to heavy condensation and are to be used generally on masonry or plastered surfaces. Suitable primer as per manufacturer shall be provided.

9.2 Paint

Plastic emulsion paint of approved brand and manufacture and of the required shade shall be used.

9.3 Preparation of Surface

The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulation and then sand papering the same after it is dry.

9.4 Application: The number of coats shall be as stipulated in the item. The paint will be applied in the usual manner with brush or roller.

The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine.

Thinning with water will be particularly required for the undercoat which is applied on the absorbent surface. The quantity of thinner to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

9.5 Precautions

Old brushes if they are to be used with emulsion paints, should be completely dried of turpentine or oil paints by washing in warm soap water.

Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.

In the preparation of walls for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.

Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

Washing of surfaces treated with emulsion paints shall not be done within 3 to 4 weeks of application.

9.6 Other Details: These shall be as per specification for "Painting" as far as they are applicable.

10.0 SYNTHETIC PLASTERING IN PLAIN / STONE OR METALLIC FINISH

10.1 General

Synthetic plaster reinforced by using fibres and shall be based on chemicals having acid and alkally resistant properties. It can be applied to any hard, plain surface both internally and externally. It does not require any further application or treatment once it is applied on the surface.

Synthetic Plaster is available in ready-mixed form in any desired colour and can be applied by using a trowel. The synthetic plaster avoids cracks formation as well as it provides a waterproofing coating on the surface treated.

10.2 Base Coat

An average 20mm thick cement plaster shall be provided as rendering coat which shall be roughened lightly with wire brush so as to form very mild keys on the rendered surface.

The surface shall be allowed for curing for a period of minimum 14 days before the application of synthetic plaster.

10.3 Applications

Synthetic plaster is applied in three coats:

One coat of plaster by trowel and ; Subsequent two coats of chemical overcoat by brush in approved colour and finished as specified (plain/stone or metallic).

10.5 Other Details

The synthetic plaster treatment shall be executed through an approved agency and written performance guarantee shall be submitted by the Contractor for a minimum period of Ten years through the agency. The contractor and the agency shall be jointly responsible for the performance of the treated surface until the expiry of the guarantee period.

11.0 ACRYLIC PAINTING TO EXTERNAL SURFACES

Acrylic weather shield paint of approved brand shall be applied over plastered surfaces as directed by the Engineer.

Other specifications including preparation of surfaces, application of paint etc. shall conform to section 6.3 above and as directed by Engineer-In-Charge . The priming coat, anti-fungal treatment, preparation of paint etc. shall be carried out as per manufacturer's specification / as directed by Engineer-In-Charge .

WAX POLISHING

Wax polish shall either be prepared on site or obtained ready made from market. Polish made on the site shall be prepared from a mixture of pure bees wax, linseed oil, turpentine oil and varnish in the ratio of 2:1 1/2:1 1/2 by weight. The bees wax and the boiled linseed oil shall be heated over a slow fire when the wax is completely dissolved the mixture shall be cooled till it is just warm, and turpentine oil and varnish added to it in the required proportions and the entire mixture is well stirred.

Surface shall be prepared as described under French spirit Polish except that the final rubbing shall be done with sand paper which has been slightly moistured with linseed oil. Mixture of polish shall be applied evenly with a clean cloth pad in such a way that no blank patches are left and rubbed continuously for half an hour. When the surface is quite dry a second coat shall be applied in the same manner, and rubbed continuously for half an hour or until the surface is dry. Final coat shall then be applied and rubbed for 2 hours or more if necessary, until the surface has assumed an uniform Gloss and is quite dry showing no sign of stickiness when touched. Gloss of the polish depends on the amount of rubbing, therefore rubbing must be continuous and with uniform pressure and frequent change in direction.

VARNISHING

Surface shall be prepared as described above. After preparation of surface, two coats of clean boiled linseed oil shall be applied at sufficient interval of time. After the linseed oil has dried two coats of varnish obtained from approved manufacturer shall be applied at sufficient interval of time. If the surface fails to produce the required gloss an additional coat shall be applied without any extra cost.

OIL EMULSION (OIL BOUND) DISTEMPERING

MATERIALS

Oil bound distemper of approved brand and manufacture conforming to latest edition of IS:428 shall be used. The primer shall be cement primer or distemper primer of same brand and manufacturer preferably. Distemper shall be diluted with water or any other prescribed thinner as per manufacturer's instruction. Distemper is to be prepared for the quantity which can be consumed for the day's work.

PREPARATION OF SURFACE

The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulation and then sand papering the same after it is dry.

Pitting in plaster shall be made good with plaster of paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

Application

The priming coat shall be with distemper primer or cement primer, as required.

Distemper Coat

After the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off rubbing. One coat of distemper properly diluted with thinner (water or other liquid as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed immediately by vertical ones which together constitute one coat.

The subsequent coats shall be applied in the same way. Two or more coats of distemper as are found necessary shall be applied over the primer coat to obtain an even shade.

A time interval of at least 24 hours shall be allowed between consecutive coats to permit of the proper drying of the preceding coat.

15 cm double bristled distemper brushes shall be used. After each days work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

The specifications in respect of scaffolding, protective measures, measurements etc shall be as described under dry distempering.

PAINTING OIL/ENAMEL/ACRYLIC EMULSION ETC

Ready mixed oil paint, acrylic emulsion paint, ready mixed synthetic enamel paint, Aluminium paint, etc shall be brought in original containers and in sealed tins. If for any reason thinner is necessary the brand and quantity of thinner recommended by the manufacturer or as instructed by the Employer/Architects shall be used.

The surface shall be prepared as specified above and a coat of approved primer shall be applied. After 24 hours drying, approved of specified quality paint shall be applied evenly and smoothly . If required a filler putty coating may be given to give smooth finish. Each coat shall be allowed to dry cut thoroughly and then lightly rubbed down with sand paper and cleaned of dust before, the next coat is applied. Number of coats shall be as specified in the item and if however the finish of the surface is not uniform additional coats as required shall be applied to get good and uniform finish at no extra cost. After completion no hair marks from the brush or clogging of paint puddles in the corners of panel angles of mouldings shall be left on the work. The glass panes floor etc., shall be cleaned of stains.

When the final coat is applied, if directed, the surface shall be rolled with a roller or if directed it shall be supplied with a stippling brush.

MELAMINE FINISHIES

Apcolite Natural Wood finish clear glossy is a premium quality melaminised coating specially formulated as a protective and decorative finishing clear coating for wood.

TECHNICAL DATA

Method of Application:		Brushing at 25.30 seconds by Ford Cup B4 at 30 Degree C
	:	Spraying at 20.25 seconds by Ford Cup at 30 degree C
Thinner recommended	:	Brushing - Thinner 106
		Spraying - Thinner 124
Thinner intake	:	20.25% by volume
Mixing ratio	:	Base to hardener in 10.1 by volume
Drying Time	:	8 hours
		Surface dry - less than 30 minutes Hard dry 16.20 hours
		Recoating period - Overnight.
Finish	:	25 microns film thickness smooth glossy
Flash point	:	Above 14 degree C (57 degree F)

Sand the surface along the grains with Emery paper No.180 or with a suitable grade sand paper. Brush the surface free of loose dust. Fill the wood using Apcolite Wood Filler. Remove excess filler immediately after applications. Allow 2.3 hours of drying, before sanding with Emery Paper No.240 or 280. If desired, apply Apcolite Natural Wood Finish upto 20% by volume and apply by spraying after Sealer Coat. In application by ragging allow a drying time of 5.10 minutes in between coats and 30.60 minutes before overcoating with finish coats. Apply a coat of Apcolite Natural Wood Finish Clear Sealer, After overnight drying, smooth sand with Emery Paper No.320 and wipe the surface free of loose dust. Apply Apcolite Natural Wood Finish Clear Glossy as follows. Ensure that the surface to be coated is free from loose matter.

Apcolite Natural Wood Finish Clear Glossy is a two component system consisting of base and hardener. These should be mixed in the recommended ratio. The two components should be mixed in a glass, plastic or enamelled container. Allow the mixture to stand for 30 minutes and then apply by brushing or spraying using the recommended thinner for consistency adjustment. The mixture of base and hardener should be used within 8 hours. To enhance gloss and decorative value Apcolite Natural Wood Finish Clear Glossy can be buffed using suitable buffing mops but only after 48 hours of application.

MATT

Apcolite Natural Wood finish clear glossy or approved equivalent is a premium quality melaminised coating specially formulated as a protective and decorative finishing clear coating for wood.

TECHNICAL DATA

Method of Application	:	Brushing at 25.30 seconds by Ford Cup B4 at 30 Degree C
	:	Spraying at 20.25 seconds by Ford Cup at 30 degree C
Thinner recommended	:	Brushing - Thinner 106
		Spraying - Thinner 124

Thinner intake	:	20.25% by volume
Mixing ratio	:	Base to hardener in 10.1 by volume
Drying Time	:	8 hours
		Surface dry - less than 30 minutes Hard dry 16.20 hours
		Recoating period - Overnight.
Finish	:	25 microns film thickness smooth glossy
Flash point	:	Above 14 degree C (57 degree F)

Sand the surface along the grains with Emery paper No.180 or with a suitable grade sand paper. Brush the surface free of loose dust. Fill the wood using Apcolite Wood Filler or approved equivalent. Remove excess filler immediately after applications. Allow 2.3 hours of drying, before sanding with Emery Paper No.240 or 280. If desired, apply Apcolite Natural Wood Finish or approved equivalent upto 20% by volume and apply by spraying after Sealer Coat. In application by ragging allow a drying time of 5.10 minutes in between coats and 30.60 minutes before over-coating with finish coats. Apply a coat of Apcolite Natural Wood Finish Clear Sealer or approved equivalent. After overnight drying, smooth sand with Emery Paper No.320 and wipe the surface free of loose dust. Apply Apcolite Natural Wood Finish Clear Glossy or approved equivalent as follows. Ensure that the surface to be coated is free from loose mater. Apcolite Natural Wood Finish Clear Glossy is a two component system consisting of base and hardener. These should be mixed in the recommended ratio. The two components should be mixed in a glass, plastic or enamelled container. Allow the mixture to stand for 30 minutes and then apply by brushing or spraying using the recommended thinner for consistency adjustment. The mixture of base and hardener should be used within 8 hours.

H. STEEL DOORS

STEEL DOORS & WINDOWS

1.0 APPLICABLE CODES

The provisions of the largest Indian Standards mentioned below shall form a part of these specifications:

IS: 1956	Glossary of terms relating to iron and steel.
IS:814 (Part I)	Specifications for covered electrodes for metal arc welding of structural steel.
IS:814 (Part II)	1) For welding products other than sheets. Specifications for covered electrodes for metal arc welding of structural steel. 2) For welding sheets
IS: 815	Classification and coding of covered electrodes for metal arc welding of structural steel.
IS: 816	Code of practice for use of metal arc welding for general construction in mild steel.
IS: 817	Training of Welders- Code of practice: Part 1 manual metal arc welding
IS: 818	Code of practice for safety and health requirements in electric and gas welding and cutting operations.
IS: 1948	Aluminium doors, windows & ventilators.
IS:1977	Low tensile structural steels – Specifications.

IS: 6227	Code of Practice for use of metal arc welding in tubular structure.
IS: 6248	Specifications for metal rolling shutters and rolling grill.
IS: 1081	Code of Practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
IS: 2062	Weldable Structural Steel.
IS: 1361	Specifications for steel windows for Industrial Buildings.
IS:1200 (Part VIII)	Measurements for steel work and iron work.
IS.1038	Specifications for steel doors, windows and ventilators.
IS: 226	Specifications for structural steel (Standard quality).
IS: 823	Code of procedure for manual metal arc welding of metal steel.
IS: 102	Ready mixed paint, brushing, red lead non sitting, priming.
IS: 1363	For black hexagon bolts, nut and lock nuts (dia 6 to 39 mm) and black hexagon screws (dia 6 to 24 mm).
IS: 813	Scheme of symbols for welding.

Other IS Codes not specifically mentioned here but pertaining to Metal Doors, Windows & Ventilators form part of these specifications.

2.0 MATERIALS

2.1 Structural Steel

Standard quality mild steel of various varieties and designations shall be used for different works as mentioned below:

(i) St 42 - S:

This variety of steel (standard quality) shall conform to specifications given in IS: 2062 (latest) and shall be used for

Riveted steel work

Bolted steel work

Steel work where welding is employed for fabrication provided that the thickness of material does not exceed 20 mm. When material conforming to this standard is over 20 mm thick special precautions may be required in case the material is to be welded (see IS: 823 - latest).

(ii) St 30 - 0:

This variety of steel (ordinary quality) shall conform to specifications given in IS: 1977 and is intended for general purposes such as door and window frames, window bars, grills, steel gates, hand railing , builder's hardware, fencing post, tie bars, etc. All finished steel material shall be properly and neatly rolled to dimensions, sections and weights as specified. The finished material shall be free from visible as well as hidden defects and excessive rusting. The ends of the tubes shall be cut square, unless otherwise specified.

Steel sections and tubes shall be well protected and kept free from excessive rust and scaling. In this regard, decision of Engineer-in-charge shall be final and binding on the contractor.

2.1.1 Black Bolts

Also known as machine bolts, these bolts shall be made from rods and they come from the rolling mills and are not finished to exact size. A lower working stress is taken for these types of bolts than those of rivets and 'turned fitted bolts'.

2.1.2 Welding Equipment:

The welding plant and equipment shall be of modern design and shall be got approved by the Engineer-in-charge.

The electrodes required for metal arc welding shall be 'covered electrodes' and shall conform to IS: 814 (Part I) for welding products other than sheets and IS: 814 (Part II) for welding sheets.

The type of covering shall be as per IS: 815 for classification and coding of covered electrodes for metal are welding of structural sheets.

2.2 Workmanship

2.2.1 Structural Steel Work

The steel sections as specified or required shall be cut, square and to correct lengths, as per drawing 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 a member, except as indicated in the drawings or directed by the Engineer-in-charge . 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.

All holes shall be generally drilled to the required size and at the required position. Sub-punching shall be permitted, provided it is done 3 mm less in diameter and reamed thereafter to the required size.

Holes for rivets and black bolts shall be larger by 0.4 to 0.6 mm than the nominal diameter of the rivets and black-bolts depending upon the dia of rivets.

Holes for counter-sunk bolts shall be made in such a manner that their heads fit flush with the surface after fixing.

All bolt heads and nuts shall be hexagonal and of equal size, unless specified otherwise. The screwed threads shall conform to IS: 1363 and the threaded surface shall not be tapered. The bolts shall be of such length as to project two clear threads beyond the nuts when fixed in position and these shall fit in the bolts without any shake. The nuts shall fit in the threaded ends of bolts properly. Tapered washers shall be provided for all heads and nuts bearing and levelled surfaces. The threaded portion of the bolt shall not be within the thickness of the parts bolted together. The faces of bolt heads and nuts shutting against steel members shall be machine finished.

Welding shall generally be done by electric process. The electric arc method being economical is usually adopted. Where public electricity is not available a suitable generator shall be arranged. Gas welding shall be resorted to using oxyacetylene flame with specific prior approval of the Engineer-in-charge .

Types of welding: Welds used for joining structural members are generally of the following two types as under:

(i) Fillet weld: The cross section of fillet weld is triangular and it is used to joint two surfaces normally at right angles to each other. This type of weld is used more frequently in structural connections than any other type, and is usually in the form of isosceles triangle. The fillet welds shall be continuous or intermittent as specified in the design.

(ii) Butt welds: These are classified according to the method of grooving or preparing of the base metal. The metal pieces shall be filled or obisolled chiseled to the required shape for butt welding at the throat for which no extra payment shall be made.

Fillet and Butt welds shall conform to IS: 816. Special type of welds as slot-welds shall be used where so specified. Either direct or alternating current (but not both types) may be used throughout the whole work. An ammeter shall be provided to each arc and so situated that the Engineer-in-charge can easily check the current being used by the operator.

Each welder shall be supplied with a portable current regulator to enable him to adjust the welding current within the approved limits without leaving his work. Only qualified operators shall be employed for welding and they shall have been trained and shall be tested after every three months as per provisions of IS: 817 for "Code of Practice for training and testing of Metal Arc Welders".

In welded structure holes are necessary for service bolts required during erection. These holes shall be made as specified above. The holes in the various sections shall be filled with punches and welded properly to form a composite section.

Surfaces which are to be welded together shall be free from loose mill-scale, rust, paint, grease or other foreign matter. A coating of boiled linseed oil shall be permitted.

Before welding is commenced, the plates shall first be brought together and firmly clamped or spot welded at specified distance. This temporary connection has to be strong enough to hold the parts accurately in place without displacement.

All operators connected with welding and cutting equipment conform to the safety requirement given in IS 818 for "Safety and Health Requirements in Electric and Gas Welding and Cutting Operations".

The following points shall be borne in mind during the process of welding:

(a) Welds shall be made in the flat position, wherever applicable.

(b) Arc length, voltage and amperage shall be suited to the thickness of material, type of groove and other circumstances of the work.

(c) The sequence of welding shall be such that where possible the members which offer the least resistance to compression are welded first.

Processor Welding

The electrode manipulation during welding shall be such as to ensure that:-

(i) The base metal is in a fused state when the filler metal makes contact with it.

(ii) The filler metal does not overflow upon any unfused based metal.

(iii) The base metal is not under-cut along the weld edges.

(iv) The flowing metal floats the slags, the oxides, and the gas bubbles to the surface behind the advancing pool.

In case any of these requirements is unattainable by manipulation, the current shall be adjusted or the electrode size changed. Each time the arc is started, the electrode shall be moved in such a way that the fusion of base metal at the starting point is assured. At the completion of a run the movement of electrode shall be slowed down to fill the arc crater.

After every interruption of the arc except at completion of a run the arc shall be restarted ahead of the previous deposit and then moved back to fill the crater, or such alternative technique shall be used as will ensure complete filling of the crater or complete fusion between the new and old deposits and the base metal at the point of junction and result in continuity of weld. Before welding operation is completed, all traces of slag shall be removed from the deposit, by chipping if necessary and the deposited and adjoining base metal shall be wire brushed and cleaned at all points. The requirements shall apply not only to successive layers but also to successive beats, and to the overlapping area whatever a junction is made on starting a new electrode:

(v) The welds shall be free from cracks, discontinuity in welding and other defects such as :-

(a) under size

(b) over size

(c) undercutting

(d) over cutting

All defective welds which shall be considered harmful to the structural strength shall be cut out and re-welded.

Finished welds and adjacent parts shall be protected with clean boiled linseed oil and after all slag has been removed, welds and adjacent parts shall be painted after the same are approved by the Engineer-in-charge .

Inspection and testing of welds:

The method of inspection and testing shall be as under:

(a) Visual Inspection: The following factors shall be considered during the visual inspection:

(i) Dimensions of weld deposit. The size of the weld shall be as specified and it may be slightly over but not under.

(ii) Shape of profile: The profile of the weld is affected by the position of the joint, but it shall be uniform. In the case of butt and corner welds, the profile shall be slightly convex and in the case fillet welds it shall be usually slightly concave.

(iii) Uniformity of Surface: The height and spacing of the ripple shall be uniform; these being indicative of workmanship.

(iv) Degree of undercut: Undercutting is undesirable. The weld joint shall be free from undercut but slight intermittent occurrences may be disregarded.

(v) Smoothness of joints: The joints in the weld run where welding has been adopted, shall be as uniform and smooth as possible and shall show no pronounced bump or crater in the weld surface.

(vi) Freedom from surface defects. The surface of the weld shall be free from porosity, cavities and burnt on scale.

(vii) Penetration bead in Butt Welds: A slight penetration bead shall be present and it should be reasonably uniform in width and appearance. Intermittent occurrences of lack of penetration bead may be disregarded.

(viii) Degree of fusion: Fusion shall be complete over the whole area of the joint surface.

(ix) Degree of Root Penetration: These defects are most likely to occur at the root of the weld and in this position they are liable to have the maximum effects in reducing the strength of the weld. A close examination of the root shall, therefore, be made. In butt-welds, the penetration should extend to the underside of the plates producing a penetration bead of the right size. In fillet welds with good root penetration, the weld metal should reach the corner.

Note: 1: In case of fusion welding or non-fusion welding fillet welds will appear in joint, (fillets being at the cretches).

Note: 2: In case of non-fusion welding of cast iron the points shall show satisfactory penetration and adhesion.

(x) Gas Cavities and Flux Entrapments: Unless they are caused by the use of unsuitable material, they are attributable to the quality of workmanship, the desired result being to achieve uniform appearance and freedom from cavities and flux entrapments (where flux is used). In fusion welding of mild steel, cast iron and aluminium where neutral flame is used, and in fusion welding of brass or braze welding of cast iron where oxidizing flame is used, current welding technique may result in rough, porous, discolored and lusterless appearance in the fracture.

Note

(a) In case of fusion welding or non-fusion welding of cast iron isolated blow holes or concentration of pinholes in the weld metal shall be regarded as grounds for rejection but isolated pinholes shall not be so regarded.

(b) Bending Testing (for ductility): The elongation shall be not less than 30 percent for stress relieved welds and not less than 25 percent for non-stress relieved welds.

(c) Tensile Testing: (Reduced Section Tensile Testing): The tensile strength shall be not less than minimum of the specified tensile range of the parent metal.

Radiographic Examination: This shall be done as given in IS: 4853.

3.0 ROLLING SHUTTERS WITH / WITHOUT M. S. GRILL WORK

Rolling shutters shall be motorized gate having motorized operational facility, obtained from manufacturers such as Standard quality and approved make. Shutters up to 12 Sqm. shall be push and pull type.

Shutters exceeding 12 sq.m shall be provided with gears operated by mechanical devices with chain and / or handle or shall have electrically operated arrangement as specified.

Rolling shutters of 8 Sqm or beyond shall be provided with ball bearings. The width and thickness of M.S. lath shall be 80mm and 1.25 mm.

The shutters shall be of length and width as specified. The spring shall be preferably of coiled type and shall be manufactured from high tensile spring steel wire or strip of

adequate strength to balance the shutters in all positions. The spring pipe shaft etc. shall be supported on strong mild steel brackets.

Guide channels shall be of mild steel deep channel section and of rolled, pressed or built-up construction. The thickness of sheet shall not be less than 3.175mm (10 gauge). The depth of side channels shall be 60mm for clear shutter with width upto 3.0 m and 75mm for width 3.0m and above. The gap between two legs of guide channel shall be close enough to prevent rattling due to wind and wide enough for free movement of shutters.

Guide channels, each shall have 3 fixing cleats spaced at not more than 0.75m. Cleats shall be fixed to walls or RCC work with bolts or screws.

The guide channels shall be fixed to the jambs either (a) embedded in grooves (b) projecting or (c) overlapping, as directed by the Engineer-in-Charge.

Any cutting to side walls shall be made good after fixing of cleats/lugs.

The cover of shaft etc. shall be of the same gauge materials as laths. M. S. Grill work shall be manufactured with grill made out of 8mm dia. M.S. Rounds bent to required shape and connected by means of flat iron 20mm x 6mm as shown on the drawings and fixed in the rolling shutter.

4.0 M.S. WICKET GATE IN ROLLING SHUTTERS

These shall be manufactured with M.S. members of sheet of sizes and as per the details shown on the drawings and fixing in position all fittings required such as hinges, locking arrangements, etc. shall be provided. Painting shall be carried out as per the parent rolling shutters.

5.0 M.S. LADDERS

M.S ladders shall be fabricated out of M.S. rounds, squares, flats etc. as described, as per the drawing or as directed. The work shall include cutting to required sizes, welding, fixing in position, bending and curving the flat iron stringer at top to form handles, embedding the bottom of ladders, providing and casting cement concrete at top and bottom in 1:2:4 (nominal mix) (1 cement: 2 sand: 4 stone aggregate 20mm nominal size) of 60 mm x 30 mm x 150 mm. All the work shall receive one coat of red oxide zinc chromate primer and two coats of synthetic enamel paint of approved make, quality, colour and shade.The width of the ladder shall be 450 mm in between stringers made out of 50mm x 6mm flats as specified and 16mm dia.

M.S. round at maximum 30 cm centres, notched and welded to stringer flats. The ladder shall be fixed at top with welding or with nuts and bolts as required.

6.0 S.S. RAILING

Fabricating stainless steel pipe railing for terraces/ staircase and other areas, up to 1000mm high from finished floor level made out of stainless steel pipe balusters welded to stainless steel pipe top rail and stainless steel pipe intermediate rails (stainless steel pipe shall not be less than 1.5mm thick) including profile cutting, fixing in position, necessary anchor fasteners / approved fixing arrangements, welding using special electrodes for stainless steel welding, etc. complete as per approved shop drawing and as directed by the Engineer in charge .

The railing pipe shall be of non magnetic type stainless steel and conforming grade 304 of AISI. The item also includes providing and fixing rigid type, high impact, smooth 0.8mm

thick Teflon separators (both side) between dissimilar metals (MS & SS) or other non-conducting materials as approved by the Engineer in charge .

Providing and fixing upto 65mm (OD) 12G stainless steel hand rail with 40mm (OD) 14G balustrades at every alternate step fixed/slid on to suitable MS sleeve embedded in stair wall. Each balustrades shall be provided with stainless steel shoe at the wall junction. The joint of the balustrade and the sleeve shall be fixed with lead.

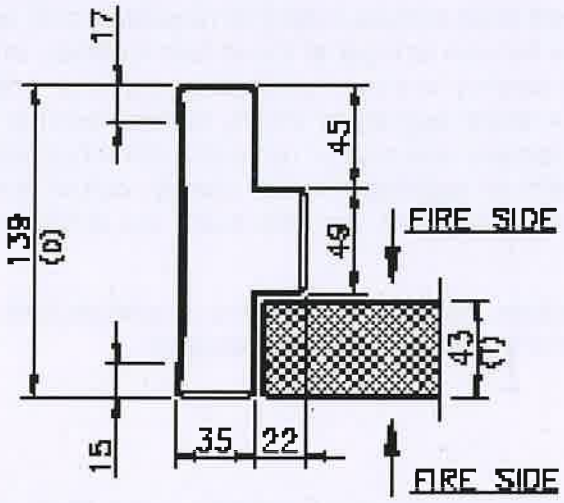
In railing / hand rails at all levels including necessary anchor fasteners, insert plates, scaffolding / staging etc. all complete as directed by the Engineer.

7.0 M.S. PIPE RAILING

The M.S. pipe railing shall be fabricated as per drawings and instructions of EIC, out of specific dia, which indicate nominal bore. Unless otherwise shown on the drawings or as directed, the top horizontal or inclined pipe shall be at a height of 1.0 metre and the middle horizontal or inclined pipe shall be at a height of 0.5 metre. The top pipes will be bent at ends and form into vertical support. The vertical supports shall consist of 40mm to 50mm pipe as shown in the drawing or as directed/ specified, at not more than 1.5 meter centres. All vertical pipes shall be anchored to the structure by approved fixing arrangements. The vertical pipes shall be full from bottom to the top horizontal, which shall be continuous without any break. The middle horizontal pipe shall be continuous between vertical supports. The joints shall be properly made and welded and the welding finished to give a smooth surface. The railing shall be fixed truly vertical and shall have a neat appearance. The railing shall be finished with paint / coating as specified in the item description and as per architectural requirements.

FIRE RATED DOORS

Specifications for 2 Hours 2 Criteria Fire door



2 hours 2 Criteria Fire Rated Door, is fabricated for two hours and two criteria performance in Stability and Integrity as per BS 476 PART 22 AND IS 3614 PART II.

Frame: shall be fabricated from 1.6 mm thick galvanized steel or 2 mm thk. M.S.CRCA sheets depending on the size of the doors. Frames will have a double rebate profile. They will be provided with stiffeners for hardware/ lock mounting and holdfasts for grouting.

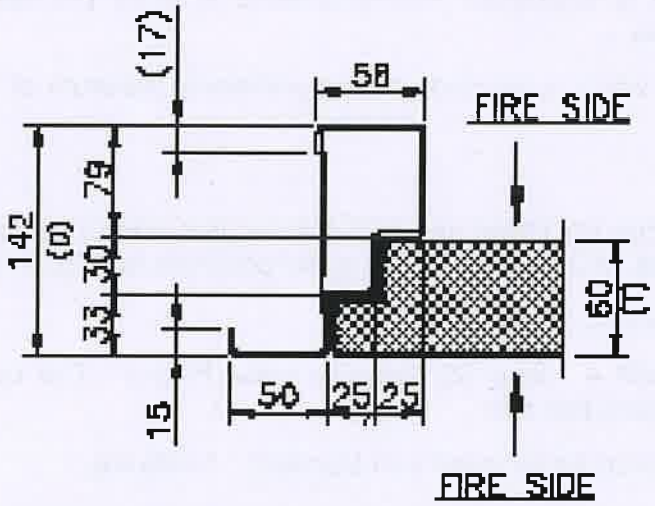
Shutter: of overall thickness 43 mm shall be formed from two outer skin panels of 1.25 mm thick galvanized steel sheets .shutters shall have multibend construction with lock seam joinery for high strength & resistance. Reinforcements shall be provided in the shutter at locking / hardware area. The infill material shall be mineral wool.

Material: The sheet metal used for 1.6 mm thk frame and 1.25 thk shutters panels conform to IS 277 ;1992 . The sheet metal used for 2 mm Thk.CRCA sheet conforms to IS 513: 1994. The doors shall be provided with intumescent seals between frame and shutter at top and two sides for standard and large size doors. The doors shall be provided with 4 "long SS Magnum make hinges. The number of hinges provided shall depend upon door size.

Locking - the doors should be provided with fire resistant three point locking per shutter.

Painting - Both the frames and shutters shall be coated with etch primer, followed by coats of epoxy zinc phosphate primer and final coat of Polyurethane paint.

Specifications for 2 Hours 3 Criteria Fire door.



2 hours 3 Criteria Fire Rated Door, fabricated for two hours and three criteria performance in Stability, Integrity and Insulation as per BS 476 Part 22 and IS 3614 Part II, in both directions .

Frame : shall be fabricated from 1.6 mm thick galvanized steel or 2 mm thk.M.S.CRCA sheets depending on the size of the doors . frames will have a multibend profile . they will be provided with stiffeners for hardware/ lock mounting and holdfasts for grouting .

Shutter: of overall thickness 60 mm shall be formed from two outer skin panels of 1.25 mm thick galvanized steel sheets .shutters shall have multibend construction with lock seam joinery & stepped design for high strength & resistance . Reinforcements shall be provided in the shutter at locking / hardware area . The infill material shall be a Proprietary Ceramic Based Material with internal reinforcements .

Material : The sheet metal used for 1.6 mm thk frame and 1.25 thk shutters panels conform to IS 277 ;1992 . The sheet metal used for 2 mm Thk.CRCA sheet conforms to IS 513 : 1994 . The infill material shall be a Proprietary Ceramic Based Material researched and developed in collaboration with CBRI. the doors shall be provided with intumescent seals between frame and shutter at top and two sides . The doors shall be provided with 4

" long SS Magnum make hinges . The number of hinges provided shall depend upon door size.

Locking - the doors should be provided with fire resistant three point locking per shutter .

Painting - Both the frames and shutters shall be coated with etch primer, followed by coats of epoxy zinc phosphate primer and final coat of Polyurethane paint.

Specifications for Hollow Metal Pressed Sheet Doors (HMPS doors).

HMPS Doors are fabricated using multi bend design and lock seam joinery.

Frame:

shall be fabricated from 1.6 mm thick galvanized steel or 2 mm thk.M.S.CRCA sheets depending on the size of the Doors.

Frames can have a double or a single rebate profile. They will be provided with stiffeners for hardware/ lock mounting and holdfasts for grouting.

Shutter: of overall thickness 43 mm shall be formed from two outer skin panels of 1.25 or 1 mm thick galvanized steel sheets .shutters shall have multi bend construction with lock seam joinery for high strength & resistance. Reinforcements shall be provided in the shutter at locking / hardware area.

The infill material shall be PUF which is injected under a restraining pressure of 1.5 kgs / cm2 .

Material :

The sheet metal used for 1.6 mm thk frame and 1.25 thk shutters panels conform to IS 277:1992 . The sheet metal used for 2 mm Thk.CRCA sheet conforms to IS 513 : 1994 .

PUF shall have a density of approx 0.04 kg/cm3.

The doors shall be provided with 4 " long SS Magnum make hinges . The number of hinges provided shall depend upon door size.

Locking & hardware- the doors shall be provided with standard hardware.

Painting –

Both the frames and shutters shall be coated with etch primer, followed by coats of epoxy zinc phosphate primer and final coat of Polyurethane paint.

Accessories:

vision panel 200x300x6mm as approved.

Dorma PHA 2000 single Panic Bar for Single leaf/active leaf of double leaf door / as approved.

Dorma PHA 2000 3point Panic bar for Double leaf Door/ as approved.

Dorma PHT3905 Outside Access device for Panic Bar / as approved.

Godrej 240 Mortise lock with latch, deadbolt, 2C Cylinder, SS Tubular Handles / as approved.

Godrej Heavy duty door closer:/ as approved.

Hager Door coordinator for double leaf doors/ as approved.

SS D handles: as approved.

SS Tower Bolt: (as approved if required).

Flush Doors Specifications			
TYPE	HONEY COMB	FLAX	TIMBER
A. STILE & RAIL	Mango Treated & Seasoned or Equivalent	Mango Treated & Seasoned or Equivalent	Mango Treated & Seasoned or Equivalent
	Finger Jointed 50 - 60 MM	Finger Jointed 50 - 60 MM	Finger Jointed 50 - 60 MM
B. LOCK RAIL	4" x 15" Height on two sides	4" x 15" Height on two sides	Solid battons
C. FILLER	Honey comb Honicell	Flax Board 400 - 450 Density	Treated Mango or Pine / Meranti / Neem or Equivalent
	BLS 140 15 MM Cell size	Imported Flax Board	
D. CROSS SECTION	Plywood 3.5 MM /3 / 3.5 MM MDF	Plywood 3.5 MM /3 / 3.5 MM MDF	Core Veneer 2.5 MM x 4 Layer Balance Panel 0.5 MM x 2 Face Veneer 0.5 MM x 2 (9 Ply Construction)
E. FACE PANEL	Decorative Veneer / Laminate sheet	Decorative Veneer / Laminate sheet	Decorative Veneer / Laminate sheet
	Commercial Face Veneer	Commercial Face Veneer	Commercial Face Veneer
F. ADHESIVE	AS APPROVED	AS APPROVED	AS APPROVED

I. CEMENT CONCRETE PAVEMENTS

SPECIFICATIONS FOR ROAD WORKS

1.0 SCOPE

1.1 These specifications cover the work of the construction of roads including clearing and grubbing (if required), setting out, embankment / excavation, preparation of sub-grade, laying of sub-base, base, dense bituminous macadam topped by bituminous concrete. The work also involves construction of shoulders, roadside drains medians and all other related works.

1.2 The Contractor shall clear the area (if required) set out the works, provide all the materials, transportation including all leads and lifts, labour, equipment, supervision, and all other incidental temporary and ancillary works required to complete the construction described in the preceding paragraph.

2.0 CODES AND SPECIFICATIONS

The roadwork shall be done as per "Specifications for road and bridge works" published by the Indian Roads Congress on behalf of the Govt. of India, Ministry of Road Transport & Highways (MoRTH) and the various Indian Standards mentioned in the body of these specifications. The following are extracted out of MoRTH specifications.

3.0 SETTING OUT

3.1 The Contractor shall establish working Bench Marks tied with the Reference Bench Mark in the area soon after taking possession of the site. The Reference Bench Mark for the area shall be as indicated in the Contract Documents and the values of the same shall be obtained 'by the Contractor from the Engineer. The working Bench Marks shall be at the rate of four per km and also at or near all drainage structures, over-bridges and underpasses. The working Bench Marks/levels should be got approved from the Engineer. Checks must be made on these Bench Marks once every month and adjustments, if any, got agreed with the Engineer and recorded. An up-to-date record of all Bench Marks including approved adjustments, if any, shall be maintained by the Contractor and also a copy supplied to the Engineer for his record.

3.2 The lines and levels of formation, side slopes, drainage works, carriageways and shoulders shall be carefully set out and frequently checked, care being taken to ensure that correct gradients and cross-sections are obtained everywhere.

3.3. On construction reaching the formation level stage, the centre line shall again be set out by the Contractor and when approved by the Engineer , shall be accurately referenced in a manner satisfactory to the Engineer by marker pegs set at the outer limits of the formation.

3.4. No reference peg or marker shall be moved or withdrawn without the approval of the Engineer and no earthwork or structural work shall be commenced until the centre line has been referenced.

3.5. The Contractor will be sole responsible party for safeguarding all survey monuments, benchmarks, beacons, etc. The Engineer will provide the Contractor with the data necessary for setting out of the centre line. All dimensions and levels shown on the drawings or mentioned in documents forming part of or issued under the Contract shall be verified by the Contractor on the site and he shall immediately inform the Engineer of any apparent errors or discrepancies in such dimensions or levels. The Contractor shall, in connection with the staking out of the centre line, survey the terrain along the road and shall submit to the Engineer for his approval, a profile along the road centre line and cross-sections at intervals as required by the Engineer.

Suitable references for the transverse grid lines should be left in the form of embedded bricks on either ends or by other means so that it is possible to locate the grid points for level measurements after each successive course is laid.

For pavement courses laid only over widening portions, at least one line of levels shall be taken on each strip of widening, or more depending on the width of widening as decided by the Engineer in charge .

Notwithstanding the above, the measurements may be taken at closer intervals also, if so desired by the Engineer, the need for which may arise particularly in the case of estimation of the volume of the material for profile corrective course (leveling course). The average thickness of the pavement course in any area shall be the arithmetic mean of the difference of levels before and after construction at all the grid points falling in that area, provided that the thickness of finished work shall be limited to those shown on the drawings or approved by the Engineer in writing.

As supplement to level measurements, the Engineer shall have the 3 ption to take cores/make holes to check the depth of construction. The holes made and the portions cut for taking cores shall be made good by the Contractor by laying fresh mix/material including compacting as required at no extra cost immediately after the measurements are recorded.

3.6 The lump sum rate quoted by the Contractor shall, unless otherwise specified, also include compliance with/supply of the following:

(i) General works such as setting out, clearance of site before setting out and clearance of works after completion;

(ii) A detailed programme for the construction and completion of the work (using CPM/PERT techniques) giving, in addition to construction activities, detailed network activities for the submission and approval of materials, procurement of critical materials and equipment, fabrication of special products/equipment and their installation and testing, and for all activities of the Employer that are likely to affect the progress of work, etc., including updating of all such activities on the basis of the decisions taken at the periodic site review meetings or as directed by the Engineer;

(iii) Samples of various-materials proposed to be used on the Work for conducting all tests thereon as required as per the provisions of the Contract;

(iv) Testing of various materials including soil / coarse and fine aggregates / cement, design of concrete mixes and all testing for the same, drilling of cores from finished work and testing the same and all other work tests as required under these Specifications and furnishing lest reports/certificates;

(v) Inspection Reports in respect various items of work as per the relevant Specifications;

(vi) Any other data, which may be required as per these. Specifications or the Conditions of Contract or any other annexure / schedules forming pan of the Contract;

(vii) Any other item of work which is not specifically provided in the Bill of Quantities but which is necessary for complying with the provisions of the Contract;

(viii) All temporary works

(ix) Establishing and running a laboratory with facilities for testing for various items of works as specified hereafter.

(x) Cost of in-built provisions for Quality Assurance:

(xi) Cost of safeguarding the environment; and

(xii) Cost of providing "as-built drawings" in original and two sets of prints.

4.0 EXCAVATION FOR ROADWAY AND DRAINS

4.1 Scope

This work shall consist of excavation, removal and satisfactory disposal of all materials necessary for the construction of roadway, side drains and waterways in accordance with requirements of these Specifications and the lines, grades and cross-sections shown in the drawings or as indicated by the Engineer. It shall include the hauling and stacking of or hauling to sites of embankment and sub-grade construction, suitable cut materials as

required, as also the disposal of unsuitable cut materials in specified manner, trimming and finishing of the road to specified dimensions or as directed by the Engineer.

4.2 Classification of Excavated Material

The rate for excavation is for all soils and hence there will be no need for classification.

4.3 Construction Operations

4.3.1 Setting out: After the site has been cleared, the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer. The Contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboos, stones, lime, mortar, concrete, etc., required in connection with the setting out of works and the establishment of bench marks. The Contractor shall be responsible for the maintenance of benchmarks and other marks and stakes as long as in the opinion of the Engineer, they are required for the work.

4.3.2 Excavation - General: All excavations shall be carried out in conformity with the directions given herein under and in a manner approved by the Engineer. The work shall be so done that the suitable materials available from excavation are satisfactorily utilized as decided upon beforehand.

While planning or executing excavations, the Contractor shall take all adequate precautions against soil erosion, water pollution etc., and take appropriate drainage measures to keep the site free of water.

The excavations shall conform to the lines, grades, side slopes and levels shown on the drawings or as directed by the Engineer. The Contractor shall not excavate outside the limits of excavation. Subject to the permitted tolerances, any excess depth/ width excavated beyond the specified levels/dimensions on the drawings shall be made good at the cost of the Contractor with suitable material of characteristics similar to that removed and compacted to the requirements of Clause 6.0.

All debris and loose material on the slopes of cuttings shall be removed. No backfilling shall be allowed to obtain required slopes excepting that when boulders or soft materials are encountered in cut slopes, these shall be excavated to approved depth on instructions of the Engineer and the resulting cavities filled with suitable material and thoroughly compacted in an approved manner.

After excavation, the sides of excavated area shall be trimmed and the area contoured to minimise erosion and ponding, allowing for natural drainage to take place. If trees were removed, new trees shall be planted, as directed by the Engineer. The cost of planting new trees shall be deemed to be incidental to the work.

4.3.3 Methods, tools and equipment: Only such methods, tools and equipment as approved by the Engineer shall be adopted / used in the work. If so desired by the Engineer, the Contractor shall demonstrate the efficacy of the type of equipment to be used before the commencement of work.

4.3.4 Marsh excavation (if encountered): The excavation of soils from marshes/ swamps shall be carried out as per the programme approved by the Engineer.

Excavation of marshes shall begin at one end and proceed in one direction across the entire marsh immediately ahead of backfilling. The method and sequence of excavating and backfilling shall be such as to ensure, to the extent practicable, the complete removal or displacement of all muck from within the lateral limits called for on the drawings or as staked by the Engineer, and to the bottom of the marsh, firm support or levels indicated.

4.3.5 Excavation for surface/sub-surface drains: Where the Contract provides for construction of surface/sub-surface drains, excavation for these shall be carried out in proper sequence with other works as approved by the Engineer.

4.3.6 Slides: If slips, slides, over-breaks or subsidence occur in cuttings during the process of construction, they shall be removed at the cost of the Contractor as ordered by the Engineer. Adequate precautions shall be taken to ensure that during construction, the slopes are not rendered unstable or give rise to recurrent slides after construction. If finished slopes slide into the roadway subsequently, such slides shall be removed and paid for at the Contract rate for the class of excavation involved, provided the slides are not due to any negligence on the part of the Contractor. The classification of the debris material from the slips, slides etc. shall conform to its condition at the time of removal and payment made accordingly regardless of its condition earlier.

4.3.7 Dewatering: If water is met with in the excavations due to springs, seepage, rain or other causes, it shall be removed by suitable diversions, pumping or bailing out and the excavation kept dry whenever so required or directed by the Engineer. Care shall be taken to discharge the drained water into suitable outlets as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore to the original condition at his own cost or compensate for the damage.

4.3.8 Disposal of excavated materials: All the excavated materials shall be the property of the Employer. The material obtained from the excavation of roadway, shoulders, verges, drains, cross-drainage works etc., shall be used for filling up of (i) roadway embankment, (ii) the existing pits in the right-of-way and (iii) for landscaping of the road as directed by the Engineer, including leveling and spreading with all lifts and lead up to 3000 m and no extra payment shall be made for the same.

Unsuitable and surplus material not intended for use within the lead specified above shall also, if necessary, be transported with all lifts and lead beyond initial 3000 m, disposed of or used as directed by the Engineer.

4.4 Plying of Construction Traffic: Construction traffic shall not use the cut formation and finished sub-grade without the prior permission of the Engineer. Any damage arising out of such use shall be made good by the Contractor at his own expense.

4.5 Preparation of Cut Formation: The cut formation, which serves as a sub-grade, shall be prepared to receive the sub-base/base course as directed by the Engineer.

Where the material in the sub-grade (that is within 500 mm from the lowest level of the pavement) has a density less than specified in Table 6-2, the same shall be loosened to a depth of 500 mm and compacted in layers in accordance with the requirements of Clause 6.0.

Any unsuitable material encountered in the sub-grade level shall be removed as directed by the Engineer and replaced with suitable material compacted in accordance with Clause 6.0.

6.6 Finishing Operations

Finishing operations shall include the work of properly shaping and dressing all excavated surfaces.

When completed, no point on the slopes shall vary from the designated slopes by more than 150 mm measured at right angles to the slope, except where excavation is in rock (hard or soft) where no point shall vary more than 300 mm from the designated slope. In no case shall any portion of the slope encroach on the roadway.

The finished cut formation shall satisfy the surface tolerances described in Quality control of road works clause 900 of MoRTH specifications.

5.0 EMBANKMENT CONSTRUCTION

5.1 General

5.1.1 Description: These Specifications shall apply to the construction of embankments including sub-grades, earthen shoulders and miscellaneous backfills with approved material obtained from roadway and drain excavation, borrow pits or other sources. All embankments, sub-grades, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the requirements of these Specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the Engineer.

5.1.2 Materials and General Requirements

51.3 Physical requirements:

5.1.4 The materials used in embankments, sub-grades, earthen shoulders and miscellaneous backfills shall be soil, moorum, gravel, a mixture of these or any other material approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment/ sub-grade.

The following types of material shall be considered unsuitable for embankment:

(a) Materials from swamps, marshes and bogs;

(b) Peat, log, stump and perishable material; any soil that classifies as OL, OI, OH or Pt -in accordance with IS: 1498;

(c) Materials susceptible to spontaneous combustion;

(d) Materials in a frozen condition;

(e) Clay having liquid limit exceeding 70 and plasticity index exceeding 45; and

(f) Materials with salts resulting in leaching in the embankment.

5.1.5 Expansive clay exhibiting marked swell and shrinkage properties ("free swelling index" exceeding 50 per cent when tested as per IS: 2720 - Part 40) shall not be used as a fill material. Where expansive clay with acceptable "free swelling index" value is used as a fill material, sub-grade and top 500 mm portion of the embankment just below sub-grade shall be non-expansive in nature.

5.1.6 Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO3) per litre when tested in accordance with BS: 1377 Test 10, but using a 2:1 water-soil ratio shall 'not be deposited within 500 mm or other distance described in the Contract, of concrete, cement bound materials or other cementitious materials forming part of the Permanent Works.

Materials with a total sulphate content (expressed as SO3) exceeding 0.5 per cent by mass, when tested in accordance with BS: 1377 Test 9 shall not be deposited within 500 mm, or other distances described in the Contract, of metallic items forming part of the Permanent Works.

5.1.7 The size of the coarse material in the mixture of earth shall ordinarily not exceed 75 mm when being placed in the embankment and 50 mm when placed in the sub-grade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the placement

of fill material and its compaction to the requirements of these Specifications. The maximum particle, size shall not be more than two-thirds of the compacted layer thickness.

5.1.8 Ordinarily, only the materials satisfying the density requirements given in Table 6-1 shall be employed for the construction of the embankment and the sub-grade.

TABLE 6.1. DENSITY REQUIREMENTS OF EMBANKMENT AND SUB-GRADE MATERIALS

S.No.	Type of Work	Maximum laboratory dry unit weight when tested as per IS: 2720 (Part 8)
1.	Embankments up to 3 metres	Not less than 15.2 kN/cu.m.
	Height, not subjected to extensive flooding.	
2.	Embankments exceeding 3 metres	Not less than 16.0 kN/cu. m.
	height or embankments of any height	
	subject to long periods of inundation	
3.	Sub-grade and earthen shoulders/ verges/ backfill	Not less than 17.5 kN/cu. m.

Notes: (1) This Table is not applicable for lightweight fill material e.g. cinder, fly ash etc.

(2) The Engineer may relax these requirements at his discretion taking into account the availability of materials for construction and other relevant factors.

(3) The material to be used in sub-grade should also satisfy design CBR at the dry unit weight applicable as per Table 6-2.

6.0 General requirements

6.1. The materials for embankment shall be obtained from approved sources with preference given to materials becoming available from nearby roadway excavation or any other excavation under the same Contract.

The work shall be so planned and executed that the best available materials are saved for the sub-grade and the embankment portion just below the sub-grade.

6.2. Borrow materials: Where the materials are to be obtained from designated borrow areas, the location, size and shape of these areas shall be as indicated by the Engineer and the same shall not be opened without his written permission. Where specific borrow areas are not designated by the Employer/the Engineer, arrangement for locating the source of supply of material for embankment and sub-grade as well as compliance to environmental requirements in respect of excavation and borrow areas as stipulated, from time to time by the Ministry of Environment and Forests, Government of India and the local bodies, as applicable, shall be the sole responsibility of the Contractor.

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition.

No excavated acceptable material other than surplus to requirements of the Contract shall be removed from the site. Should the Contractor be permitted to remove acceptable

material from the site to suit his operational procedure, then he shall make good any consequent deficit of material arising there from.

Where the excavation reveals a combination of acceptable and un-acceptable materials, the Contractor shall, unless otherwise agreed by the Engineer in charge , carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately.

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing programme approved by the Engineer. It shall be ensured that the sub-grade material when compacted to the density requirements as in Table 6-2 shall yield the design CBR value of the sub-grade.

TABLE 6-2. COMPACTION REQUIREMENTS FOR EMBANKMENT AND SUB-GRADE

Type of work/ material		Relative compaction as percentage of max. laboratory dry density as per IS: 2720 (Part 8)
1.	Sub-grade and earthen shoulders	Not less than 97
2.	Embankment	Not less than 95

The Contractor shall at least 7 working days before commencement of compaction submit the following to the Engineer for approval:

(i) The values of maximum dry density and optimum moisture content obtained in accordance with IS: 2720 (Part 7) or (Part 8), as the case may be, appropriate for each of the fill materials he intends to use.

(ii) A graph of density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.

(iii) The Dry density-moisture content -CBR relationships for light, intermediate and heavy compactive efforts (light corresponding to IS: 2720 (Part 7), heavy corresponding to IS: 2720 (Part 8) and intermediate in-between the two) for each of the fill materials he intends to use in the sub-grade.

Once the above information has been approved by the Engineer, it shall form the basis for compaction.

6.3 Construction Operation

6.3.1. Setting out: After the site has been cleared, the work shall be set out to Clause 5.3.1. The limits of embankment/sub-grade shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. The embankment/sub-grade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is to the desired density and in position specified and conforms to the specified side slopes.

6.3.2 Dewatering: If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is feasible to remove it, the same shall be removed by bailing out or pumping, as directed by the Engineer and the area of the embankment foundation shall be kept dry. Care shall be taken to discharge the drained water so as not to cause damage to the works, crops or any other property. Due to any negligence on the part of

the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore it to original condition or compensate the damage at his own cost.

6.3.3 Compacting ground supporting embankment/sub-grade: Where necessary, the original ground shall be leveled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling so as to achieve minimum dry density as given in Table 6-2.

In case where me difference between the sub-grade level (top of the sub-grade on which pavement rests) and ground level is less than 0.5 m and the ground does not have 97 per cent relative compaction with respect to the dry density as given in Table 6-2, the ground shall be loosened up to a level 0.5 m below the sub-grade level, watered and compacted in layers in accordance with Clauses 6.3.4 and 6.3.5 to not less than 97 per cent of dry density as given in Table 6-2.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced by approved materials laid in layers to the required degree of compaction.

Embankment or sub-grade work shall not proceed until the foundations for embankment/sub-grade have been inspected by the Engineer for satisfactory condition and approved.

Any foundation treatment specified for embankments especially high embankments, resting on suspect foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the Engineer. Where the ground on which an embankment is to be built has any of the material types (a) to (f) in Clause 6.1.4 at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.

6.3.4 Spreading material in layers and bringing to appropriate moisture content

6.3.4.1 The embankment and sub-grade material shall be spread in layers of uniform thickness not exceeding 200 mm compacted thickness over the entire width of embankment by mechanical means, finished by a motor, grader and compacted as per Clause 6.3.5. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slope and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as in Table 6-2 and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross-section of the embankment.

6.3.4.2 Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made good. Where water is required to be added in such constructions, water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by blading, discing or harrowing until a uniform moisture content is obtained throughout the depth of the layer.

If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, compaction work shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with IS: 2720 (Part 2), and unless otherwise mentioned, shall be so adjusted, making due allowance for

evaporation losses, that at the time of compaction it is in the range of 1 per cent above to 2 per cent below the optimum moisture content determined in accordance with IS: 2720 (Part 7) or IS: 2720 (Part 8) as the case may be. Expansive clays shall, however, be compacted at moisture content corresponding to the specified dry density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.

After adding the required amount of water, the soil shall be processed by means of graders, harrows, rotary mixers or as otherwise approved by the Engineer until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have a maximum size of 75 mm when being placed in the embankment and a maximum size of 50 mm when being placed in the sub-grade.

6.3.4.3 Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and other vehicular traffic uniformly over them. Damage by construction plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength as the material had before it was damaged.

Embankments and other areas of unsupported fills shall not be constructed with steeper side slopes, or to greater widths than those shown in the Contract, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material.

Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations steeper than 1 vertical on 4 horizontal, such faces shall be benched immediately before placing the subsequent fill.

All permanent faces of side slopes of embankments and other areas of fill formed shall, subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer, on the slope or any other method approved by the Engineer.

6.3.5 Compaction

Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Smooth wheeled, vibratory, pneumatic tyred rollers, etc. of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

The compaction shall be done with the help of vibratory roller of 80 to 100 kN static weight with plain or pad foot drum or heavy pneumatic tyred roller of adequate capacity capable of achieving required compaction.

The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for these site trials shall first be submitted to the Engineer for approval.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.

Each layer of the material shall be thoroughly compacted to the densities specified in Table 6-2. Subsequent layers shall be placed only after the finished layer has been tested

according to Section 900 of Quality Control of Road Works of MoRTH specifications and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture/density gauge used in accordance with agreed procedure and the gauge is calibrated to provide results identical to that obtained from tests in accordance with IS: 2720 (Part 28). A record of the same shall be maintained by the Contractor.

When density measurements reveal any soft areas in the embankment /sub-grade/ earthen shoulders, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted to the density requirements and satisfaction of the Engineer.

6.3.6 Drainage

The surface of the embankment/sub-grade at all times during construction shall be maintained at such a cross fall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding.

6.3.7 Repairing of damages caused by rain/spillage of water

The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density . If the cut is not sufficiently wide for use of required mechanical means for compaction. the same shall be widened suitably to permit their use for proper compaction. Tests shall be carried out as directed by the Engineer to ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery/equipment for the purpose.

6.3.8 Finishing operations

Finishing operations shall include the work of shaping and dressing the shoulders/verge/roadbed and side slopes to conform to the alignment, levels, cross-sections and dimensions shown on the drawings or as directed by the Engineer subject to the surface tolerance as per Quality Control of Roadworks Section 900 of MoRTH Specifications. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.

When earthwork operations have been substantially completed, the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated.

6.4 Construction of Embankment and Sub-grade under Special Condition

6.4.1 Construction of embankment over ground incapable of supporting construction equipment

Where embankment is to be constructed across ground which will not support the weight of repeated heavy loads of construction equipment, the first layer of the fill may be constructed by placing successive loads of material in a uniformly distributed layer of a minimum thickness required to support the construction equipment as permitted by the Engineer. The Contractor, if so desired by him, may also use suitable geo-synthetic material to increase the bearing capacity of the foundation. This exception to normal procedure will not be permitted where, in the opinion of the Engineer, the embankments could be constructed in the approved manner over such ground by the use-of lighter or modified equipment after proper ditching and drainage have been provided. Where this exception is permitted, the selection of the material and the construction procedure to obtain an acceptable layer shall be the responsibility of the Contractor. The cost of

providing suitable traffic conditions for construction equipment over any area of the Contract will be the responsibility of the Contractor and no extra payment will be made to him. The remainder of the embankment shall be constructed as specified in Clause 6.3.

6.4.2 Embankment construction under water

Where filling or backfilling is to be placed under water, only acceptable granular material or rock shall be used unless otherwise approved by the Engineer. Acceptable granular material shall consist of graded, hard durable particles with maximum particle size not exceeding 75 mm. The material should be non-plastic having uniformity coefficient of not less than 10. The material placed in open water shall be deposited by end tipping without compaction.

6.5 Surface Finish and Quality Control of Work

The surface finish of construction of sub-grade shall conform to the requirements of Clause 902 of as per Quality Control of Road works Section 900 of MoRTH specifications. Control on the quality of materials and works shall be exercised in accordance with Clause 903.of the same.

6.6 Sub-grade Strength

6.6.1 It shall be ensured prior to actual execution that the borrow area material to be used in the sub-grade satisfies the requirements of design CBR.

6.6.2 Sub-grade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed sub-grade shall be determined on undisturbed samples cut out from the compacted sub-grade in CBR mould fitted with cutting shoe or on re-moulded samples, compacted to the field density at the field moisture content.

7.0 SURFACE/SUB-SURFACE DRAINS

7.1 Scope

This work shall consist of constructing surface and/or sub-surface drains in accordance with the requirements of these Specifications and to the lines, grades, dimensions and other particulars shown on the drawings or as directed by the Engineer.

Schedule of work shall be so arranged that the drains are completed in proper sequence with road works to ensure that no excavation of the completed road works is necessary subsequently or any damage is caused to these works due to lack of drainage.

7.2 Surface Drains

Surface drains shall be excavated to the specified lines, grades, levels and dimensions to the requirements of Clause 5. The excavated material shall be removed from the area adjoining the drains and if found suitable, utilised in embankment/sub-grade construction. All unsuitable material shall be disposed of as directed.

The excavated bed and sides of the drains shall be dressed to bring these in close conformity with the specified dimensions, levels and slopes.

Where so indicated, drains shall be lined or turfed with suitable materials in accordance with details shown on the drawings.

All works on drain construction shall be planned and executed in proper sequence with other works as approved by the Engineer, with a view to ensuring adequate drainage for the area and minimising erosion/ sedimentation.

8.0 PREPARATION AND SURFACE TREATMENT OF FORMATION

Preparation and surface treatment of the formation, that is top of the sub-grade, shall be carried out only after completion of any specified sub-grade drainage and unless otherwise agreed by the Engineer, immediately prior to laying the sub-base or the road base where no sub-base is required. The sequence of operations shall be as follows:

(a) All surfaces below carriageway, lay-byes, footways and hard shoulders shall, after reinstatement of any soft areas to the required Specifications be well cleaned and freed of mud and slurry.

(b) The surface shall be compacted by 4 passes of a smooth wheeled roller of 80 to 100 kN weight after spraying requisite amount of water, if required, before the commencement of rolling.

(c) The formation shall, wherever necessary, be regulated and trimmed to the requirements of Clause 6.3.8 with motor grader.

(d) The trimmed formation shall be rolled by one pass of smooth wheeled roller of 80 to 100 kN weight after spraying requisite amount of water, if required, before the commencement of rolling.

Where the completed formation is not immediately covered with sub-base or road base material, its moisture content shall be maintained to prevent cracking in the formation by suitable measures as approved by the Engineer. The entire work of surface treatment of formation shall be deemed as incidental to the work of sub-base/base course to be provided on the sub-grade and as such no extra payment shall be made for the same.

9.0 WORKS TO BE KEPT FREE OF WATER

9.1 The Contractor shall arrange for the rapid dispersal of water collected/accumulated on the earthwork or completed formation during construction or on the existing roadway or which enters the earthwork or any other item of work from any source, and where practicable, the water shall be discharged into the permanent outfall of the drainage system. The arrangements shall be made in respect of all earth work including excavation for pipe trenches, foundations or cuttings.

9.2. The Contractor shall provide, where, necessary, temporary water courses, ditches, drains, pumping or other means for maintaining the earthwork free from water. Such provisions shall include carrying out the work of forming the cut sections and embankments in such manner that their surfaces have at all times a sufficient minimum cross fall and, where practicable, a sufficient longitudinal gradient to enable them to shed water and prevent ponding.

The works involved in keeping the earthwork or any other item of works free of water shall be deemed as incidental to the respective item of work and as such no separate payment shall be made for the same.

10.0 GRANULAR SUB-BASE

10.1 Scope

This work shall consist of laying and compacting well-graded material on prepared sub-grade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

10.2 Materials

10.2.1 The material to be used for the work shall be natural sand, moorum, gravel, crushed stone, or combination thereof depending upon the grading required. Materials like crushed slag, crushed concrete, brick metal and kankar may be allowed only with the specific approval of the Engineer.

The material shall be free from organic or other deleterious constituents and conform to one of the three gradings given in Table 10-1.

While the gradings in Table 10-1 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm, the corresponding gradings for the coarse-graded materials for each of the three maximum particle sizes are given at Table 10-2.

The grading to be adopted for a project shall be as specified in the Contract.

10.2.2 Physical requirements

The material shall have a 10 per cent fines value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS:812 (Pan 111). The water absorption value of the coarse aggregate shall be determined as per IS : 2386 (Pan 3); if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS : 3.83. For Grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 per cent.

TABLE 10-1. GRADING FOR CLOSE-GRADED GRANULAR SUB-BASE MATERIALS

IS Sieve Designation	Per cent by weight passing the IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	–	–
53.0 mm	80–100	100	–
26.5 mm	55–90	70–100	100
9.50 mm	35–65	50–80	65–95
4.75 mm	25–55	40–65	50–80
2.36 mm	20–40	30–50	40–65
0.425 mm	10–25	15–25	20–35
0.075 mm	3–10	3–10	3–10
CBR Value (Minimum)	30	25	20

TABLE 10.2. GRADING FOR COARSE GRADED GRANULAR SUB-BASE MATERIALS

IS Sieve Designation	Per cent by weight passing the IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	–	–
53.0 mm		100	