

JSW Academic Block
National Law School of India University, Bengaluru
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TECHNICAL SPECIFICATIONS

1. EXCAVATION AND EARTHWORK

SCOPE

The scope of work includes clearing of the site, excavation of basement pits in all types of soils and /or rocks, back filling, disposal of surplus earth as required, Dewatering, shoring and strutting. No blasting shall be permitted under any circumstances.

Contractor shall thoroughly acquaint himself with the type of soil / rock in excavation, by an inspection of the nature of the ground at site and scrutiny of the soil investigation details available with the Owner and the CC. If soil of any classification other than the specified is met with during excavation, the decision of the CC's as to the classification of soil, levels of the strata of different classifications and their location shall be binding on all concerned. Contractor shall apprise himself of the lead and lift for all excavation and filling

APPLICABLE CODES AND STANDARDS		
IS 3764 – 1996	:	Excavation work, Safety code
IS 11134 – 1984	:	Setting out of buildings, Code of practice
IS 1200 – 1974	:	Measurement of building
IS 9759 – 1981	:	Guidelines for Dewatering during construction
IS 2720 -(Part 1 to 41)	:	Soils, methods of tests
IS 1498 – 1970	:	Classification and identification of soils for general Engineering purposes

The site on which the structure is to be built as shown on the drawing and the area required for setting out and other operations like roads, drains, etc., should be cleared and all obstructions, loose stones, materials and rubbish of all kinds, stumps, brush wood etc., removed as directed, roots being entirely grubbed up. All useful materials obtained shall be the property of the Owner and shall be sorted out and stacked as directed by the EIC. Rejected materials shall be removed beyond the site boundary by the Contractor at his own cost.

GROUND LEVELS AND SITE LEVEL PLAN

Before starting excavation work, the requisite block levels of the entire plot shall be taken by the Contractor in consultation with the EIC and a proper record of the levels kept, which shall be jointly signed by the Contractor and the EIC.

SETTING OUT

After clearing the site, and preparing the site level plan, the Contractor shall set out the center lines of the building or other works involved and get the same approved by the EIC.

It shall be the responsibility of the Contractor to install substantial reference marks, bench marks etc., and maintain them as long as required by the EIC. The Contractor shall assume full responsibility for proper setting out, alignment, elevation and dimension of each and all parts of the work.

EXCAVATION AND PREPARATION OF FOUNDATION FOR CONCRETING

The basement pits or foundation trenches shall be dug to the dimensions as shown on the drawings or to a stratum of good hard soil is met as directed by the EIC. The excavated material shall be stacked at a sufficient distance away from the edge of the excavated pit so as not to endanger the stability of the sides and prevent fall-in.

The Contractor shall, at his own expenses and without any extra charge, make provision for all shoring and strutting, extra excavation in slope, pumping, dredging or bailing out water, and the excavation shall be kept free from water when the foundation work is in progress.

If excavation is carried out to a greater width, length or depth than specified in the drawings, the extra depth shall be made up by filling in lean concrete and extra length or width by filling in earth rammed hard or by masonry as directed by the EIC.

If required to protect the sides of pits and trenches, timber shoring and strutting shall be erected. The timbering shall be closed or open depending on the nature of the soil and work, and the arrangement of timbering including sizes and spacing of members used shall be as approved by the EIC.

The bottom of all excavation shall be trimmed and levelled in accordance with the drawings and be rammed and wetted before deposition of concrete.

The Contractor shall report to the EIC when the excavations are ready to receive concrete. No concrete shall be placed in foundation until the Contractor has obtained the approval of EIC.

After completion of the excavation (and before laying the concrete) the Contractor shall get the depth, dimensions of the excavation and levels checked and approved by the EIC.

PROTECTION

All foundation pits, lift pits, well pits and similar excavation shall be strong fenced and marked with red lights at night and placed in charge of watchman to avoid accidents. Adequate protective safety measures shall

be taken to see that the excavation does not affect or damage adjoining structures. All safety measures shall be taken by the contractor at his own cost, he being entirely responsible for any injury to persons and damage to property by the negligence or accident due to his constructional operations.

STACKING OF EXCAVATED MATERIALS

After excavation work is completed the Contractor shall sort out useful materials and stack them on site; different types of excavated material shall be stacked separately as directed by the EIC. Materials suitable and useful for back-filling, plinth filling or levelling of the plot or other use shall be stacked at convenient places but not in such a way as to obstruct free movement for constructional purposes.

CLASSIFICATION OF SOIL

All soils shall be taken as ordinary soil unless hard rock of old masonry or concrete or running sand which requires special treatment for the purpose of excavation are met with, when an additional / extra item shall be formed.

BACK FILLING

Back filling to sides of foundation trenches and basement shall be done with soil approved by the EIC taken from excavation or from outside the site, in layers.

QUALITY OF FILL

Fill shall be of well compatible, well graded earth and shall be free from tree stumps, organic matter, seed, peat etc., where earth from source other than excavation at site is used, the quality of such earth shall be the same as that obtained from excavation at site or superior to it.

COMPACTION

The fill shall be spread in layers not exceeding 150 mm and each layer shall be watered and thoroughly consolidated by mechanical rollers / rammers or other approved plant / equipment or by hand rammers where specifically permitted by the EIC. The fill material shall be pulverized before depositing in place. An optimum moisture content shall be maintained for the fill materials. Compaction shall be done so as to achieve a dry density of not less than 90% of the maximum density obtained at optimum moisture content, except for the upper 200 mm layer which shall be compacted to a density of not less than 95% of the maximum density. The Contractor shall obtain prior approval of EIC before starting filling work in any location. Where necessary symmetrical filling load shall be maintained and also care shall be taken to prevent any wedging action.

DEWATERING

Dewatering by bailing or pumping out water which may accumulate in the excavation during the progress of works from seepage, springs, rain or any other cause, diverting surface flow if any by bunds or other means. Pumping out water shall be done in such approved manner as to preclude the possibility of any damage to the foundation trenches, concrete or masonry or any adjacent structure. When water is met in foundation trench or in basement excavations, pumping out of water shall be from an auxiliary pit of adequate size dug slightly outside the building excavations. The auxiliary pit shall be refilled with approved excavated materials after the Dewatering is over.

The excavated trenches / pits shall be kept free from water during inspection and measurement.

When concrete and / or masonry are in progress and till they come above the natural water level, and till the EIC considers that the concrete / mortar is sufficiently set, the Contractor shall provide for the required type and no. of pump sets and other tools / plant, which shall operate under all conditions.

EXCAVATION IN ORDINARY / HARD ROCK

Excavation in rock shall be carried out to the lengths, breadths, depths and profiles required for the construction of the works and to the dimensions and levels shown on the drawings. In the event of the excavation being taken out to greater depth or plan dimensions than shown on the drawing and required by the EIC, the excess excavation will not be paid to the Contractor. The contractor shall fill the extra depth with compacted cement concrete 1:4:8 (1 cement, 4 coarse sand, 8 graded stone aggregate) at his own cost. The size of the stone aggregate shall be 40 mm or 20 mm nominal size as directed by the EIC. Moreover the extra refilling in the sides shall also be provided by and at the cost of the Contractor as per directions of the EIC.

Excavation in all types of rocks shall be carried out by crowbars, pickaxes or pneumatic drills, or by chiseling.

GENERAL EARTHWORK AND LEVELLING

Surface dressing of the ground shall be carried to levels as shown on the drawings and the area levelled by excavation including clearing of all obstructions, loose stones, materials and rubbish of all kinds, stumps, brush wood etc. All useful materials obtained shall be the property of the Owner and shall be sorted out and stacked as directed by the EIC. Rejected materials shall be removed beyond the site boundary by the Contractor as directed.

General leveling of the site shall involve cutting and filling in all kinds of soil except hard rock. In all case of site levelling, micro levelling shall be done so that the surface water travels to the roadside drain.

TRANSPORTATION

All surplus earth soft rock spoil etc., not required for the works shall be cleared away by means of mechanical transport inclusive of loading, unloading etc.

EXCESS EXCAVATION

Where excavations are made in depth more than required as per the EIC, it shall be back filled up to formation level with lean concrete 1:4:8 and in roads / pavements either by increasing the thickness, number of layers of road foundations or with approved hard material in layers including consolidation, at the cost of contractor

SOIL BEARING CAPACITY

UNCONFIRMED CONDITIONS

If during excavation, conditions discovered at the site do not conform to the findings of the "SOIL INVESTIGATION REPORT", the Contractor shall immediately, notify the CC or his representative, in writing of such conditions.

SOIL INVESTIGATION SPECIALIST / STRUCTURAL DESIGN CONSULTANT

The Soils investigation Specialists and the Structural Engineer shall visit the site and make the changes in foundation designs as necessary.

WRITTEN NOTICE TO PROCEED

The Contractor may proceed with excavated work but foundation forms and reinforcement shall not be installed until after the receipt of written notice to proceed from the CC.

FOOTINGS

No footings shall rest on fill.

BOULDER STONE SOLING

MATERIAL

Stone for soling shall be granite trap or basalt or any other rock as approved by the EIC. Stones shall be clean, hard reasonably free from laminations, unsound fragments, decay and weathered effects.

SIZE

The stone shall be regular as can be obtained by quarrying without attempting to sharpen or dressing. Stone for soling shall be of height equal to the thickness with a tolerance of +/- 10 mm and shall have a base area of not less than 0.025 sqm nor more than 0.050 sqm. The smallest dimension of any stone shall not be less than half the dimension. Smaller stones for filling voids

shall be not inferior to that of larger stone

BINDING MATERIAL

Murram

The plasticity index of binding material in the screening shall not exceed 9. Gravel shall be composed of large coarse siliceous grains sharp and gritty to touch, free from dirt and impurities. Laterite gravel may be used if the excess clay is separated by screening. The binding material shall contain a sufficient proportion of fine material to fill all interstices and to ensure binding when consolidated.

Materials shall be brought to site sufficiently in advance of their use.

Sand

Sand shall be clean River sand, hard, sharp, gritty, coarse dry particles, free from earth, silt, organic matter and other deleterious material.

CAST-IN-PLACE REINFORCED CONCRETE

2.1 SCOPE

The scope of work for Cast-in –place Reinforced Cement Concrete including materials, proportioning, batching, mixing, testing, placing, compacting, finishing, jointing, curing and all other related work. Concrete shall be composed of cement, fine aggregate, coarse aggregate, water with or without admixture as approved, proportioned and mixed as specified.

The work to be provided for by the Contractor, unless otherwise specified, shall include but not be limited to the following.

Furnish all labour, supervision, services, materials, forms, templates, supports: scaffolding, approaches, aids, tools and plants, transportation etc., required for the work.

Prepare progressively and submit for approval Bar Bending Schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.

Design and prepare progressively and submit for approval working drawings of formwork, scaffolding, supports, etc.

Prepare progressively and submit for approval shop drawings for various inserts, anchors, bolts, pipe sleeves, embedment hangers, openings, frames, joint seals etc.

Prepare progressively and submit for approval Detailed schemes of all operations required for executing the work – Material handling, placement of concrete, services, Approaches etc.

Prepare progressively and submit for approval Design Mix concrete to be adopted for the work.

Furnish samples and submit for approval results of tests of various properties of the following:

- I. Concrete
- II. Ingredients of concrete
- III. Embedment's
- IV. Joint seals

Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings. The cost of all tests shall be borne by the Contractor.

For supply of certain materials normally manufactured by specialist firms, the Contractor may have to produce, if directed by the EIC, a guarantee

proforma for satisfactory performance for a reasonable period as may be specified, binding both the manufacturer and the Contractor jointly.

Related work specified elsewhere:

- a) Steel reinforcement
- b) Form work

2.2 APPLICABLE CODES AND STANDARDS

IS 4845 – 1968 – Definitions and Terminology relating to hydraulic cement
IS 269 – 1976 - High strength ordinary Portland Cement
IS 1489 – 1976 - Ordinary and low heat Portland cement
IS 8042 – 1978 – Portland Pozzolana cement
IS 8042 – 1978 - White Portland cement
IS 7861 (Part-1) – 1975 – Extreme weather concreting, code of practice – Recommended practice for hot weather concreting.
IS 7861(Part – 2) –1981 –Extreme weather concreting, code of practice – Recommended practice for cold weather concreting.
IS 10262 – 1982 – Recommended guidelines for concrete mix
IS 1199 – 1959 – Sampling and analysis of concrete.
IS 5816 – 1970 – Splitting tensile strength of concrete cylinders.
IS 516 – 1959 – Strength of concrete
IS 383 – Coarse and fine aggregates from natural sources for concrete
IS 455 – Portland slag cement
IS 456 – Code of practice for plain and reinforced concrete
IS 1836 – Performed fillers for expansion joints in concrete non-extruding and resilient type.
IS 1946 – Code of practice for use of fixing devices in walls, ceilings and floors of solid constructions.
IS 2386 – Methods of test for aggregates for concrete (part I & II)
IS 2505 – 1980 – Concrete vibrators, immersion type
IS 4925-1968 – Concrete batching and mixing plant
IS 7251-1974 – Concrete finishing
IS 1791-1985 – Concrete mixers, batch type
IS 2645-Integral cement waterproofing compounds
IS 3414 – Code of practice for design and installation of joints in buildings
IS 3535- Methods of sampling hydraulic cement
IS 3558 – Code of practice for use of immersion vibration of joints in buildings
IS 4031 – Methods of physical tests for hydraulic cement
IS 4032 – Methods of chemical analysis of hydraulic cement
IS 4082 – Recommendations on stacking and storage of construction materials at site
IS 6925 – Methods of test for determination of water soluble Chlorides in concrete admixtures
IS 7861 – Code of practice for extreme weather concreting (part I)
IS 9103 – Admixtures for concrete
IS 2386 – (Part 1 to 8) Methods of test for aggregates for concrete.

2.3 SUBMITTALS

2.3.1 Material Report

Prior to delivery of materials required for concrete, the following shall be submitted by the Contractor to the EIC for approval:

Recommended suppliers and / or sources of all ingredients for making concrete such as cement, fine aggregate, coarse aggregates, water and additives.

Quality Inspection Plan to ensure continuing quality control of ingredients by periodic sampling, testing and reporting to the EIC on the quality of materials being supplied.

2.3.2 MIX DESIGN

The Contractor shall make design mixes for each class of concrete indicating that the concrete ingredients and proportions will result in concrete mix meeting requirements as specified between Prior to commencement of concreting work the Contractor shall submit the mix design as a report for the approval of the EIC.

2.3.3 PLANT AND EQUIPMENT

The Contractor shall submit the following to the EIC well in advance.

The proposed program, methods, details of plant and equipment to be used in testing ingredients, mix design and concrete samples.

The Contractor shall set up a concrete testing laboratory adequately equipped and suitably staffed.

2.3.4 CERTIFICATES

2.3.4.1

With each mix design, the Contractor shall submit laboratory test reports and manufacturer's certificates attesting that ingredients are conforming to the specifications.

In case the source, brand or characteristic properties of the ingredients need to be varied during the term of the contract, a revised laboratory mix report shall be submitted.

During concreting operations, the Contractor shall carry out inspection and testing as described in subsection herein, and all reports thereon shall be submitted in summary form to the EIC

2.3.4.2 Schedules

The Contractor shall prepare working schedule for dates and placing of concrete for each item of work, well in advance and submit same to the EIC for approval

2.3.4.3 MATERIALS

Before bringing to the site, all source and quality of materials for concrete shall be approved by the EIC. All approved samples of materials shall be deposited in the office of the EIC, before placing orders. The materials brought, shall conform in every respect to the quality of the approved samples.

Fresh samples be deposited with the EIC whenever type or source/brand of any material changes. The Contractor shall check each fresh consignment as and when brought to the site to ensure that they conform to the quality of the approved samples.

The EIC shall have the opinion to have any of the materials tested to find whether they are in accordance with the specifications, at the Contractor's expense. All bills, vouchers and test certificates which in the opinion of the EIC are necessary to convince him about the quality of materials, shall be produced for his inspection when required.

Any materials, which have not been found to conform to the specifications and not approved by the EIC shall be rejected and shall be removed from the site by the Contractor within the time stipulated by the EIC. The EIC shall have the powers to cause the Contractor to purchase and use materials from any particular source / brand, as may in his opinion be necessary for the proper execution of work.

2.3.4.4 CEMENT

The cement shall be Ordinary Portland cement conforming to IS 269.

The cement brought to the site shall be deemed to conform to the applicable specifications.

However, the Contractor shall test in an approved laboratory, to ascertain the test results. In case test results of any particular sample of cement are considered by the EIC as not satisfactory the particular batch/consignment of cement shall not be incorporated in the work.

Contractor shall be fully responsible for stability of structure/buildings constructed by using the cement issued and incorporated in the work.

The Contractor shall maintain records in approved form showing details of incorporation of cement and other such necessary details. The Contractor shall carry out 7 days tests from time to time in accordance with IS 3535, IS 4031, and IS 4032. Different brand of cement from different sources shall not be used without prior notification.

Unless otherwise agreed by the EIC, the cement shall be supplied packed in bags. Packaged cement shall be delivered to the site in original sealed bags, which shall be labelled with the weight, date of manufacture, name of manufacturer, brand and type. Cement received in torn bags, shall not be used. Bags of cement, which vary in weight by more than 3% shall not be accepted. All cement shall be fresh when delivered and at ambient atmospheric temperature.

In fair-faced elements, the cement used in the concrete for any complete element shall be from a single consignment. All cement for exposed concrete shall be from the same approved source and uniform in colour.

With each and every delivery of cement the contractor shall submit the manufacture certificate to the EIC that the cement conforms to the relevant Indian standards.

Aggregates from natural source shall be in accordance with IS 383. The Contractor shall submit to the EIC certificates of grading and compliance from the suppliers for all consignments of aggregate. In addition from time to time, the contractor shall test that aggregates at site in accordance with IS 2386 Parts, I and III. The contractor shall allow for and provide all necessary apparatus for carrying out such tests and for supplying test records to the EIC.

For fair faced concrete, the Concrete shall ensure that the aggregate are free from iron points and impurities, which may cause discoloration.

2.3.4.5 FINE AGGREGATE

The fine aggregate shall be approved river sand, it shall be free from clay, loam, earth, vegetable matter, salt and other harmful chemical impurities. Its shall be clean, sharp, strong, angular and composed of hard siliceous material.

The grading of sand as determined by the method prescribed in IS 2386 Part I shall be within the limits of Grading zone III.

TABLE – I-FINE AGGREGATE	
IS Sieve Designation	Percentage passing for Grading Zone III
10 mm	100
4.75 mm	90 – 100
2.36 mm	85 – 100
1.18 mm	75 – 100
600 micron	35 – 60
300 micron	8 – 30
150 micron	0 – 10

The maximum quantity of silt as determined by the method prescribed in IS 2386 Part II shall not exceed 8 percent. By volume

2.3.4.6 COARSE AGGREGATES

The coarse aggregate shall be Granite stone. Coarse aggregates obtained from crushed or broken stone shall be angular, hard, strong, dense, durable, clean and free soft, friable, thin, flat, elongated or flaky pieces. The Contractor shall ensure that aggregates are free from iron pyrites and impurities which may cause discoloration.

Aggregates from natural sources shall be in accordance with IS 363. The Contractor shall submit to the EIC certificates of grading and compliance from the suppliers for all consignments of aggregate. In addition from time to time, the Contractor shall test the aggregates at site in accordance with IS 2386 Parts I, and III. The Contractor shall allow for and provide all necessary apparatus for carrying out such tests and submit test records to the EIC.

2.3.4.7 WATER

Water used for the works shall be potable water and free from deleterious materials. Water used for mixing and curing concrete as well as for cooling and /or washing aggregates shall be fresh and clean, free from injurious amounts of oil, salts, acids, alkali, other chemicals and organic matter.

Water shall be from the source approved by the EIC and shall be in accordance with clause 4.3 of IS 456. Before starting any concreting work and wherever the source of water changes, the water shall be tested for its chemical and other impurities to ascertain its suitability for use in concrete for approval by the EIC. No water shall be used until tested and found satisfactory.

2.3.4.8 ADMIXTURES AND ADDITIVES

Chemical admixtures shall not be used without the approval of the EIC. In case their use is permitted, the type, amount and method of use of any admixture proposed by the Contractor shall be submitted to the EIC for approval. The admixtures when used shall conform to IS 9103. The suitability of all admixtures shall be verified by trial mixes.

The Contractor shall further provide the following information concerning each admixture to the EIC.

1. Normal dosage and detrimental effects if any of under dosage and over dosage.
2. The chemical names of the main ingredients in the admixture.
3. The chloride ion content if any expressed as a percentage by weight of admixture.
4. Whether or not the admixture leads to the entrapment of air when used in the manufacturers recommended dosage.
5. Where two or more admixtures are proposed to be used in any one

mix, the manufacturer's written confirmation of their compatibility.

In reinforced concrete, the chloride ion of any admixture used shall not exceed 2% by weight of the admixture as determined in accordance with IS 6925 and the total chloride ion in all admixtures used in concrete mix shall not exceed 0.03% by weight of cement. The addition of calcium chloride to concrete containing embedded metal will not be permitted under any circumstances. Retarding admixtures when used shall be IS 7861. Waterproofing admixtures shall comply with IS 2645.

2.3.5 PLANT

The Contractor shall obtain the approval of the EIC for all plant items he proposes to use for the manufacture and placing of concrete. The arrangement and siting of plant for the manufacture of concrete shall be agreed with the EIC. The Contractor shall maintain all items of plant at all times in a clean and efficient working condition.

2.3.6 STORAGE

All goods and products covered by these specifications shall be procured well in advance and stored as specified below.

2.3.6.1 CEMENT

Cement shall be stored and stacked in bags in dry, waterproof, draught free but well ventilated shed. The bags shall be stacked at least 100 to 200 mm clear the floor. A space of 600 mm around should be kept between the exterior walls and the stacks. Cement bags should be placed close together in the stock to reduce circulation of air as much as possible. Cement bags shall not be stacked more than 10 bags high to avoid lumping under the bags in header and stretcher fashion, that is alternatively lengthwise and crosswise so as to tie them together and lessen the danger of topping over. For extra safety cement for an unusually long period, enclose the stock completely in polythene sheet or any other suitable water proofing material. The flap will close on the sheet is not damaged any time during use. When removing are thus stepped back, there is less chance of over turning them. When removing cement bags for use apply the "first in first out", rule, that is, take the oldest cement out first. Each consignment of cement shall be stacked separately therein to permit easy access for inspection and facilitate removal.

Cement stored during monsoons or cement expected to be in store for more than eight weeks shall be completely enclosed in polythene sheet so arranged that the flap closes on the top stack. The Contractor shall ensure that protective polythene sheet is not damaged at any time during use. Consignments of cements shall be used in order of delivery. A record shall be kept of the batch numbers of cement deliveries in such a form that the part of the works in which the cement to be used can be readily identified. Cement stored longer than eight weeks shall meet the test requirements at

any time after storage when re testing is ordered. Cement which has deteriorated in quality that it no longer conforms in all respects to the requirements of this specification will be rejected by the EIC and shall not be used in the work. The Contractor shall immediately remove from the site all cement, which has been so rejected.

2.3.6.2 AGGREGATES

Aggregates shall be stored on a suitable well – drained raft of concrete, timber, metal or other approved material. The storage of aggregate on the ground will not be permitted. Each size of aggregate shall be stored separately in such manner as to prevent spillage and mixing of one aggregate with an adjacent aggregate. The dividing walls of any bins shall be of sufficient height and the aggregate shall be so deposited that a distance of 300 mm shall be left between the top, of the division wall and any part of the aggregate stack, when stack piling, the aggregate shall not form pyramids resulting in segregation of different size particles. The stacks shall be regular and of a height not exceeding 600 mm.

2.3.7 CONCRETE MIX PROPORTIONS

Cement concrete used in the works shall be one of the two categories given below:

2.3.7.1 Ordinary concrete

All cement concrete not designated by strength shall be treated as ordinary concrete of nominal volumetric mix as specified. The aggregates and cement shall be as specified and measured by volume. Mixing water shall be measured in graduated liter cans.

2.3.7.2 Controlled Concrete

All cement concrete designated by strength shall be treated as controlled concrete. The controlled concrete shall conform to one of the grades specified herein or on the drawings. The aggregates and cement shall be measured by weight in approved weigh batching equipment. Mixing water shall be measured in graduated liter cans. One or more complete bags of cement shall be used for each batch of concrete.

The controlled concrete shall meet with the strength requirement laid down in Table 2. The aggregate cement ratio and water cement ratio to be used for obtaining the specified cube strengths, given in Table 2, shall be determined in accordance with the design of the mix.

The Contractor shall be responsible for designing mixes of the specified performance to suit the degree of workability and characteristic strength

TABLE -2					
Minimum compressive strength of 150 mm cement cubes					
Grade Kg/cm Concrete	Minimum of Cement content per cum			Works Test	
				7 days	28 days
M 15	300 Kg			According to Proportional Strength of Preliminary Test	165
M 20	320 Kg				220
M 25	340 Kg				280
M 30	360 Kg				330

required for the various parts of the works.

Alternative mixes may be designed by the Contractor for use in thin, narrow and thick sections. Special mixes using fine aggregates may be designed by him for infilling pockets, narrow spaces and regions of congested reinforcement.

The minimum cement content for controlled concrete shall not be less than the amounts given in Table 2 for the particular grade of concrete.

2.3.8 WATER / CEMENT RATIO

The quality of water added to the cement and aggregates during mixing shall be such as to produce concrete having sufficient workability to enable it to be properly compacted, to be worked into the corners of the shuttering and around reinforcement.

Due care shall be taken to the variation of moisture content. Within any consignment of aggregate and variations due to watering, exposure to rain or drying weather, the Contractor shall carry out regular moisture content tests in accordance with IS 2386 Part III on stacked aggregates as directed by the EIC.

In case of ordinary concrete the maximum value of water / cement ratio shall be 0.50 and in the case of controlled concrete the water cement / ratio is determined by the mix design.

The Contractor shall exercise in particular tight control of the water content for fair faced concrete, the color of which is sensitive to small variations of water in the mix.

When a suitable water cement ratio has been determined and agreed with the EIC, it shall be maintained throughout the corresponding part of the works. Approved tests shall be undertaken periodically by the Contractor to satisfy the EIC the maintenance of the consistency. However the amount of water added to a mix other than for fair faced concrete may be reduced below the agreed design amount with the consent of the EIC, if the Contractor is able to demonstrate that such a reduction is consistent with

producing concrete of the required workability and characteristics strength. The Contractor shall frequently test the concrete for slump cone test. The slump at the point of placing as measured in accordance with the methods laid down in IS 1199 shall not be more than 75 mm and not less than 50 mm except for concrete containing a retarding / plasticizer admixer when the initial slump shall be 100 mm + /- 25 mm.

2.3.9 APPROVAL OF DESIGN MIX

The Contractor shall submit to the EIC for comment sufficient evidence based on trial mixes that for each grade of concrete the intended workability, the proposed mix proportions and the method of manufacture will produce concrete of the required quality.

The Contractor shall obtain from the EIC his written approval on the mix design for each grade of concrete before any concrete of that grade is placed in the works.

For each grade of concrete, three separate batches of concrete shall be made by the Contractor using materials typical of the proposed supply and under full-scale site conditions.

The workability of each of the trial batches shall be determined and 6 specimen preliminary test cubes shall be produced from each trial batch. Three cubes of each set shall be tested at 7 days and the remaining 3 cubes of each set shall be tested at 28 days.

The trial mix proportions for each grade of concrete shall be considered satisfactory if the mean strength of the 9 cubes tested at 28 days characteristic strength and the Contractor has satisfied the EIC that the concrete contain the correct amount of cement and the free water / cement ratio is below the maximum specified value.

Following agreement with the EIC on the trial mix proportions should the Contractor wish to make substantial changes in the materials or in the proportions of the materials to be used in a mix, the EIC will require further trial mixes to be made and their result submitted for his comments prior to such material or proportions being adopted by the Contractor.

2.3.10 CONCRETE TESTING

2.3.10.1 Test cubes

The strength of concrete either in assessing the suitability of the trial mixes or when placing in the works shall be determined from 150 mm cubes made, cured, stored, transported and tested in accordance with IS 516. The criteria for acceptance of concrete shall be as per clause 15 of IS 456 1978 or as specified otherwise. Test cubes shall be made as, directed by the EIC.

Test cubes shall be made under the direct supervision of the competent person appointed by the Contractor to supervise all stages of the

preparation and placing of concrete. They shall be made by the Contractor in the presence, of the EIC generally from concrete taken at the point of discharge from the mixer and the Contractor shall provide suitable facilities in the form of a hut or other covered protection as agreed with or directed by the EIC for the storing and curing of the test cubes during the first 24 hours after casting them and until they are dispatched to the testing laboratory.

Test cubes shall be marked and dated in such a manner that the grade and the part of the works in which the concrete they represent has been placed can be readily identified. Testing shall be done at an approved laboratory or at the site itself and the results shall be submitted promptly by the Contractor to the EIC.

2.3.10.2 Works Tests

When concrete of a particular grade is first used in the works, 2 cubes shall be taken from 3 separate batches during each of the first 7 days of using that grade. Of these 6 cubes made daily, 3 cubes (each cube representing concrete made of a different batch) shall be tested at 7 days and the remaining 3 cubes shall be tested at 28 days.

For every subsequent 20 CUM of concrete or for every day's concreting be the less in volume, 6 cubes shall be made for each grade of concrete and tested at, both 7 and 28 days.

If the mean concrete strength determined from such 28 days cube test does not reach the characteristic strength for that grade, the materials and / or their proportions for that grade shall be modified by the Contractor to the satisfaction of the EIC.

In addition the Contractor shall at his own expense take such actions as the EIC may consider necessary on the concrete placed in that part of the Works represented by the set of cubes so found to be below the characteristic strength. **(Refer IS 456 -2000)**

2.3.11 WEIGH BATCHING

Unless otherwise agreed with the EIC, all concrete ingredients except water for controlled concrete shall be weigh batched using a platform balance (similar to one used for weighing luggage Railway station) weighing upto 200 kg to the nearest 100 gm or any other approved type of weigh batcher.

The weigh batching equipment shall have an accuracy of 3 percent. The weigh batchers shall be tested for accuracy of calibration before commencement of work and at least once a fortnight thereafter, or more frequently if so desired by the EIC.

2.3.12 MIXING

All concrete, whether ordinary or controlled, shall be mixed in an approved mixer for the minimum time necessary to ensure adequate quality and

uniform distribution of the materials. The cement and aggregates shall normally be first mixed dry until all particles of aggregate are coated with cement after which the water shall be added. Allowance shall be made for the moisture content of the aggregates when calculating the amount of water to be added for each mix.

The temperature of the aggregate, water and cement when added to the mixer shall be such that the temperature of the concrete at the time of placement is less than 40 C.

Materials for concrete shall be deposited into the drum while it is in rotation. Mixers shall not be loaded beyond their rated capacity and each batch shall be completely discharged from the drum before recharging takes place.

Facilities shall be provided to spray the mixer drum with cool water between batches and on the completion of concreting the drum shall be washed down. The surface of the mixer drum shall be maintained in a clean condition at all times.

Re-tampering and /or mixing of concrete, which has partially hardened and set, will not be permitted under any circumstances. Adequate number of stand by mixers with diesel /petrol driven engines shall be arranged by the Contractor to carryout uninterrupted concreting work in case of power failure.

2.3.13 TRANSPORTING

The period between mixing and placing it in the final position shall be kept to a minimum and the delivery of concrete shall be coordinated with the rate of placement to avoid delays in delivery and placement.

Concrete shall be handled from the place of mixing to the place of final deposit by methods, which prevent segregation, loss of ingredients, contamination and maintain the required workability.

Should any segregation have occurred in any batches arriving at the place of deposition, such batches shall be deposited and thoroughly turned over by hand before placing in the works.

Where concrete is conveyed by chutes, the chutes shall be made of metal or fitted with metal linings. The approval of the EIC shall be obtained for the use of chutes in excess of 3 meters long and in such cases the concrete shall be remixed if so required by the EIC.

All plant and equipment used in the transportation of concrete shall be thoroughly cleaned before and after each working period and at all changes of concrete mixes, water used for this purpose shall be discharged well clear of formwork or the concrete already in place.

2.3.14 PREPARATION BEFORE CONCRETING

The inside surface of the forms against which concrete is to be placed shall

be clean and free from dried or hardened spattering of coatings of concrete. The forms shall be well wetted before placing concrete.

When the work has to be resumed on a surface which has hardened, such surface shall be roughened. It shall then be swept clean, thoroughly wetted and covered with 12 mm layer of freshly mixed mortar composed of cement and (in the same ratio as the cement and sand in the concrete mix) immediately before placing of concrete.

Before any concrete is placed on the subgrade, the subgrade shall be checked and approved for degree of compaction and alignment. The subgrade shall be kept damp ahead of concreting.

Concrete shall not be placed in the works until the EIC has inspected the formwork, reinforcement, inserts, sleeves if any and given his permission to place concrete.

2.3.15 PLACING

Concreting of any portion of the works shall be done only in the presence of the representative of the EIC.

Concreting shall be carried out continuously between construction, contraction or expansion joints, shown on the drawings or agreed with the EIC. The Contractor shall closely follow the sequence of concreting where specified on the drawing. If concreting is interrupted before reaching the predetermined joint an approved construction joint shall be provided.

Immediately before placing of concrete for columns, the reinforcement within and the old concrete at the bottom of the formwork shall be given a coating of cement sand mortar of the identical materials and proportions to be used in the subsequent concrete, to prevent the loss of fine material from the initial concrete pour.

Concrete shall be deposited as nearly as is practicable in its final position and shall not be dumped in a large quantity at any point to be run or worked along the form work manually or with vibrators. Concrete shall not be deposited at a faster than it can be placed and compacted.

Concrete shall be thoroughly worked into the forms so that they are entirely filled, reinforcing bars adequately and tightly surrounded and entrained air released from the mass of concrete. Placing shall be carried out by hand prodding as well as vibrators in a manner directed by the EIC.

The concrete shall be placed in layers not greater than 30 mm thickness and thoroughly compacted before subsequent layers are placed. Concrete shall be placed in single operation to the full thickness of slabs, beams and similar members. No new concrete shall be placed on concrete, which has set sufficiently to cause the formation of planes of weakness.

2.3.16 COMPACTION

Each layer of concrete whilst being deposited shall be compacted by approved methods to form a dense material with all surface free from honey combing, air holes or other blemishes. The Contractor shall use mechanical vibration for all concrete and shall take care that internal vibrators shall not be brought into contact with the reinforcement or the form work. Where external vibration of the forms is not adopted for fair faced surfaces, the concrete shall be tamped using steel rod adjacent to such surfaces in addition to internal vibrating.

An adequate number of vibrators shall be used to ensure that compaction of concrete is achieved within minutes of placing. Particular attention shall be given to the compaction of the concrete around the water bars to ensure that no voids or porous areas are left.

Compacting shall cease as soon as excess water appears on the face of concrete. Any water accumulating on the surface of newly placed concrete shall be removed by approved methods and no further concrete shall be placed thereon until such water has been removed.

Notwithstanding the requirements regarding mix design, should it be found that the proportion of water in the mix is such that latency forms before compaction (i.e. completion of expulsion of air) is complete, the quantity of water in the mix shall be reduced. No water shall be added to concrete after mixing has been completed, but where the proportion of water in the mix is such that it is impossible to achieve complete compaction, the quantities of aggregate shall be reduced without any alteration to the quantities of cement and water. Whenever either of the aforesaid procedures are to be adopted, an additional set of 6 cubes for testing at 7 days or 28 days shall be made from the adjusted mix.

The time elapsing between the discharge of the concrete from the mixer and the completion of compaction shall not exceed 30 minutes.

Sufficient number of spare vibrators shall be kept readily accessible to the place of deposition of concrete to ensure adequate vibration in case of breakdown of those in use. Also, stand by petrol / diesel vibrators shall be kept on site for use in case of power failure.

2.3.17 FINISHES

All concrete surfaces shall have a good, dense finish, except for slabs, the exposed faces of concrete for which form work is not provided shall be smoothed with a steel or wooden trowel to provide a finish equal to that face where form work is provided.

The top surface of all floor and roof slabs specified as smooth shall be levelled and trowelled before the concrete begins to set to a smooth finish at the levels or falls shown on the drawings. The trowelling shall be done at such a time and in such a manner that an excess of mortar is not brought to the surface of concrete nor the aggregate displaced. The top surfaces of

concrete slabs specified to receive an integral finish shall be uniformly roughened by deep hacking before the finish is laid.

Immediately after striking the form work and removing any superficial water, honeycombed areas in normal unfinished concrete shall be inspected by the EIC and where directed the Contractor shall immediately make good at his own expense such honeycombing whilst the concrete is still green to the satisfaction of the EIC. All air holes shall be similarly filled in.

The Contractor shall be responsible for providing an adequate key in concrete where plastering or rendering is specified to be applied. Hacking of the concrete surface immediately after striking the form work will be permitted.

The faces of all fair faced concrete shall be of even color throughout, free from air bubbles, cracks, honeycombing or other blemishes and will be inspected by the EIC, immediately after the Formwork has been struck. Such faces shall not be rubbed down after striking the formwork to remove fins or any similar imperfections without the prior permission of the EIC.

Concrete surface finishes shall be according to the requirements and all instructions by the EIC with regards to the method of achieving such finishes shall be implemented.

2.3.18 CURING AND PROTECTING

Walling on concrete shall not be permitted for atleast 24 hours after it has been placed in position, or for such additional length of time as directed by the EIC.

Immediately after compaction and completion of any surface finishes, the concrete shall be protected from the evaporation of moisture by means of polythene sheeting, wet hessian or other similar material kept soaked by spraying. As soon as the concrete has attained a degree of hardening sufficient to withstand surface damage, moist curing shall be implemented and maintained for a period of at least 15 days after casting.

Method of curing and their duration shall be such that the concrete will have satisfactory durability and strength and members suffer a minimum distortion, be free from excessive efflorescence and will not cause, by its shrinkage, undue cracking in works.

The top surfaces of slabs and other horizontal surfaces shall be cured by impounding water in cement mortar bunds. Steeply sloping and vertical formed surfaces shall be kept completely and continuously moist prior to and during the striking of formwork by applying water to the top surfaces and allowing it to pass down between the formwork and the concrete.

The Contractor shall give careful consideration to the curing methods and

conditions for fair faced concrete. Components which are specified to have exposed concrete finish shall receive the same curing treatment. Moreover water used for curing shall be clean so as not to discolour the concrete.

All fair faced concrete shall be protected from damaged from the time of striking the formwork. All edges and surfaces of such concrete shall be protected from chipping using notched timber corner pieces or other suitable covers, which shall be maintained, in place until the completion of the works.

The Contractors shall be responsible for ensuring all fair faced concrete free from stains of concrete materials and shall clean all such staining as soon as possible to the satisfaction of the EIC.

2.3.19 CONSTRUCTION JOINTS

Construction joints shall be formed only where shown on the drawings. Where the Contractor wishes to form joints in concrete other than those shown on the drawings, he shall submit his proposals giving the position, form and treatment of such joints to the EIC for his approval.

Vertical construction joints shall be formed against a stop board and horizontal construction joints shall be level.

Except where shown otherwise on the drawings, reinforcement shall continue through construction joints.

As soon as possible after the formwork has been struck for vertical joints or after the concrete has set in horizontal joints, the surface laitance of the hardened concrete on the face of the joint shall be removed to expose the coarse aggregate in such a manner that the loosened particles of aggregate and damaged concrete are not left on the surface. The exposed face shall be swept clean of foreign matter and laitance. Feathered construction joints will not be permitted immediately before placing the new concrete, neat cement grout shall be poured over the old concrete followed for horizontal joints by a 12 mm thickness of sand cement mortar of the same materials and proportions to be used in the new concrete.

2.3.20 CONSTRUCTION JOINTS

Contraction joints required will be as shown on the drawings. Contraction joints shall not be hacked, wetted or mortared before concrete is placed against them

2.3.20.1 JOINT SEALING COMPOUNDS

Joint sealing compounds shall seal joints in concrete against the passage of water, prevent the ingress of grit or other foreign material and protect the joint filler. The compound shall have good extensibility and adhesion to concrete surfaces and shall be resistant to flow and weathering.

Polysulphide joints where specified on the drawings shall be seated with polysulphide liquid polymer, stored, mixed, handled applied and cured strictly in accordance with the manufacturer's written instructions. Such joints shall be formed to the correct dimensions, thoroughly cleaned and treated with recommended primer strictly in accordance with the manufacturers written instructions prior to sealing. The contractor shall use only competent personnel experienced in the application of polysulphide for such work.

Where specified in the drawings, rubber /bituminous/ epoxy based sealant shall be of an approved manufacture. The treatment of the joint and the use of sealing compound shall be strictly in accordance with the manufacturers' written instructions.

2.3.20.2 WATER BARS

Where water bars are shown on the drawings, the joints shall incorporate an approved PVC external type water bar complete with all necessary moulded or prefabricated intersection pieces assembled in accordance with the drawings with bends and butt joints in running length made by heat welding in an electrically heated jig.

Jointing and fixing of water bars shall be carried out strictly in accordance with the manufacturers written instructions.

The water bars shall be installed so that they are securely held in their correct position during the placing and compacting of the concrete.

Where reinforcement is present adjacent to water bars, adequate clearance shall be left between the reinforcement and water bars to facilitate compaction of the concrete.

Double headed nails may be used in the edge of the water bar outside the line of the external grooves for fixing purposes, but no other holes shall be permitted through the water bars.

2.3.20.3 INSERTS

The Contractor shall fix all necessary inserts such as steel plates, pipe sleeves, bolts etc., and make provision for holes, pockets, dowels etc., in the formwork to enable subsequent fixing of supports, brackets, precast members etc., as indicated on the drawings or as required by the EIC. In –situ concrete inserts shall be as per IS 1946 and of a type approved by the EIC.

With the prior agreement of the EIC, expansion type fasteners may be used by the contractors in hardened concrete.

2.3.20.4 CRACKS

If any cracks develop in the reinforced cement concrete construction, which

in the opinion of the EIC may be detrimental to the strength of the construction, the contractor shall test the structural element in question. If under these test loads the cracks shall develop further the contractor shall dismantle the construction and cart away the debris, replace the construction and carryout all consequential work thereof.

If the cracks are not detrimental to the stability of the construction in the opinion of the EIC, the contractor shall grout the cracks with pneumatically applied mortar or epoxy grout. The contractor shall also make good all other building works such as plaster, moulding, surface finish of floors, roofs, ceiling etc., which in the opinion of the EIC have suffered damage either in appearance or stability owing to such cracks

2.3.21 LOAD TESTING ON COMPLETED STRUCTURES

During the period of construction or within the defect liability period the EIC may at his discretion order the load testing of any completed structure or any part thereof if he has reasonable doubts about the adequacy of the strength of such structure for any of the following reasons:

- Results of compressive strength on concrete test cubes falling below the specified strength.
- Premature removal of formwork
- Inadequate curing of concrete
- Over loading during the construction of the structure or part thereof.
- Carrying out concreting of any portion without prior approval of the EIC.
- Honey combed or damaged concrete which in the opinion of the EIC is particularly weak and will affect the stability of the structure to carry the design load, more so in important or critical areas of the structure.
- Any other circumstances attributable to allowed negligence of the contractor which in the opinion of the EIC may result in the structure or any part thereof being of less than the expected strength.

All the loading tests shall be carried out by the contractor strictly in accordance with the instructions of the EIC. Such tests should be carried out only after expiry of minimum 28 days or such longer period as directed by the EIC.

All costs involved in carrying out the tests and other incidental expense thereto shall be borne by the contractor regardless of the result of the tests. The contractor shall take down or cut out and reconstruct the defective work or shall make the remedial measures instructed at his own cost.

In addition to the above load tests non destructive test method such as core test and ultrasonic pulse velocity test shall be carried out by the contractor at his own expense if so desired by the EIC. Such tests shall be carried out by an agency approved by the EIC and shall be done under BNADES guidance using only recommended testing equipment. The acceptance criteria for these tests shall be mutually agreed between the EIC and the contractor.

2.3.22 SUPERVISION

All concreting work shall be done under strict supervision of the qualified and experienced representatives of the Contractor as well as those of the EIC. The Contractor's engineer and supervisor who are in charge of concreting work shall be skilled in this type of work and shall personally superintend all the concreting operations.

Special attention shall be paid to the following

- Proportioning, mixing and quality testing of the materials with particular control on the water/cement ratio.
- Laying of material in place and thorough compaction of the concrete to ensure solidity and freedom voids and honey combing.
- Proper curing for the requisite period.

Reinforcement position is not disturbed during concreting and consolidation by vibration

2.3.23 QUALITY CONTROL

2.3.23.1 TESTING ROOM

Testing room of not less than 10 sqm equipped with the following apparatus and qualified concrete technician, labour and materials required for carrying out test therein shall be provided by the contractor.

1.	Sieve set (for aggregate 20 mm down)	
	40 mm	Dia 45 cms.
	20 mm	Dia 45 cms.
	16 mm	Dia 45 cms.
	12.5 mm	Dia 45 cms.
	10 mm	Dia 45 cms.
	4.75 mm	Dia 45 cms.
	600 Micron	Dia 20 cms.
	300 Micron	Dia 20 cms.
	150 Micron	Dia 20 cms.
	75 Micron	Dia 20 cms.

2.	Weighing	
a.	Physical balance cap. 200 gms with weight box (accuracy 0.5 gm)	
b.	Counter scale cap. 20 kg	
c.	Weights	
	5Kg.	500 Gms.
	2 kg.	200 Gms.
	1 Kg.	100 Gms.
d.	Slump cones	
e.	15 cms moulds	
f.	Electric / kerosene heater	
g.	Fans etc., as directed by the EIC	
h.	Vicat Apparatus with needles, test tubes, breakers, thick glass plate etc.,	
i.		
j.	Measuring cylinder	1000 ml, 500 ml., 100 ml, 10 ml.
k.	Wash bottles	Cap 500 ml
l.	Sink	
m.	Work benches, shelves, desks and any other furniture and lighting as required by the EIC.	
n.	Spring balance dial type cap. 100 Kg	
o.	Liter measures	10 Ltr
		05 Ltr
		02 Ltr
		01 Ltr
		0.5 Ltr

APPENDIX 1

STANDARD CONCRETE MIX DESIGN PRESENTATION

Grade of Concrete :

Cement content and type :

Water Cement Ratio :

Free water :

Specified Strength at 28 days :

Current Standard Deviation :

Admixture Type :

Admixture Dosage :

Slump 30 minutes/slump	:	
60 minutes (in laboratory)	:	
Air Content	:	
Chlorides (as NaCl)	:	
Sulphates (as SO ₃)	:	
Combined Aggregate Grading	:	
Sieve Size	75 m 38.1 mm 19 Mm 9.5 m 4.75 mm 2.36 mm 1.16 mm 0.60 mm 0.30 mm 0.15 mm 75 Micro	
% Passing		
Total in mix, expressed as a percentage by weight of cement		

2.4. FORMWORK.

2.4.1 SCOPE

The scope of work for Formwork includes for providing, fabricating and erecting of formwork including propping, bracing, shorting, strutting, fitting, bolting, wedging and all other temporary supports to the concrete during the process of setting and subsequent removal of forms

2.4.2 APPLICABLE CODES AND STANDARDS

IS 456 : Code of practice for plain and reinforce concrete

IS 4900: Plywood for Concrete shuttering work

2.4.3 SUBMITTALS

2.4.3.1 Type of formwork

Prior to start of procurement of material for formwork, the Contractor shall submit samples of various types and obtain approval of the EIC.

2.4.3.2 Design of forms

Before fabricating of forms, the Contractor shall submit design calculations for proposed formwork to the EIC for approval. The approval of the formwork design in no way will relieve the Contractor of his responsibility for adequately constructing and maintaining the form of proper functioning.

2.4.3.3 Tie Bolts

In case tie bolts are used running through the concrete, the location and size of such tie bolts shall be submitted to the EIC before hand cost of tie bolt include in

2.4.4 MATERIALS

2.4.4.1

Formwork shall be of timber, plywood, steel or any other material capable of resisting damage to the contact faces under normal conditions of erecting forms and placing concrete. The selection of material suitable for formwork shall be made by the contractor based on the maximum quality with the specified finished and safety.

2.4.4.2 Timber

Timber used for formwork shall be easily workable with rails without splitting. It shall be stable and not liable to warp when exposed to sun and rain or wetted during concreting.

2.4.4.3 Plywood

Plywood used for formwork shall be of appropriate thickness and of shuttering quality complying with IS 4990 and of make approved by the EIC.

2.4.4.4 Steel

Steel formwork shall be made of 4 mm thick black sheets stiffened with M S angle – 40 mm x 40 mm x 6mm.

2.4.5 DESIGN CRITERIA

Formwork shall be designed for the loads and lateral pressures due to dead weight of concrete, superimposed live loads of workmen, materials and plants and for other loads as indicated the drawings. The tolerance for formwork shall be as per clause 10.1 of IS 456 1978.

Forms shall be designed to have sufficient. Strength to carry the hydrostatic head of concrete as a liquid without deflection tolerance exceeds the acceptable limits.

Where necessary to maintain the tolerance indicated; on the drawings, the formwork shall be cambered to compensate for anticipated deflections due to the weight and pressure of the fresh concrete, and also due to any other construction loads. Unless otherwise shown or specified the camber shall be provided as below:

Type of member	Compression Steel as % of Tensile steel	Camber coefficient
Simple span	0 %	0.666
	50 %	0.037
Continuous	0 %	0.032
Restrained span	50 %	0.022
Cantilever	0 %	0.086
	50 %	0.046

Camber in Cms = $K \times (L / D) \times 2.54$

Where K = Camber Coefficient
L = Length of member in meter
D = Depth of member in meter

2.4.6 ERECTION OF FORMWORK

Forms shall be used wherever necessary to confine the concrete during vibration and to shape it to the required lines. The formwork shall conform to shapes, lines, levels and dimensions of the concrete shown on the drawings. Forms shall have sufficient strength to withstand the pressures resulting from placement and vibrations of concrete and shall be maintained rigidly in positions. Formwork shall be adequately supported by adequate number and size of struts, braces, ties and props to ensure rigidity of forms during concreting. Where props rest on natural or filled up ground, to avoid any settlement the soil shall be thoroughly compacted and bases of props shall be of sufficient size so as to restrict the bearing pressure on the ground to 5 T/Sqm.

Form shall be tight enough to prevent loss of mortar from the concrete and to produce a dense homogeneous and uniformly coloured concrete completely free from honeycombing or surface roughness. Joints in formwork shall be rigid and watertight, and be designed to prevent leakage not only between and individual elements forming the panels but also from the horizontal and vertical junction between the panels themselves.

If formwork is held together by bolts or wires, those shall be so fixed that no iron shall be exposed on surface against which concrete is to be laid. The EIC may at his discretion allow the contractor to use tie bolts running through the concrete at his own cost. Holes left in the concrete by these tie bolts shall be filled as specified by him at the Contractor's expense.

Formwork shall be constructed so as to facilitate loosening and permit removal without jarring the concrete. Wedges, clamps and bolts shall be used wherever practicable instead of nails.

All formwork erected shall be approved by the EIC before concreting is started.

2.4.7 CLEANING AND OILING OF FORMS

At the time concrete is placed in the forms, the surface of the forms in contact with the concrete shall be free from encrustation of mortar, grout or other foreign material. Temporary openings shall be left at the bottom of formwork to enable sawdust, shavings, wire cutting and other foreign material to be worked out from the interior of the forms before the concrete is placed.

The surface of the form to be in contact with the concrete shall be coated with an approved coating that will effectively prevent sticking and will not stain the concrete surfaces. After each use the surfaces of forms in contact with concrete shall be cleared, well wetted and treated with form oil approved by the EIC. Lubricating (machine) oils, Retarding Liquids etc., shall not be used.

Oiling shall be done before reinforcement has been placed and care shall be taken that no oil comes in contact with the reinforcement while it is being fixed in position.

2.4.8 REMOVAL OF FORMWORK

Shuttering shall be removed by gradual easing without jarring and only in the presence of a competent supervisor. Before removal of the shuttering the concrete shall be examined and removal shall only proceed has attained sufficient strength to support its own weight and if any loading in excess of the design load be anticipated, approved props shall be provided after removal of the shuttering. The Contractor shall in consultation with the EIC maintain record showing the date on which each part of the work is concreted and the data on which the shuttering is removed. Notwithstanding any limitations or other requirements of this specification relating to the period elapsing between placing of concrete and removing shuttering the assessment of such period and any damage or other consequences arising there from shall be the contractor's entire responsibility.

The period shall be increased by an approved number of days if the hardening of the concrete is delayed due to low temperatures or other causes. The period shall like wise be increased for concrete mixtures with high water content, for heavy sections, and for high ratio of dead load to total design load. For beams or similar members the period shall be increased by one day for every 0.60 meters of span in excess of 6.0 meters.

In no circumstances shall forms be struck until the concrete reaches a strength of atleast twice the stress to which the concrete may be subjected at the time of striking.

The strength referred to shall be that of concrete using the same cement and aggregates, with the same proportions, and cured under conditions of temperature and moisture similar to those existing on the work. Where possible, the form work should be left longer, as it would assist the curing.

In normal circumstances (generally where temperature are above 20 deg. C) and where ordinary cement used, forms may be struck after expiry of the following periods.

a.	Walls, Columns and sides of beams	: 24 to 48 hours or as decided by EIC
b.	Removing of props to slabs:	
	Spanning up to 4.5 m	: 15 days
	Spanning over 4.5 m	: 21 days
c.	Removal of props to beams & arches	
	Spanning up to 6 m	: 14 days
	Spanning over 6 m	: 21 days

If the quality of concrete is acceptable, honeycombed surfaces shall be made good immediately upon removal of the shuttering and superficial water and air holes shall be filled. If required and directed by the EIC, the face of exposed concrete placed against shuttering shall, after removal of the shuttering be rubbed with corborundum stone with cement grout lubricant or similar to remove fins and other irregularities. This however, is not a substitution for plaster, which may be required to be carried out for purpose of finishing.

The surface of non-shuttered faces of concrete work other than slabs shall be smothered with a wooden float (or if approved with a steel trowel) to give a finish equal to that of the rubbed down shuttered faces.

Concealed concrete faces shall be left as obtained on removal of shuttering except that honeycombed surface shall be made good.

The top of slabs not intended to be left exposed shall be levelled and floated to a smooth finish at the levels or falls shown on the drawings or elsewhere. The floating shall not be executed to the extent of bringing excess fine material to the surfaces.

Rubbed surfaces of slabs shall where instructed be formed at the time of tamping and levelling. Indentations in slab or stair surfaces shall be formed by approved implements giving the depth and patterns as instructed.

The top faces of slab intended to be covered with screed, granolithic or similar surfacing shall be left with a rough finish.

The soffits of slabs and faces of walls intended to be rendered shall be roughened by approved means to form a key.

Concrete surfaces to take finishes other than those specifically referred to herein shall be prepared in an approved manner as instructed to suit the

finish.

2.4.9 REUSE OF FORMS

Immediately after the forms are removed, they shall be cleaned with jet of water and soft brush before they are reused.

The Contractor shall not be permitted to reuse any forms which in the opinion of the Engineer-in-charge has worn out and has become unfit for formwork. The EIC may in his absolute discretion order rejection of any forms he considers unfit for use in the works, and order their removal from the site.

2.4.10 FORMWORK FOR SLOPED SURFACES

Forms for sloped surfaces shall be built so that the formwork can be placed board by board immediately ahead of concrete placement so as to enable ready access for placement, vibration inspection and repair of the concrete.

The formwork shall also be built so that the boards can be removed one by one from the bottom up as soon as the concrete has attained sufficient stiffness to prevent sagging. Surfaces of construction joints and finished surfaces with slopes steeper than 4 horizontal: 1 vertical shall be formed as required herein.

2.4.11 FORMWORK FOR EXPOSED CONCRETE SURFACES

Where it is desired, directed or shown on the drawings to have original face finish of concrete surface without any rendering or plastering, formwork shall be carried out by using wooden planks, plywood or steel plates of approved quality and as per direction of the EIC.

The Contractor shall use one type of material for all exposed concrete surfaces and the forms shall be constructed so as to produce a uniform and consistent texture and pattern on the face of the concrete. Patches or forms for these surfaces will not be permitted. The formwork shall be placed so that all horizontal form works are continuous across the entire surface. If forms are constructed of lumber and are not panelled the frame work shall be staggered.

To achieve a finish which shall be free of board marks, the formwork shall be faced with plywood or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Wherever possible, joints between sheets shall be arranged to coincide with PCural features, sills, window heads or change in direction of the surface. All joints between panels shall be vertical or horizontal unless otherwise directed. Suitable joints shall be provided between the sheets. The joints shall be arranged and fitted so that no blemish or mark is imparted to the finished surfaces.

To achieve a finish which shall give the rough appearance of concrete cast against sawn boards, formwork boards unless otherwise stated shall be an

average 150mm wide, securely jointed with tongued and grooved joints if required to prevent grout loss with rod positions and direction of boards carefully controlled. Saw boards shall be set horizontally, vertically or at an inclination shown in the drawings. All bolt holes shall be filled with matching mortar recessed 5 mm back from the surrounding concrete face.

Forms for exposed concrete surfaces shall be constructed with grade strips (the underside of which indicated top of pour) at horizontal construction joints unless the use of groove straps is specified on the drawings. Such forms shall be removed and reset from lift to lift, they shall not be continuous from lift to lift. Sheathing of reset forms shall be tightened against the concrete so that the forms will not be spread and permit abrupt irregularities or loss of mortar. Supplementary ties shall be used as necessary to hold the reset forms tight against the concrete.

For fair faced concrete, the position of through bolts will be restricted and generally indicated on the drawings.

Chamfer strips shall be placed in the corners of forms for exposed exterior corners so as to produce 20 mm bevelled edges except where otherwise shown in the drawings. Interior corners and edges at formed joints shall not be bevelled unless shown on the drawings. Mouldings for grooves drip courses and bands shall be made in the form itself.

The wood planks, plywood and steel plates used in formwork for obtaining exposed surfaces shall not be used for more than 3 times in case of wooden planks, 6 times for plywood and 10 times for steel plates respectively. However no forms will be allowed for reuse, if in the opinion of the EIC it is doubtful to produce desired texture of exposed concrete.

In order to obtain exposed concrete work of uniform colour it shall be necessary to ensure that the sand used for all exposed concrete work shall be of approved uniform colour. Moreover the cement used in the concrete for any complete element shall be from single consignment. No exposed concrete surface shall be rendered or painted with cement or otherwise. Plastering of defective concrete as a means of achieving the required finish shall be permitted, except in the case of minor porosity on the surface. The EIC may allow a surface treatment by rubbing down with cement and sand mortar of the same richness and colour as for the concrete. This treatment shall be made immediately after removing the formwork.

The Contractor shall also take all precautionary measures to prevent breaking and chipping of corners and edges of completed work until the building is handed over.

2.5 STEEL REINFORCEMENT

2.5.1 SCOPE

The scope of Steel Reinforcement covers the requirements for providing,

fabricating, delivering and placing of steel reinforcement for all types of concrete work.

2.5.2 APPLICABLE CODES AND STANDARDS

IS 280	Mild steel wire for general engineering purpose
IS 432	Part I Mild steel and medium tensile steel bars Part II Hard drawn steel wire.
IS 456	Code of practice for plain and reinforced concrete
IS 814	Covered electrodes for metal and welding of structural steel.
IS 816	Code of practice for use of metals and welding for general construction in mild steel.
IS 1139	Hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcement.
IS 1566	Hard drawn steel wire fabric for concrete reinforcement
IS 1786	Cold twisted steel bars for concrete reinforcement
IS 2502	Code of practice for bending and fixing of bars for concrete reinforcement
IS 2629	Recommended practice for hot dip galvanizing of iron and steel
IS 3370	Code of practice for concrete structures for the (Part I to IV) storage of liquids
IS 4759	Hot dip zinc coating on structural steel and other allied products.

2.5.3 BARBENDING SCHEDULE

Before commencement of fabrication of any steel reinforcement, the Contractor shall submit the bar bending schedule to the EIC for his approval.

2.5.4 MATERIAL

Steel Reinforcement used shall be high yield strength cold worked deformed steel bars of tested quality conforming to IS 1786 or hot rolled high tensile deformed steel bars of tested quality conforming to IS 1139. It is the responsibility of the Contractor to satisfy himself by any means that steel brought conforms to the required quality and standards as per IS and shall be tested in an approved testing laboratory. If it is established by test results that the characteristics and quality of steel tested do not conform to the standards laid down in the relevant applicable IS the particular batch/consignment of steel from which the above samples are tested shall not be incorporated in the work. The contractor shall be solely responsible for structural stability and safety of all structures/ buildings constructed with Steel Reinforcement and fabricated and incorporated in the work.

Binding wire shall be black annealed steel wire conforming to IS 280 of minimum 18 gauge, except for galvanized reinforcement the wire shall be galvanized steel wire.

Electrodes used for welding of steel bars shall be ordinary mild steel grade

electrodes conforming to IS 814 and shall be of the best quality approved by the EIC.

2.6 STORAGE

Reinforcement shall be handled and stored in a manner that bending or distortion of the bars is avoided and contamination of steel is prevented

All reinforcement shall be stored horizontally above ground level on platforms, skids or other approved supports, clear of any running or standing water. Contact with soil should be avoided to avoid corrosion.

Bars of different classification and diameters shall be stored separately.

A record shall be kept of the batch numbers of reinforcement deliveries in such a form that the part of the works in which particular reinforcement is used can be readily identified.

Welding electrodes shall be stored in moisture controlled environment in accordance with the manufacture's recommendations.

2.7 FABRICATION

Reinforcement steel shall be carefully and accurately cut, bent or formed to the dimensions and configurations shown on the drawings and bar bending schedules.

All reinforcement shall be bent cold using appropriate pin sizes. Bars may be preheated only on approval of the EIC. Hot bars shall not be cooled by quenching. Bends shall be in accordance with IS 2502.

It shall be ensured that the bars are not bent or straightened in any manner that will injure the material. Any bars incorrectly bent shall be used only if means for strengthening and rebending be such as not to affect the material adversely. Reinforcement shall not be rebent or straightened without prior review by the EIC. No Reinforcement shall be bent when in position on the works without the approval of the EIC, whether or not it is partially embedded in hardened concrete.

Reinforcement steel having a reduced section, visible transverse cracks in bends, or otherwise damaged in anyway shall not be used.

Spiral reinforcement shall be accurately fabricated to the pitch shown on the drawings. One and one half (1 ½) finishing turns shall be provided at both top and bottom unless shown otherwise.

2.8 PLACEMENT

All reinforcement shall be placed accurately and maintained in the position indicated on the drawings.

The contractor shall provide approved type of supports for maintaining the bars in position and ensuring required spacing and correct cover of concrete to the reinforcement as noted on the drawings. Precast cement concrete cover blocks of required shape and size, chairs and spacer bars shall be used in order to ensure accurate positioning of reinforcement. Precast concrete cover blocks shall be cast well in advance and shall be at least, equal in quality to the class of concrete specified in the work.

In fair faces of concrete, temporary spacers shall only be used and removed or withdrawn as the compaction of concrete proceeds. Spacers will not be permitted to be left in fair faces of concrete.

All intersections of the reinforcements shall be securely tied with two strands of binding wire twisted tight to make the skeleton or network rigid so that the reinforcement is not displaced during placing of concrete.

TAC welding of crossing bars shall not be done except as approved by the EIC.

The Contractor shall take all reasonable precautions to ensure that when handling or erecting reinforcement no damage shall occur to finished concrete. Bars that are partially embedded in concrete shall not be field bent unless approval has been obtained from the EIC.

Walkways and barrow runs for placing and compacting the concrete shall be independent of the reinforcement.

Loose binding wire and other extraneous metal shall be removed from inside the formwork prior to concrete placing.

Without relieving the Contractor of the responsibilities for the correctness thereof, the reinforcement shall be inspected and approved by the EIC in writing before any concrete is placed and the Contractor shall, allow sufficient time for such inspection and any subsequent remedial action to be carried out.

No part of the reinforcement shall be used for conducting electrical currents.

2.9 COVER TO REINFORCEMENT

Unless shown otherwise on the drawings, minimum cover for all reinforcement shall be provided as per IS 456. Care shall be taken to maintain the correct cover to reinforcement.

For Concrete members exposed to weather, earth, action of harmful chemicals, acid vapour, saline atmosphere, sulphurous smoke etc., minimum cover for reinforcement shall be increased by 15mm to 40 mm as directed by the EIC.

For Concrete members of water retaining structures minimum cover for reinforcement shall be as stipulated in IS 3370 Part II.

The maximum cover for reinforcement shall not be greater than that specified above or shown on the drawings plus 10 mm except for bundled bars.

For bundled bars, minimum concrete cover shall be equal to the equivalent diameter of the bundle but need not be greater than 50 mm.

Exposed reinforcement intended for binding with future extensions shall be protected from corrosion as directed by the EIC.

2.10 CLEANING

After placing, the reinforcement shall be maintained in a clean condition until the concrete is placed. On no account the bars shall be oiled or painted or mould oil used on the formwork be allowed to come in contact with the bars.

Before concreting commences, the bars shall be thoroughly cleaned with dry gunny bags if they are coated lightly with rust or other impurities.

2.11 WELDED LAPS

Wherever specified on the drawings or instructed by the EIC welded laps shall be provided.

The welding of bars shall be done in accordance with IS 816 and as specified on the drawings and instructions. But welding between the ends of bars in line whereby the stress is transferred across the weld shall not be permitted. No welding shall be done at the bend in a bar.

Following sizes of electrodes shall be used for lap with longitudinal beads:

Bar diameter (mm)	6	10	20	32	40
Electrode size (mm)	2	2.5	3.5	5	5

The thickness of weld shall be 0.2 diameter of the smaller diameter bar unless otherwise specified in the drawings. The length of longitudinal bead to weld cold twisted deformed bars shall be 12 diameters of the bar, of which not more than half the length shall be permitted for a continuous bead. Gaps between two such consecutive beads shall be provided as indicated in the drawings.

The Contractor shall employ only a qualified and tested welder specifically trained and experienced in welding of reinforcement bars to execute the welding of laps to the complete satisfaction of the EIC.

Before carrying out the welding of bars on site, the Contractor shall make

minimum 3 joints and get them tested in an approved laboratory (including X ray testing of welds if required) The Contractor shall be permitted to carry out the welding only after the satisfactory test certificate from the laboratory has been obtained. Whenever the welder changes, similar tests shall be carried out. The following precautions must be taken for welded laps:

If the cold twisted deformed bar to be lapped has an untwisted end at the lapping point, the same portion shall be cut off prior to welding up to a length of atleast 100 mm from such end.

Bars shall be free from rust at the joints to be welded. Bars shall be aligned and kept in proper axis in order to minimize crookedness in bar after welding. Slag produced in welding after alternative run should be chipped and removed by brush. Electrode should not be lighted by touching the hot bar.

3.0 STONE MASONRY

3.1 SCOPE

The scope of work for stone masonry including materials and the construction of load bearing and filler/partition walls using the type, dimensions, arrangements, and the coursing as required with mortar, jointing, pointing and other accessories.

3.1.1 APPLICABLE CODES AND STANDARDS

- IS 269 Ordinary Portland Cement and low heat Portland cement.
- IS 2250 Code of practice for preparation and use of Masonry Mortars
- IS 2572 Specification for structural granite
- IS 3620 Specification for laterite stone block for Masonry
- IS 1121 Method of strength properties (First revision) (Part 1) of natural building stones compressive strength.
- IS 1124 Methods of test determination of water absorption, apparent specific gravity and porosity of natural building stones (First revision)
- IS 1706 Method of determination of resistance to wear by abrasion of natural building stones
- IS 2116 Specification for sand for masonry mortars

3.1.2 MATERIALS

The length of stone shall not exceed three times the height and the breadth of base shall not be greater than three fourth of the thickness of wall and less than 150mm. The height of stones may be up to 300mm.

Face stones shall be hammer dressed on all beds and joints, so as to give them approximately rectangular block shape. These shall be squared on all joints and beds. The joint shall be rough chisel dressed for at least 80mm back from the face, and side joints for at least 40mm such that no portion of the dressed surface is more than 6mm from a straight edge placed on it. The bushing on the face shall not project more than 40mm on an exposed face and 1-mm on a face to be plastered.

The minimum compressive strength shall be 1000 kg/sqcm and maximum water absorption shall be 0.50% by weight.

3.1.3 MORTAR

The mortar for jointing as specified in the schedule or drawings and in conformance with IS 2250.

3.1.4 DRESSING OF STONE

Stone used shall be hammer dressed on sides and beds in such a way as to close up with the adjacent stone in the masonry work. The face stone shall be dressed as to give a specific pattern, facing etc., the face of stone shall be so dressed that bushings on the exposed face shall not project beyond 6mm from a straight edge. The bushings on the face shall not project on any surface by more than 10mm on a face to be plastered. All angles and edges that are to remain exposed in final position shall be true, square and free from chipping.

3.1.5 LAYING

All stones shall be wetted before laying to prevent absorption of water from mortar. The walls shall be truly vertical. The height of each course shall not be less than 200 mm and more than 300mm. No part of the wall during its construction shall raise more than one meter above the general construction level to avoid unequal settlement.

The natural bed of stratified stone shall be so laid that the pressure is always perpendicular to the strata and are laid along their plane of stratification.

Face stones shall be laid as alternate headers and stretchers. No pinning shall be allowed on the face. No face stone shall be less in breadth than its height and atleast one third of the stones shall tail into the work of length not less than twice their height.

The hearting or the interior filling of the wall shall consist of stones carefully laid on their proper beds in mortar, chips and spawls of stones may be used (to the fitting of interstices between adjacent stones in earthing) to avoid thick bed of joints of mortar and at the same time ensuring that no hollow spaces are left anywhere in the masonry. The hearting shall not exceed 15% of the quantity of masonry. The chips shall not be used below the hearthing stone to bring these up to the level of face stones.

The masonry in a structure shall be carried up regularly but where breaks are unavoidable, the joints shall be raked back at angle not steeper than 45 degrees. Toothing shall not be allowed.

Wherever required and as approved by the EIC chases not exceeding 600mm width for vertical chases, and 300mm height for horizontal chases shall be filled in with ordinary cement concrete of nominal mix 1:3:6 (1 cement: 3 coarse sand: 6 stone aggregate) using 12mm nominal size or down gauge as directed.

Bond or through stones running right through the thickness of walls, shall be provided in walls upto 600mm thick and in case of walls above 600mm thickness, a set of two or more bond stones overlapping each other by a least 150mm shall be provided in a line from face to back.

At least one bond stone or a set of bond stones shall be provided for every

0.5sqm of the wall surface or as specified. Where bond stones of suitable lengths are not available cement concrete blocks of nominal mix 1:3:6 (1 cement: 3 coarse sand: 6 stone aggregate) using 2-mm nominal or down gauge graded aggregates shall be used.

All bond stones in stone masonry shall be suitable marked as directed by the EIC.

The quoins shall be stones specially selected and neatly dressed for forming the external angle of a wall or building. These shall be of the same height as the course in which these occur, shall be 450 mm long but not less than the thickness of the wall and shall be laid as stretchers and headers alternatively. These shall be laid square on the bends, which shall be rough chisel dressed to a depth of atleast 100mm. Incase of exposed work, these stones shall have a minimum of 25mm wide chisel drafts at four edges, all edges being in the same plane.

3.1.6 JOINTS

All bed joints shall be horizontal and all side joints vertical. All joints shall be fully packed with mortar, face joints shall not be more than 25mm thick.

When plastering or pointing is not required, the joints shall be struck flush and finished at the time of laying. Otherwise the joints shall be raked to a minimum depth of 12mm by raking tool during the progress of work, when the mortar is green.

3.1.7 CURING

Masonry work in cement mortar shall be kept constantly moist on all faces for a minimum period of seven days, watering shall be done carefully so as not to disturb green mortar.

3.1.8 PROTECTION

Green work shall be protected by suitable covering. The work, particularly exposed faces shall be suitably protected from damage, mortar dropping etc., during construction.

3.1.9 SIZE STONE MASONARY

Size stone shall be hard granite, basalt or trap stone obtainable from approved quarry. The stones shall be clean and wetted before they are used.

height of course, shall not be less than 200mm. All courses shall be of uniform height, unless otherwise instructed the depth of higher courses should not be more than the depth of lower courses. Bed and sides shall be hammer or chisel dressed from the face 75mm and 35mm.

No face stone shall be less in depth than in height or shall tail into the work to a length less than the height. Stones shall break joints atleast half the height of the course. Faces of stones shall be hammer dressed and bushing shall not be more than 25mm, edges of face stones of exposed faces shall be chiselled true to both longitudinal and vertical lines. Exposed faces of corner stone to be 2 line dressed 50mm wide.

Bond or through stones shall be provided not exceeding 2.0 mtr apart in each course and shall be staggered. Bond stone shall be from the front to the back of the walls. For wall upto 500mm thick, bond stones shall be in one piece. For walls over 600mm thick, Bond stones shall either be in one piece (if available locally) or be in a series of headers; each header over lapping the adjoining one by not less than 150mm Bond or through stones shall be marked as directed to enable these being easily detected even after having been built in position. The hearting or interior filling shall be with flat bedded stones laid in mortar. Chips, spalls shall be used to avoid thick mortar joints and shall not exceed 15% of the quantity of stone masonry. Care shall be taken to prevent dry work or hollow spaces being left in the masonry.

4.0. BRICK MASONRY

4.1. SCOPE

The scope of work for Brick masonry including materials and the construction load bearing and Partition walls using the type, dimensions, arrangements, and the coursing as required with mortar, jointing, pointing and other accessories.

4.1.1. APPLICABLE CODES AND STANDARDS

IS 1077-1976	Specification for common burnt clay building bricks (third revision)
IS 5454-1978	Method for sampling clay burnt bricks
IS 2116-1980	Specification for sand for masonry mortars (First Revision)
IS 269-1976	Specification for ordinary and low heat port land cement (third revision)
IS 1489-1976	Specification for Portland Puzzolona cement (Second revision)

4.1.2. MATERIALS

4.1.2.1 BRICKS

Bricks shall be common burnt clay bricks conforming to sub class 'B' having compressive strength of not less than 35 kgs/sqcm and in accordance with IS 1077-1976.

Bricks shall have smooth rectangular faces with sharp comers and shall be uniform in colour, Nominal dimension of bricks shall be 229x114x75 and actual dimensions shall not be less than 225x111x75. The tolerance in dimensions for sub clause 'B' bricks shall be +/- 5%. The average water absorption of bricks after immersion in cold water for 24 hours shall not be more than 20%.

4.1.2.2 SAND FOR MORTAR

Sand for masonry mortar shall be natural river sand conforming to IS 2116:1980. Sand shall be hard, durable, clean and free from adherent coatings and shall not contain clay and other impurities such as iron pyrites, alkalies, salts, coal, mica, shale or similar impurities exceeding the specified limits. The maximum content of clay, fine silt, and fine dust shall not be more than 5% by weight. The organic impurities shall be below that attained by comparison with standard solution specified in IS 2386-1963 (Part II).

4.1.2.3 MORTAR

Mortar shall be composed of cement and sand, unless otherwise specified. All mortar shall be prepared in accordance with IS 2250. The proportions of mortar measured by volume shall be as specified. In case of wet sand, the quantity in the mix shall be corrected for bulk age.

Cement mortar shall be prepared by mixing cement and dry sand in required proportions by using measuring boxes, on a clean and dry platform or in a mechanical mixer. The dry mix shall be turned over till a uniform colour is obtained. Water shall then be added in requisite quantity to produce a stiff paste of required consistency. At a time only the required quantity of mortar paste shall be prepared which can be used in the work within half an hour from the time of mixing water to the dry mixture. Mortar paste which is not used in the work within half an hour as aforesaid shall be rejected and shall not be used in the work under any circumstances and shall be removed from the site.

4.1.2.4 WATER

Water used for mixing and curing shall be potable clean and free from deleterious substances i.e., oils, acids, alkalies, salts and other organic substances. If insisted by the EIC the water sample shall be tested by the Contractor in approved Laboratory and test results submitted to the EIC. The water shall be used in the work if the test results are considered satisfactory by the EIC.

Water shall conform to the requirements stipulated in IS 2116.

4.1.2.5 WORKMANSHIP

The brick masonry work shall be carried out by experienced and skilled masons. Bricks shall be thoroughly soaked in water for at least 6 hours before placing them in position. NO bits or cut bricks shall be used in the work unless it is absolutely necessary for adjusting the dimensions of different courses and for closures in which case full bricks shall be laid at the ends/corners and cut bricks being placed in the middle of courses.

Before starting laying of bricks, all loose materials dirt and set lumps of mortar etc., lying over the surface on which brick work is to be laid shall be removed with wire brush and surface wetted. Bricks shall be pressed with the handle of trowel so that mortar gets into all pores of brick so as to ensure proper adhesion. All the joints shall be properly flushed and packed with mortar, so that no hollows and cavities are left in bed and joints. Addition of water to mortar during the course of laying shall not be permitted. Bricks shall be laid with frog up except in top course, which is exposed where, the brick shall be laid with frog down. Care shall be taken to fill the frogs with mortar before embedding the bricks in position.

Verticality and horizontally of the courses shall be frequently checked by means of plumb boss and spirit levels respectively. Tolerance allowed in verticality and horizontally, shall be as per IS specifications.

The thickness of joints shall not exceed 12 mm. Where no pointing or plastering is indicated the mortar in joints shall be struck flush when green as the work proceeds. Where pointing or plastering or other finish is indicated

the joints shall be squarely raked out to a depth of not less than 12 mm. The vertical joints shall break with the joints of the courses below.

All brickwork shall be built in English bond unless otherwise instructed by EIC in specified situations.

Doors, windows, plugs and such other fixtures shall be fixed in position with holdfasts embedded in PCC as the work proceeds. However in specific situations these may be fixed at a later date-if so instructed by the EIC. In such situations openings of adequate dimension shall be left in the brickwork so as to avoid demolition/breaking of sides at a later date.

The height of brick wall to be built/raised in a day shall not be more than one meter above the general level to avoid unequal settlements, and unequal transfer of load. Parts of walls left at different levels shall be properly raked back. Walls shall be carried up regularly in all cases, leaving no part one meter lower than another. In situations where it is not possible/practicable to raise the walls to uniform height all-round, the breaks shall be stepped at an angle not more than 45 degrees so as to enable the latter courses of masonry to bond with the former and stepping up not start within 600 mm of a corner.

4.1.2.6 SCAFFOLDING

Scaffolding may be of timber or steel at the discretion of the Contractor, but shall be of adequate strength to withstand all dead, live and impact loads which are likely to occur on them. Scaffolding shall be provided so as to allow easy approach to every part of work.

For exposed brick facing double scaffolding having two sets of vertical supports shall be provided, where single scaffolding is provided one end of putlog shall rest in the hole provided in the header course. Not more than one header shall be left out for each putlog. Such holes shall not be allowed in case of pillars or narrow masonry portions between openings which are less than one meter in width or are immediately under or near the structural member supported by the walls. Such holes shall be made good after removal of the walls. Such holes shall be made good after removal of shuttering to the adjoining surface as directed by EIC. Timber scaffolding work shall conform to provisions in IS 3696 (part 1) 1966. Steel scaffolding shall conform to provisions in IS 2750 1964, and also to relevant provisions in IS 3696 (part 1) 1966.

4.1.2.7 CURING

The Brick work shall be kept wet for atleast seven days. In inclement weather newly built brick shall be protected with gunny bags or tarpaulin so as to prevent mortar being washed away.

4.1.2.8 DEFECTIVE WORK

Any defective work such as work not to plumb or not truly horizontal or brick work becoming hollow due to mortar being washed away either due to improper curing or improper protection during inclement weather etc., shall when pointed out by the EIC, be demolished and reconstructed with new materials in accordance with the specifications stated above.

4.1.2.9 HALF BRICK WALLS

Where shown on drawings, half brick walls shall be constructed in cement sand mortar 1:4 with stretcher bond only. Material and workmanship shall be as specified herein before. Every Tenth course shall be reinforced with 8mm Tor steel completely embedded in mortar securely anchored at the ends/comers as directed by the EIC.

5.0. CONCRETE BLOCK MASONRY

SCOPE

The scope of work for concrete Block masonry includes materials and the construction in load bearing and non load bearing walls using the type, dimensions, arrangements and the coursing as required complete with reinforcement, anchorage, mortar, jointing, grouting, pointing and masonry accessories.

APPLICABLE CODES AND STANDARDS.

- IS: 269 Ordinary and low heat Portland Cement.
- IS: 383 Aggregates, coarse and fine from natural sources for concrete.
- IS: 456 Code of Practice for plain and reinforced concrete.
- IS: 2185 Specifications for concrete masonry units (Part I & II) Hollow & Solid concrete block.
- IS: 2250 Code of practice for preparation and use of Masonry Mortars.
- IS: 2572 Code of practice for construction of hollow concrete block masonry.

SOLID CONCRETE MASONRY BLOCKS

Concrete masonry blocks shall be of approved make conforming to IS 2185. The concrete mix used for blocks shall not be richer than 1 cement: 6 combined aggregate by volume before mixing. Cement used in making concrete masonry units shall conform to IS 269 and the aggregates used shall conform to IS 383. All aggregates shall pass through IS sieve 12.5 mm and not more than 10% shall pass through IS 300 microns. In addition, 15% shall be retained on IS sieve 10mm and 40% on IS sieve 4.75mm. The Fineness Modules of the combined aggregate shall be between 3.6 to 4.0 all units shall be cured in a curing tank/curing yard or steam cured. The minimum strength of solid concrete block should be 50kgs /sq cm

PHYSICAL REQUIREMENTS

All units shall be sound and free from cracks, honeycombing, broken edges and other defects. However minor chipping resulting from the methods of handling during delivery shall not be deemed grounds for rejection. The face of masonry units shall be flat and rectangular, opposite faces shall be parallel and all arises shall be square. The bedding surface shall be at right angles to the face of the blocks.

TEXTURE

Concrete masonry units used in constructing exposed walls shall be of the specified surface texture free from stains and discoloration, blemishes and defects which detract the desired appearance of the finished wall. The ends of the blocks which form the vertical joints shall be plain butt or tongue and grooved as directed.

DIMENSIONS

Unless specified otherwise the nominal dimensions of solid concrete masonry units shall be as follows:-

Designation	Nominal size			Actual size		
	L	B	H	L	B	H
SIZE A	40	20	20	39	2-	19
SIZE B	40	15	20	39	15	19
SIZE C	40	10	20	39	10	19

The maximum variation in dimension shall not be more than 1.5mm in height and breadth and 3mm in length.

SPECIAL UNITS

Solid concrete block masonry units shall include closer jamb, header, and bond beam units.

COMPRESSIVE STRENGTH

The minimum average compressive strength at 28 days when determined in the manner described in IS 2185-1967 shall not be less than 50 kgs/sqcm of the gross area. The strength of the lowest individual block shall not be less than 75% of the average compressive strength.

WATER ABSORPTION, DRYING SHRINKAGE AND MOISTURE MOVEMENT

The water, absorption, being the average of 3 units, shall not be more than 10% by mass. The drying shrinkage, being the average of 3 units, shall not be exceeded 0.1 percent. The moisture movement of the dried blocks on immersion in water, being the average of 3 units, shall not exceed 0.09 percent.

TRANSPORTATION

The contractor shall be responsible for transporting solid concrete masonry units in such a manner that the units are adequately protected during transportation. Cracked, chipped, or otherwise damaged concrete masonry units, delivered at the site shall be considered unacceptable and shall not be used in the work. Concrete masonry units shall be delivered to the site in air dry condition.

HANDLING AND STORAGE

Concrete block masonry units shall be handled, stored and protected with care in an approved manner to avoid any contact with moisture on the site,

soiling, chipping or damage of any kind. They shall be stock piled in neat piles on planks or other supports free from contact with the ground and covered to protect against wetting. Broken, chipped or otherwise damaged units will be rejected and shall not be used on the works.

TESTS

Tests shall be conducted on samples of units selected according to the sampling procedure given below, to ensure conformity with the physical requirements laid down in Table above. The cost of the tests shall be borne by the Contractor.

SAMPLING

A sample of 20 blocks shall be taken from every consignment of 5000 blocks or part thereof, for the same size and same batch of manufacture. From these samples, the block shall be taken at random for conducting the tests. The sample of block shall be marked for future identification of the consignment it represents. 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 tests shall be under taken as soon as practicable after the sample has been take.

NUMBER OF TESTS

All the 20 blocks shall be checked for dimensions and inspected for visual defects. Out of 20 blocks 3 blocks shall be subjected to the test for block density, 8 Blocks for the compressive strength, 3 blocks each for the water absorption and moisture content. The remaining 3 blocks shall be reserved for retest for drying shrinkage and moisture movement if required.

CRITERIA FOR CONFORMITY

The lot shall be considered as conforming to the requirements of the specification if the conditions mentioned below are satisfied.

- a. The number of blocks with dimensions outside the tolerance limit and/or visual defects, among those inspected shall not be more than 2.
- b. For block density and compressive strength, the mean value determined shall be greater than or equal to the minimum limit specified elsewhere.
- c. 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 these blocks should satisfy the requirements.

- d. For Water absorption, the mean value determined shall be equal to or less than the maximum specified.

CEMENT

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

SAND

Sand shall be clean, neither too fine nor too coarse and shall fall within the grading zones 1 to IV given in table III of IS 386-1970. The silt content of sand shall not exceed 5% by volume. **Or** 3% by weight

Water used for mixing mortar shall be in accordance with IS 456-1978.

MIX PROPORTIONS

The mortar shall consist of one part of cement and six parts of sand for block work 150mm thick and above. For Block piers, Partition walls, honey combed Block work and hollow (cavity) walls, the mortar mix shall consist of one part cement and four parts sand.

MORTAR

Mortar shall be composed of cement and sand, unless otherwise specified, All mortar shall be prepared in accordance with IS 2250. The proportions of mortar measured by volume shall be as specified.

Cement mortar shall be prepared by mixing cement and dry sand in required proportions by using measuring boxes, on a clean and dry platform or in a mechanical mixer. The dry mix shall be turned over until a uniform color is obtained. Water shall then be added in requisite quantity to produce a stiff paste of required consistency. At a time only the required quantity of mortar paste shall be prepared which can be used in the work within half an hour from the time of mixing water to the dry mixture. Mortar paste which is not used in the work within half an hour as aforesaid shall be rejected and shall not be used in the work under any circumstances and shall be removed from the site.

Preparation

The blocks shall be wetted before and/or during laying in the walls. In case the climatic conditions require, the top and the sides of the blocks may only be slightly moistened so as prevent absorption of water from the mortar and ensure development of the required bond with the mortar. No unit having a film of water on its surface shall be laid.

SUPERSTRUCTURE

First Course

The first course of concrete block masonry shall be laid with great care and to ensure that it is properly aligned, and levelled. Before laying the first course, the alignment of the wall shall be marked on the floor or plinth. The blocks for this course shall first be laid dry long a string lightly stretched between properly located corners of the wall in order to determine the correct position of the blocks including those of cross-wall joining it and also adjust their spacing. When the blocks are set in proper position the two corner blocks shall be removed and full mortar bed spread and the blocks laid back in place truly level and plumb. The String shall then be stretched lightly along the faces of the two corner blocks and the faces of the intermediate ones adjusted to coincide with the line. Thereafter each block shall be removed and relaid over a bed of mortar. After every 3 or 4 blocks have been laid, their correct alignment, level and verticality shall be carefully checked.

HORIZONTAL JOINTS

Mortar shall be spread over the entire top surface of the block including front and shear shell as well as the webs to a uniform layer 10mm thick. Full mortar bedding shall be adopted for load bearing walls while for non-load bearing walls, the mortar may be spread only over the first and rear shell and not on the webs.

VERTICAL JOINTICAL

For vertical joints, the mortar shall be applied on the vertical edges of the front and rear shells of the blocks. The mortar shall be applied either on the unit already placed on the wall or to the next unit to be laid along with side of it. Vertical joints shall be shoved tight.

Mortar shall not be spread so much ahead of the actual laying of the units that it tends to stiffen and lose its plasticity, thereby resulting in poor bond. For most of the work, the joints both horizontal and vertical shall be 10mm thick. When the mortar has stiffened somewhat, it shall be firmly compacted with the jointing tool. It may be necessary to add mortar, particularly to the vertical joints, to ensure that they are well filled. Each unit shall be adjusted to final position whilst the mortar is still soft and plastic. Any unit that is disturbed after mortar has stiffened shall be removed and relaid with fresh mortar.

Construction of walls shall be started either at the corners first or from one end proceeding in the other direction. If the corners of the wall are built first, they shall be 4 to 5 courses higher than the centre of the wall. When each course is laid at the corner, it shall be checked for alignment, level and for being plumb. Each block shall be carefully checked with a level straightedge to make certain the faces of the block are all in the same plane. All mortar joints shall be 10mm thick. Each course, in building the corners, shall be stepped back by a half block and the horizontal spacing of the block shall

be checked by placing a mason's level diagonally across the corners of the block.

When filling in the wall between corners, the mason's line shall be stretched from corner to corner for each course and the top outside edge of the each block shall be laid to this line. The manner of handling or gripping the block shall be such as to position the block properly with minimum adjustment. Dead mortar that has been picked up from the scaffolding or from the floor shall not be used.

Concrete masonry units shall be marked for the following information.

- a. The identification of the manufacture.
- b. The grade of the unit, i.e., load bearing or non-load bearing
- c. The year of manufacture if required.

ACHORS AND TIES

The ties for laying concrete block masonry partitions to intersecting masonry and the anchorage of interior walls to shutting walls and columns shall be as indicated on the drawings.

The blocks shall be wetted before or during laying in the walls. In case the climatic conditions require, the top and the sides of the blocks may only be slightly moistened so as prevent absorption of water from the mortar and ensure development of the required bond with the mortar. No unit having a film of water on its surface shall be laid.

FOUNDATIONS

In foundation courses, plinth and basement walls, solid concrete.

CLOSURE BLOCK

When installing the closure block, all edges of the opening and all four vertical edges of the closure block shall be buttered with mortar. The closure block shall be carefully lowered into place. If any of the mortar falls out leaving open joint, the closure block shall be removed, fresh mortar applied and the operation repeated.

PROVISION FOR DOORS AND WINDOW FRAMES

M.S.holdfasts shall be so fixed to the door or window frames that these fall at block course level and their ends are embedded with 1:3:6 cement concrete.

PROVISION FOR LINTELS

Lintels shall consist of either a single precast unit and shall be adequately reinforced. In-situ concrete used for forming a composite lintel with the use of

a number of units, shall preferably be of the same mix as of the concrete that is used in the precast units and the composite unit shall also be adequately reinforced. Where openings occur close to one another a continuous lintel shall be provided.

INTERSECTING WALLS

All intersecting walls wherever they meet or intersect shall be bonded or tied securely as given below:

- a. Load bearing walls: When two load bearing walls meet or intersect and the course are to be laid at the same time, a true masonry bond between at least 50% of the units at the intersection shall be provided. When such intersecting load bearing walls are laid up separately, pockers win 200mm maximum vertical spacing shall be left in the first wall laid. The corresponding course of the second wall shall be built into these pockets.
- b. Non-load bearing walls: When be stiffened at regular intervals with pilasters, which are about twice the thickness of wall. The top courses of block in a pier shall be filled with concrete. Hollow concrete block shall not be used for isolated piers unless their hollows are filled up with concrete as directed by the EIC.

PILASTERS AND PIERS

Unsupported long walls shall be stiffened at regular intervals with pilasters, which are about twice the thickness of wall. The top courses of block in a pier shall be filled with concrete. Hollow concrete block shall not be used for isolated piers unless their hollows are filled up with concrete as directed by the EIC.

PROVISION FOR DUCTS/OPENINGS

Holes, chases, sleeves, openings for Electrical conduits and sanitary/water supply piping, etc., shall be filled/packed with PCC 1:2:4 using 12mm and down size graded coarse aggregate and neatly finished to receive plaster or such other finish. The joints shall be raked suitably to have proper key for plastering.

EMBEDDED ITEMS

Anchors, ties, wall plugs, electric outlet boxes, accessories, flashiness, pipe sleeves, and other items required to be built-in shall be built-in as the masonry work progresses. Anchor, ties, anchor bolts and cells of first masonry course below bearing plates shall be filled solidly with mortar or grout.

UNFINISHED WORKS

Unfinished work shall be stepped back for jointing with new work. Toothing shall be resorted to only when specifically approved by EIC. Before laying

new work, loose mortar shall be removed and the exposed joint shall be thoroughly cleaned.

PROTECTION

Surface of masonry not being worked on shall be properly protected at all times. When rain is imminent, the tips of exposed masonry shall be covered with strong non-staining water proof membrane well secured in place and in a manner that will prevent moisture from accumulating within cavities or cells of the unfinished wall. Adequate provisions for bracing shall be made during construction to prevent damage by wind.

POINTING

Joints to be pointed shall be raked using raking tool slightly concave with the mortar thoroughly compacted and pressed against the edges of the units. Tooling shall be done when the mortar is thumbprint hard. The Tooled joints shall be finished to uniformly straight and true lines, surfaces smoothed and made free from tool marks.

CLEANING

During progress of work before setting or hardening, all mortar daubs or splashing shall be completely removed from masonry unit surfaces that will be exposed or pointed. Before completion of the work, all defects in joints of masonry to be exposed or pointed shall be raked out, filled with mortar, and tooled to match existing joints. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened.

Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain and discoloration including scum from the cleaning operations and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning. Concrete masonry units shall be dry brushed at the end of each day's work.

CURING

New solid block work shall be kept wet for at least seven days.

SCAFFOLDING

Unless otherwise instructed by the CC, double scaffolding having two sets of vertical supports shall be provided for all building work. The supports shall be sound, strong and tied together with horizontal pieces over which the scaffolding planks shall be fixed. Contractor should use only Metal props, wooden props are not allowed

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

DEFECTIVE WORK

Any defective work such as work not to plumb or not truly horizontal etc., shall when pointed out by the EIC, are demolished and reconstructed with new materials in accordance with the specifications stated above.

6.0. FLOORING

6.1 PREPARATION OF SURFACE

Before the operation of laying any floor is started, the surface of base concrete shall be thoroughly cleaned of all dirt, loose particles, caked mortar drippings, by scrubbing with coir or steel wire brushes. If so directed by the EIC the surface shall be roughened by chipping or hacking at close intervals. The surface shall then be cleaned with water and kept wet for 12 hours and surplus water shall be removed by mopping before the flooring is laid.

6.2 GRANOLITHIC FLOORING

The flooring shall be 40mm thick and shall consist of 28mm thick 1:2:4 concrete base and 12 mm thick granolithic wearing coat. The granolithic flooring shall be laid in alternate panels. The size of panels shall be as decided by the EIC.

Preparation of surface of base concrete shall be as described earlier.

6.3 LAYING

6.3.1 Concrete Base

The 1:2:4 concrete base shall compose of 1 part of cement 2 parts of coarse sand and 4 parts of graded stone aggregate of maximum size 12mm. The ingredients shall be thoroughly mixed with sufficient water to obtain the required plasticity. The free water on the surface of the base shall be removed and a coat of cement slurry of the required consistency shall be brushed on the surface.

The prepared 1:2:4 concrete shall be laid immediately after mixing on the fresh grouted base in alternate panels of uniform size not exceeding 10sqm. The edges shall be protected by wooden/steel form work. The concrete shall be spread evenly and levelled carefully. Low places shall be filled humbs removed and the whole surface levelled.

The layer shall be 28mm as specified and 12mm below the finished level. The layer shall be compacted by trowelling and allowed to set.

6.3.2 Mixing and Laying of Wearing Coat.

One part of cement in dry state shall be mixed with two parts by volume of well graded crushed granite chips of 6mm maximum size. The ingredients shall be then mixed with sufficient water as for ordinary concrete. The wearing coat shall be laid 12mm thick over

1:2:4 cement concrete base immediately after it has set. The wearing coat

shall be compacted and levelled to give a level surface. The surface should not be over trowelled as excessive troweling shall bring the cement to the surface, which shall be strictly avoided.

When the initial set takes place further compaction by steel troweling shall be done and final brushing shall be done before the topping becomes too hard.

Hardening compounds or ironite filings shall be added to according to manufacturer's specification to obtain a dense, hard flooring top.

6.3.3 Curing

As soon as the surface is hard enough, it shall be covered with gunny sacks or sand and kept continuously wet for a period of atleast one week.

6.3.4 Polishing

Surface shall be machine polished to give a smooth and even surface with granite chips

6.4 CERAMIC TILE FLOORING/DADDOING/SKIRTING

The Ceramic tile shall be of approved quality, make, color, size shape. On the approval of the sample by the EIC, the order for the tiles shall be placed from one source and procured preferably from one batch/consignment to prevent any shade variation. The Contractor shall obtain sample of printed tiles for approval by the EIC and order placed in a similar manner.

The bedding layer for glazed tiles shall not be less than 10mm thick consisting of cement mortar 1:3. The base coat of mortar shall be 20mm thick consisting of cement mortar 1:6. Tiles shall be soaked in water sufficiently in advance as directed by the EIC before laying.

The floor surface over which the tiles are to be laid shall be properly cleaned and wetted. The bedding of cement mortar shall be laid to even thickness and uniform level and finished rough as directed by the EIC and allowed to harden enough to offer a rigid cushion for tiles.

Over the bedding layer, cement slurry of homogeneous consistency at 3kg/sqm shall be approved over an area adequate to accommodate about 20 tiles at a time. Tiles shall be washed cleaned pressed on to the grout and gently tapped in its proper position. The tiles shall be cleaned perfectly side by side so as to have fine joints truly vertical and horizontal and in level with adjoining tiles.

The joints shall be as specified on the drawings, if grooves are to be provided, it shall not exceed 1.5mm or as specified on the drawings, and shall be done using spacers of approved quality. The excess cement slurry bulging/oozing out in joints shall be removed by wiping immediately to sufficient depth as directed by the EIC.

The day after the tiles have been laid, curing shall be carried out by spraying water adequately without walking over the tiles. Curing shall continue until the tiles have adequately set as directed by the EIC.

Thereafter, the joints shall be raked out to the required depth and loose cement/mortar shall be removed and joints shall be cleaned. Joints shall be flush pointed with white cement or coloured cement (colour as approved by the EIC) to match the colour of tiles and cured by spraying water as directed by the EIC.

In the case of Dado the wall surface shall be cleaned and plastered with cement mortar 1:4 to a thickness of not less than 10mm to form a uniform backing surface, and finished rough and allowed to harden.

The tiles which have been soaked in water, shall be cleaned and cement paste of butter like consistency applied to the backside of tiles and the tiles shall be pressed on the wall face and gently tapped in its position. In this way tiles shall be placed one after another starting from the bottom line and laid upwards.

The joints shall be truly vertical and horizontal, where required spacers- glass strips or ceramic strips - are used to achieve spacing between tiles of width as specified on the drawings, and the tile surface shall be of uniform level in all directions without any depressions and bulging which shall be tested by a straight edge as directed by the EIC.

Curing the pointing of tiles in Dado shall be carried out as specified for flooring and as directed by EIC.

6.5 POLISHED GRANITE SLAB IN FLOORING

GRANITE slab shall be quarried stone slabs, hard sound durable and free from weathering and defects like cavities, cracks, raw, holes injurious veins, patches of soft materials and such other defects adversely effecting its strength and its appearance. The hardness of the Granite slab shall be as per IS. The polished GRANITE Stone slabs shall be selected and approved by the EIC. The polished GRANITE Stone slabs sample approved shall be brought by the Contractor in adequate quantity and from one single batch/source so as to ensure that the grains and shade of entire flooring laid is homogeneous and consistent. The size and shape of the polished GRANITE Stone slabs shall be cut as per the Drawings/Instructions of the EIC, edges being true and square and ensure minimum of wastage. The exposed edges of the slab shall be polished at site or in factory. Cutting of polished GRANITE Stone slabs shall be done using machines as approved by the EIC.

Mortar shall be composed of cement and sand, unless otherwise specified. All mortar shall be prepared in accordance with IS 2250. The proportions of mortar measured by volume shall be as specified.

A layer of mortar shall be spread on full width over a suitable length of the

lower course. Each slab shall be properly bedded and set in position by gently tapping with handle or trowel or wooden mallet. Its inside faces shall be buttered with mortar before the next slab is laid and pressed against it. The joints may be either paper cut or with the spacing of specified width. The levels/gradient of the flooring shall be as per Drawings and approved by EIC before laying is commenced.

In case spacing is provided between each slab, the mortar in the joints shall be raked out and pointed (type of joint as specified by the EIC and/or drawings) with cement slurry mixed with colouring pigment (the colour of the pigment and its proportion to be mixed with the cement as specified) to match the shade of the GRANITE Stone slabs. The curing shall be for a minimum period of 7 days after laying and pointing.

6.6 GRANITE STONE SLAB LAYING IN STAIRCASE TREADS, LANDING AND RISERS

The laying of polished GRANITE Stone slabs in Staircase treads, Landing and Risers shall be similar to laying of polished GRANITE Stone slabs flooring as above, except that

- The slab cut shall be from one single piece, the edges shall be treated as shown in drawings.
- Anti skid strip may be provided for every Tread and Landing as per Detail drawing.
- The Treads and Landing shall be projecting a minimum of 20mm from the top face of the riser.

The cut edges is to be polished either in site or at factory.

6.7 GRANITE STONE SLABS SKIRTING

The Prepolished GRANITE Stone slabs shall conform to the specification or requirements as that of polished GRANITE Stone slabs used in flooring/staircase. The thickness of the polished GRANITE Stone slabs used shall be 25mm thick and it is fixed over a backing coat of cement mortar of 1:4 of 12mm thick with a cement paste backed on the back of the granite tile.

The height of the skirting shall be 100mm or as specified and the cut edge (top edge) shall be polished before fixing to the wall. The top edge of the skirting shall be treated as shown in the drawing.

The joints of the polished GRANITE Stone slabs used in skirting is to be less in numbers and it shall be paper cut joint. The paste oozing out is to be wiped with a cloth and washed with water. The curing is to be place for a minimum period of 7 days.

7.0. DOORS

7.1. SCOPE

Scope of work includes Materials such as wood, labour for joinery of wooden frame and shutter, fixing of laminates or veneer, fittings and fixtures and such other related carpentry works.

7.2. MATERIALS

Wood for door/window frames shall be approved, seasoned and I Class teak wood. It shall be of fairly uniform in colour and texture. It shall be free from blemishes, hollow pockets and knots, spinal or twisted grain, warp and any kind of decay or insect attack, cupshakes, bore holes, splits, cracks, pinholes, wormholes etc.,

Wood shall be kiln seasoned before being planed to the required sizes, in accordance with IS 401-1982.

Samples of seasoned wood and Commercial Board/Plywood's shall be submitted to the EIC for approval, before placing order. The Contractor shall get the wood and Commercial Board/Plywood sample tested in an approved laboratory. If desired by the EIC, the Contractor shall submit all information such as manufacturer/brand name, test certificate etc.

The Contractor shall submit test certificate in support of the kiln seasoning including ASCU treatment for the entire quantity of timber required for the work from the factory where seasoning has been done.

Commercial Flush Shutters of thickness 32/25 mm and of size as specified on the drawings, shall be solid core type with block board core and shall conform to IS 2202 1983-PART (Specification for wooden flush door shutters solid core type) IS 1003 part 1 and 2, IS 3097. Flush door shutters shall be free from twist or warp in plane, and the four edges of the shutter shall be square. Both faces of shutter shall be sand prepared to a smooth and even texture. Tolerance on nominal thickness shall be +/- 0.8mm when measured at any two points.

All Commercial shutters shall be internally lipped using Teak Wood, pressed and ready from the Factory directly. In the case of double leaved shutters, rebating shall be as indicated on the drawings and as directed by the EIC. Where separate lipping is provided, the depth of lipping at the meeting of styles shall not be less than 35mm.

Shutters shall not be damaged during transportation, storage and fixing, damaged shutters shall be rejected and shall be replaced with new shutters as directed by the EIC whose decision will be final and binding in this regard. From the time the shutters are procured to the time they are taken up for fixing in position, the shutters shall be stored in a proper manner with adequate supports so as to avoid damage to any parts particularly to the

edges.

The Flush shutter shall be laminated with plastic laminate sheet whose samples shall be submitted along with manufacturer/brand name, test certificate etc., to the EIC for approval before placing order. The laminate sheet is protected with building paper until ready for use.

The panel filling in the case of Sesquicentennial made panelled shutters shall be pre-laminated (twin) particle board of thickness indicated in drawings, and conforming to IS 3097. The Contractor shall submit the sample of Pre-laminated (twin) particle board along with all relevant information such as manufacturers/brand name, test certificate etc., to the EIC for approval.

7.3. MOISTURE CONTENT

The average moisture content of all the WOODEN samples from a lot shall be within $\pm 3\%$ and moisture content of individual samples $\pm 5\%$ of the maximum permissible moisture content. For this purpose. The site of work shall be deemed to fall under climatic zonal. Seasoned wood as per IS 1141-1973 and IS 287-1973 shall be the basis of acceptance.

7.4. WORKMANSHIP

Timber sections for frames shall be planed smoothed to accuracy, on all sides to the full dimensions, rebated, rounded, chamfered or moulded as shown on the drawings and/or as directed by the EIC without patching or plugging of any kind before they are framed and jointed. A tolerance of ± 3 -mm shall be allowed in the finished cross sectional dimensions.

The joints shall be of mortise and tenon type or tongue & groove type (as per the drawings) simple, neat and strong. Joints shall fit in fully and accurately without wedging or filling. The joints shall be glued, framed, put together and pinned with hard wood or bamboo pins not less than 10mm dia, sash bars any shall have mitered joint with styles. Putty where used shall conform to IS 419-1967 and shall be homogeneous paste and shall be free from dust, grit and other visible impurities.

After the frames are put together, they shall be pressed in position by means of a press. The contact surfaces of tenon and mortise joints shall be treated (before putting together) with bulk type synthetic resin adhesive of a make approved by the EIC. Rails which are more than 180 mm in width shall have 2 tenons. Styles and rails of shutters shall be made out of single piece and shall have a 12 mm groove to receive panels.

Before the frames are fixed in position these shall be inspected and approved by the EIC. The frames shall be placed in proper position, secured to walls or columns as the case may be, by metallic fasteners, iron hold fasts etc. as shown on drawings and directed by the EIC. In case of door frames without sills, the vertical members shall be embedded in the flooring for full thickness of the floor. Where sills are provided these sills shall be embedded/sunk in the floor for full thickness the floor. The door frames without sills, while being

placed in position, shall be suitably struted and wedged in order to prevent warping during construction. The frames shall be protected from damage during construction.

Where glazed openings are indicated, the size, thickness and type of glazing shall be provided as per the drawings and shall be lipped internally with Teakwood. Shutters shall have

Provision for mortise locks and latches where so indicated on drawings and/or as directed by the EIC.

During installation the shutters shall be carefully lifted, carried and fixed in position as directed. Any special instruction by the manufacturer regarding position and fixing of fixtures/fittings shall be noted and complied with during installation.

Shutters shall be checked after fixing for proper location, alignment and swinging. After fixing all the fittings, shutters shall be tried again for proper closure, handling and easy movement etc., and any defects noticed shall be immediately rectified as directed.

Before Laminating the Commercial Flush board with Laminate sheet the surface to be laminated should be thoroughly cleaned, all cracks and nail holes filled as directed. The laminate sheet shall be fixed using approved quality adhesive recommended by the manufacturer and applied strictly in accordance to their instructions/specifications. The adhesive shall be applied in a thin layer and while tacky, it shall be spread evenly with a steel blade/trowel. Immediately after laminate/ veneer sheet is pressed adhesive and rolled in both directions to assume full contact with the adhesive. A constant and even pressure is applied for not less than 24 hours to ensure good bonding of the sheet to the board. The laminate / veneer surface shall be cleaned as recommended by the manufacturer.

7.5. SURFACE TREATMENT

All portions of timber built into masonry or abutting or concrete portion of the building or buried in ground shall be coated with boiling coal tar or other type of approved wood preservative or primer before fixing them in position.

7.6. FITTINGS AND FIXTURES

The fittings and fixtures for the doors and windows shall be as indicated in the schedule shown on drawings. The samples along with manufacturer's/brand name, test certificate, shall be submitted to the EIC for approval before placing order.

8.0. STEEL DOORS/WINDOWS FRAME AND SHUTTER

8.1. SCOPE

Scope of work includes supplying, fabricating, fixing in position, preparing and submitting shop drawings, welding, grinding, applying a coat of anti-corrosive paint, applying finishing coats, fixing of fittings and fixtures and such other related works.

8.2. MATERIALS

MS hollow section pipes either circular or square or rectangle, MS angles MS flats, MS plates, and MS sheet all from reputed approved manufacturer including MS bolts, nuts and washers. The thickness/gauge, size shall be read from the drawing. Samples of all the sections and items used shall be submitted to the EIC for approval before placing order for procurement. The Contractor shall get the samples tested if so required by the EIC and submit the report.

8.3. WORKMANSHIP

Steel windows shall be fabricated conforming to IS 1038 1983 and the shop drawings prepared for approval by the EIC before, commencing any fabrication work. The sizes of

Doors/Windows shall be as indicated on drawings. The size of the Doors/Windows frame shall not vary by more than +/- 1.5mm.

The doors/Windows may be top hung, side hung or fixed and also glazed, louvered or otherwise.

The frame/shutter shall be made of appropriate section/gauge, either hollow, louvered or glazed, or panelled. Louvers shall be of glass or sheet metal, Louvers in sheet metal shall of specified size and thickness with edges finished as per drawings. The louvers shall shape outwards at an angle of inclination of 45 degree. The louver slats shall be either slid into the U-clips (welded to the frame) or directly welded to the frame.

All frames for the windows shall be fabricated using sections mitred at comers. All comers of frames shall be welded to form fused welded joints. All frames shall be square and flat. The process of welding adopted shall be flash butt welding or any other approved, suitable process which complies with the requirements listed in the IS. T-Sections for glazing bar shall be tennoned and riveted to the frames.

For fixing steel hinges, slots shall be cut in the frame and the hinges inserted inside and welded properly to the frame. The hinges shall be projecting type, not less than 65mm and not more than 125mm wide. The hinge pin shall be of Electro galvanized steel of suitable thickness.

Steel doors and windows shall be stacked in upright position on level ground, to keep them in true shape without damage.

The frames of units shall be set in the openings by using wooden edges at the jambs, head and the sill and checked for Verticality. Flush finishing wedges shall be removed and gaps shall be filled with cement mortar. In case of flush jambs gap between openings and frame shall be filled with mastic from outside till it oozes out on external faces. The frame units shall be fixed to the masonry using lugs/screws. The frame unit is fixed to RCC members (where lugs cannot be used) using 8/10 mm dia metal anchor fasteners as per manufacturers specification.

Steel doors/windows shall be given a shop coat of Zinc Chromate primer or as approved by the EIC before fixing in position.

Glazing to steel windows shall be done with plane glass free from flaws, speaks or bubbles and shall have square corners and straight edges. The glass pane shall be cut so that it slides easily into the frames. The thickness of the glass unless otherwise specified shall be

- 2.5 or 3mm thick for glass area not exceeding 0.55 sq.m. Subject to one dimension not exceeding 1200mm.
- 3.0 or 4mm thick glazing for glass area between 0.5 to 1.0sqm where one side does not exceed 1200mm.
- 5.5mm thick glass for area between 0.55 to 1.0 sq.m where one side exceeds 1200 mm or for area exceeding 1sq.m.

Fixing of glass: Fixing of glass panes shall be done with special glazing clips (holes for such clips provided during fabrication) or wooden beading. Where beading is to be used, the fabricator shall be intimated in advance to drill holes for screws. Beading shall be fixed with screws spaced not more than 100mm from each corner and the intermediate screws not more than 200mm apart. When glass panes are fixed with wooden or metal beading having mitred joints, a thin layer of putty shall be applied between glass panes and sash bars, and also between glass panes and the beading. The putty used shall conform to IS 420 and shall not be less than 0.186 KG per M of the Glass perimeter.

Finishing: All steel surfaces shall be thoroughly cleaned of rust, scale and dirt. Where so specified, the steel surfaces be treated for rust proofing by the hot dip, zic spay or Electro galvanizing process. A coat of anti-corrosive paint shall be applied the doors and windows.

8.4. FITTINGS AND FIXTURES

All fittings and fixtures for the doors and windows other than those included in fabrication shall be as indicated in the schedule shown on the drawings. The samples along with manufacturers/brand name, test certificate etc., to the EIC for approval before placing order for procurement.

8.5. GLAZING.

The following Indian Standards shall be followed.

IS 1761-1960	Specification for transparent sheet glass for glazing and framing purposes.
IS 2835-1975	Specification for transparent sheet glass
IS 5437-1969	Specification for wired and figures glass
IS 419-1967	Specification for putty for use on window frames.
IS 3548-1966	Code of practice for glazing in Buildings.
IS 1200-1970	(Part XIV)

The glass shall be transparent and reasonably free from blisters, stones, scratches and bubbias so as to give a clear visibility through the glass. The sheet glass shall not show any distraction or light from its parallel nature when tested according to the method prescribed in Appendix 'B' in IS 1761 - 1960 the cut sizes of sheet glass shall be within the following tolerances, on both length and width of the prescribed cut size.

Thickness in mm	Tolerances on cut size
2.5 and below	+/- 1.5
3.0 and above	+/- 2.0

The thickness of sheet glass when tested according to the method prescribed in Appendix -C in IS 1761 - 1960, shall be as follows, within the tolerance indicated against each:

Thickness in mm	Tolerances on cut size in mm
8	±0.2
8.1.0	±0.2
9	±0.2
10	±0.2
11	±0.2
11.1.0	±0.2
11.2.0	±0.2

The size of glass for glazing shall allow a clearance of 2.5mm between the edges of the glass and the wood or metal surrounds. The clearance may be increased, provided the depth of the rebate or groove is sufficient to provide not less than 15mm cover to the glass. The detailed process of glazing shall be as specified in IS 3548 - 1966 code of practice for glazing in building.

All stains from the surface of glass shall be removed and cleaned with thinner. The edges of glass or glazing sheet when rounded shall render a uniform look throughout the length shall neatly finished.

9.0. PLASTERING

9.1. SCOPE

The Scope of work for plastering includes materials, proportions mixing, application, finishing, curing and other related works to the surfaces of concrete, brick/block masonry.

9.2. APPLICABLE CODES AND STANDARDS

IS 1542:1977 Specification for sand for plaster (First revision)

IS 712: 1973 Specification for building lime (Second revision)

9.3. MATERIALS

Cement, Sand, Lime (Neeru) and water shall conform to specification given below. Cement, Lime and sand shall be in the proportion mentioned in the items.

The following shall apply to this section.

9.3.1 CEMENT

The cement shall be ordinary Portland cement conforming to IS 269. The cement brought to the site shall be deemed to conform to the applicable specifications. The Contractor shall test in an approved Laboratory, to ascertain the test results. In case test results of any particular sample of cement are considered by the EIC as not satisfactory the particular batch/consignment of cement shall not be incorporated in the work.

The Contractor shall maintain records in approved form showing details of incorporation to cement and other such necessary details. Packaged cement shall be delivered to the said original sealed bags, which shall be labelled with the weight date of manufacture, name of manufacturer, brand and type. Cement received in torn bags shall not be used. Bags of cement which vary in weight by more than 3% shall not be accepted. All cement shall be fresh which delivered and at ambient atmospheric temperature.

9.3.2 SAND

Sand for plastering shall be river sand conforming to IS 1542-1977 and shall be obtained from approved sources. Sand shall be hard durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of clay balls. Sand shall not contain any harmful impurities such as iron pyrites, alkaloids, salts, coal, mica shale or other organic impurities in such quantities as to affect adversely the hardening, the strength, and the durability of the appearance of the plaster or applied decoration or to cause the corrosion of metal lathing in contact with plaster. The maximum quantities of clay fine silt of fine dust shall not exceed 5% by wt.

Organic impurities in the said shall not exceed the following limit.

That the colour of the liquid is below that indicated by comparison with the standard solution specified in clause 6.22 of IS 2386 (Part II) of 1963.

The particle size grading of sand for plastering and pointing shall be generally as under unless otherwise indicated by EIC.

IS sieve designation	Percentage passing by wt.
10mm	100
4.75mm	95 to 100
2.36mm	95 to 100
1.18mm	90 to 100
600Microns	80 to 100
300Microns	20 to 65
150Microns	0 to 5

NOTE:

1. Where the grading falls outside the limits of grading zones of sieves other than 600 microns IS sieve by a total amount not exceeding 5% it shall be regarded as failing within the grading. This tolerance shall not be applied to percentage passing the 600 microns IS sieve or to percentage passing through any other sieve size on the finer limit.

Concrete surfaces shall be pock marked with a pointed tool at spacing of about 50mm and to a depth of not less than 3 mm where so directed by the EIC.

In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

9.3.3 LIME (NEERU)

Lime shall be prepared out of Class 'C' lime (i.e., pure fat lime) as mentioned IS 712. All impurities, shall be picked out before slaking. The Lime shall be slaked not less than one Week and not more than 2 weeks before use. Lime shall be slaked and mixed, then be reduced to a fine paste by grinding. Lime shall be kept moist until use, and not more than can be consumed a 10 days shall be prepared at a time.

9.3.4 CEMENT WATER PROOFING COMPOUND

It shall be used with cement mortar for plastering/pointing work. Integral

cement water proofing compound conforming to IS 2645-1964 and of approved brand and manufacture shall be used. The contractor shall bring the materials to site in their original packing. The materials shall be mixed with dry cement as recommended by the manufacturer. Care shall be taken to see that the materials is integrally mixed with the cement and does not run out separately when water is added. However the mixing process shall be strictly followed in preference to the above specification as per the manufacture's specifications only.

9.3.5 SURFACE PREPARATION

All joints in the face work that is to be plastered shall be raked out to a depth equal to but not less than the width of the joints or as directed by the EIC. The raking shall be done taking care not to allow any chipping of masonry. In new work the raking out shall be done when the mortar in the joints is still green. Smooth surfaces of concrete, old plaster

etc., must be suitably roughened to provide necessary bonding 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, brushing on the walls to receive the plaster shall not be more than 12mm. The surface to be plastered shall be cleaned 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 EIC.

9.3.6 WORKMANSHIP

The mortar for dubbing coat and rendering coat shall be of the specified mix.

Patches of plaster of 150mm x 150mm size shall be put about 3M apart as gauges to ensure even plastering in one plane. In all plaster work, the thickness of mortar be firmly applied with more than the required thickness and well pressed into the joints and on the surfaces and rubbed and levelled with a flat wooden rule to give required thickness. Long straight edges shall be freely used to ensure a perfectly plane and even surface. The surface shall be finished to plane or curved surfaces as shown on the plan or as directed by the EIC 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. Plastering shall be done from top downward. In any continuous face of a wall, finishing treatment of any type should be carried out continuously and day to day breaks made to coincide with PCural breaks in order to avoid unsightly junctions. All exposed angles and junctions with door frames etc., shall be carefully finished. Arises shall be added if ordered by the EIC.

Lime shall be applied to the prepared and partially set but somewhat plastics surface with steel trowel to a thickness not exceeding 3mm and rubbed down to 1.5 mm thickness and polished to perfectly smooth and even finish, working from top to bottom. While trowelling is going on, soap stone powder

contained in thin muslin bags shall be dusted over the surface and worked in.

Moistening shall be commenced as soon as the plaster has hardened sufficiently and is not susceptible to injury soaking of wall shall be avoided and only as much water as can be readily absorbed shall be used.

Plastering operation shall not be started until all necessary pipes for water supply electric conduits etc., are fixed and permission is given by the EIC in writing.

Where two coat plastering is to be done, to avoid break down of adhesion between successive coats, drying shrinkage of first coat shall be allowed to be complete before subsequent coat is applied. Each coat shall be kept damp continuously for at least two days before applying the subsequent coat.

After application of first coat to the required thickness and before its setting, the surface shall be scored to provide key for the subsequent coat.

After preparing the surfaces as stated above the surfaces shall be properly wetted, adequate drying interval shall be allowed between erection of scaffolding and plastering to bring the surface suitable for suction adjustment. High rate of suction makes the plaster weak, porous and friable. The surface shall not be soaked but only damped evenly before applying the plaster the surface becomes dry in isolated spots such areas shall be wetted again to restore uniform suction.

All existing fittings fixtures etc., which are likely to be damaged shall be protected with suitable coverings. Splashes of mortar on doors, window chowkats etc., shall be cleaned off immediately before the mortar splashes set.

When the plaster has been brought to a true surface with the wooden straight edge, it shall be uniformly treated over its entire area with a plaster of neat cement and rubbed smooth, so that the whole surface is covered with neat cement coating. The quantity of cement applied for floating coat shall be 1 kg/SQM. Smooth finishing shall be completed with trowel immediately and in no case later than half an hour of adding water to the plaster mix

9.3.6.1 CURING

After the finishing coat is completed, the plasterwork shall be kept wet continuously for at least seven days. The water shall be supplied preferably by a very fine fog spray and excessive evaporation due to hot weather and dry spells shall be prevented by covering with gunny bags or other suitable materials which shall be kept wet continuously as directed by the EIC.

9.3.7 PRECAUTIONS

The standard of workmanship, shall be of the very best quality and the whole

of plastering is to be carried out in the best possible manner to the entire satisfaction of the CC. Tools and accessories used in plaster work shall conform to IS 1630. Metal tools shall be cleaned after each operation. All tools shall be examined to see that they are thoroughly cleaned before plastering has begun, during and after plastering, shall be according to the instructions contained in IS 1661.

All operations like construction of walls, encasement of steel columns and beams in concrete, fixing of doors, windows etc., that require plastering and or finishing by plastering shall be done much earlier so that they are sufficiently dry and strong to receive the plaster. All service pipes, wire etc., that are to be embedded in plaster shall be complete earlier.

The ceiling plaster shall not be done until the slab for the Upper Floor is cast and shuttering, centering of the slab and beams removed (of the upper floor). This precaution is necessary to avoid disturbance of plaster due to vibration.

Ceiling plaster shall be completed before commencement of wall plaster. Also the plastering should be done from top to bottom. For external plastering, the plastering operations may be started from the top floor and carried down wards.

Care shall be taken to see that other parts of the work or adjacent works are not damaged while plastering. Scaffolding shall be specified for the item of masonry.

9.4. DIFFERENT TYPES OF PLASTERING

9.4.1. INTERNAL PLASTER

Scaffolding and preparation of surface shall be as described earlier. Internal wall surfaces (brick masonry and block masonry as well as concrete surfaces) shall be plastered with 15mm thick cement mortar 1:6. Before the finishing coat of specifically prepared lime rendering 1.56mm thick shall be applied and trowelled to a smooth and even finish as directed by the EIC.

9.4.2. EXTERNAL PLASTER

Scaffolding and preparation of surface shall be as described earlier. External wall surfaces (brick masonry and block masonry as well as concrete surfaces) shall be plastered with 15mm thick cement mortar 1:5. Finishing shall be done by pressing with nylon sponge as directed by the EIC.

9.4.3. POINTING

Pointing to stone masonry/Cladding surfaces shall be in cement mortar 1:4 mixed with approved quality Water proofing compound in proportion as per the Manufacturers specifications. The joints shall be raked out to a depth of

20mm if not already done, all efflorescence shall be removed by brushing or scraping and shall be adequately wetted.

The mortar shall be pressed into the raked out joints with a pointing trowel either flush, sunk or raised. The mortar shall not spread over the corner, edges or surface of the masonry.

Flush pointing: The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of the stones so as to give a smooth appearance. The edges shall be neatly trimmed with a trowel and straight edged.

Recessed Pointing: The joints shall be initially formed for flush pointing and then size as instructed shall be formed by groove shape and size as per Drawings by running a forming tool, straight along the centre line of the joints. This operation shall be continued till a smooth and hard surface is obtained. The vertical joints shall also be finished in a similar way. The vertical lines shall make true right angles at their junctions with the horizontal lines and shall not project beyond the same.

The pointing shall be cured by continuously watering for minimum of seven days.

10.0 PAINTING

10.1 CEMENT PRIMER

The surface shall be thoroughly cleaned of dust, dirt etc., and be allowed to dry for at least 48 hours. It shall then be rubbed thoroughly with sand paper 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.

10.2 WATER PROOF CEMENT PAINT

The cement primer shall preferably be applied by brushing and not by spraying. Horizontal strokes shall be given first, and vertical strokes shall be applied be finished as smooth as possible, leaving no brush marks.

10.3 WATER PROOF CEMENT PAINT Material

The cement paint shall be (conforming to IS: 5410 - 1969) of approved brand and manufacture.

10.4 Preparation of mix

Cement shall be mixed in such quantities as can be used up within an hour of its mixing so that the finish is not affected.

The paint shall be prepared strictly as per manufacturer's specifications, in the absence of which, Cement paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and string thoroughly to obtain a liquid of workable and uniform consistency. The paint shall be mixed in such quantities as can be used up within an hour of its mixing.

10.4.1.1 Application

Before painting is commenced on surface all dirt and foreign matters shall be completely removed. The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. The application shall be on the surface, which is on the shady side of the building so that the direct heat of the sun is avoided. The painted surface shall be watered after the day's work. The second coat shall be applied after the first coat has been set for at least 24 hours. Before the application of the second or subsequent course, the surface of the previous coat shall not be wetted. It shall be kept damp at least for 7 days. Cement paint shall not be applied on surfaces already treated with white wash, colour wash, distemper, varnish etc., and on gypsum wood and metal surfaces.

10.4.2 OIL BOUND DISTEMPER

Plastic emulsion paint of approved brand and manufacture shall be used. The primer where used as on new work shall be oil based primer. These shall be of the same manufacture as the plastic emulsion or as approved by the EIC. Only sufficient quantity of paint required for a day's work shall be prepared.

The paint and primer shall be brought by the Contractor in sealed tins in sufficient quantities and from one single batch/consignment, and the same shall be kept in the joint custody of the Contractor and the EIC. The empty tins shall not be removed from the site of work, until this item of work has been completed and passed by the EIC.

Preparation of the surface: The scaffolding used for painting should be directed taking care not to rest on the walls so as to avoid any damage to the wall surface. For new work the surface shall be thoroughly cleaned of dust, old white or color washes 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 ingredients plaster of Paris, chalk powder, primer, paint etc., mixed as specified or directed by the EIC) on entire surface including filling up the undulation and then sand papering the same after it is. One coat of sealer and two coats of plastic emulsion paint shall be applied. The application is done using good quality approved make brush, on the final application roller is used to get a better and acceptable finish (The roller application is done on the smooth wall surface only). At place where required the application of putty and sand papering is required. The work is to be carried out under direct guidance and instructions from the manufacturer whose BNADES advice and supervision are to be made available in order to achieve the high-grade finish. The painters employed for this work must be capable of producing the highest standard of workmanship required. If the finish is of doubtful nature, the Contractor shall have to rectify at his own cost to the entire satisfaction of the EIC.

10.4.3 TEXTURED PAINTING

All textured paint to conform to specific is. The paints of specific make/manufacturer that mentioned in the specification are to be used.

The textured paints may be of exterior and interior grades.

The surface is prepared free of dust/dirt/Grease and other foreign matters. The scaffolding is to be done as for the other type of painting.

Texture finish painting is a well coating available in readily available textures finishes and colours and is substitute to conventional wall finishes. These paints can be textured, recessed, raised, granular, smooth etc., finishes. The glossy finish can be achieved by adding marble powder to the required proportion.

As far as possible only ready mixed color/shade to be used directly unless until a shade difference is required which shall be achieved using stainer of approved make and color, mixed in approved proportion.

The thickness of granules used in the textured paint shall be 2.5mm. This finish can be applied only surface of finish like cement plaster, good surface of brick masonry and also already painted surface. The textured finish acts as better fire retardant coat as against the conventional type of painting. This paint is also anti-corrosive.

The finish needs a minimum of 3 hours to dry and shall be ready for use after 24 hours.

The application is either done with brush or spray gun or trowel (also the manual pressure applied on the trowel) or roller depending on the required finish and as per the manufacturer's instructions.

The applicators should be skilled and specially trained by the manufacturer of the particular texture paint to do such work.

Basically the application process is:

- Application of a base coat- either one or two depending on the required finish of the selected texture. The color of the base coat is to be approved by the EIC.
- Application of ready mixed paint shall be by any of the already mentioned type i.e., by Brush, Spray, Trowel, Roller etc., depending on the type of finish required.

10.4.4 PAINTING STEEL SURFACES

The Contractor shall purchase synthetic enamel paint of approved quality, make, colour and shade.

All steel surfaces shall be thoroughly cleaned of all dirt, grease, rust and mill scale. Areas, which become inaccessible after assembly, shall be painted before assembly. The surfaces shall be perfectly dry before painting.

The priming coat for steel work shall be applied after the surface has been prepared. After the priming coat has dried, all blow holes and dents shall be filled with metal paste and surface smoothed with sand paper.

Wherever shop primer painting is damaged, the surface shall be thoroughly cleaned and touched up with the corresponding primer.

Site painting shall not be done in frosty or foggy weather or when humidity is such as to cause condensation on the surface to be painted.

Whether painting or polishing, manufacturer's specification in the contract.

The contractor shall clean thoroughly all stains of paint on glasses, walls, fittings and fixtures etc., by applying turpentine or thinner.

10.5

ANTI - TERMITE TREATMENT

These specifications shall be applicable for all types of structures, R.C.C. framed (with plinth beams, columns) and with load bearing wall foundations. Chemicals, concentration and dosage for horizontal and vertical surfaces are based on IS Code of Practice for 'Anti-Termite Measures in building' IS 6313 (part11) - 1971. Anti-termite shall be carried out for the complete building including open course, aprons (paved and unpaved), pipes, wastes and conduits.

The chemicals used for the treatment shall be any one or a combination of the following with the concentration shown against each in aqueous emulsion.

<u>Chemical</u>	<u>Concentration</u>
Heptachlor	0.5 %(by weight)
Chloropyrophos	0.5 %(by weight)

The treatment shall commence immediately after the excavation for foundations are complete and the plinth wall construction is in progress. The treatment is to be carried out in the following stages.

The top surface of masonry course (or a levelling course, if provided) just below the level of the earth formation to be kept on the outside of the building shall be soaked with chemical emulsion at the rate of 2.5 liters per sqm of the surface. This application shall be carried out slowly to enable the masonry surface (or levelling course) to absorb the emulsion properly.

The top surface of masonry course (or levelling course) at the earth fill level shall be similarly sprayed as mentioned above with chemical emulsion at the rate of 2.5 liters per sqm of the surface.

The internal face of the wall mentioned above shall be sprayed with chemical emulsion at the rate of 5 liters per sqm before the back filling of earth. This spraying shall be carried out slowly so that the emulsion soaks well into the wall thus forming a continuous chemical barrier vertically between the two termite's proof courses.

Ramming with iron rods shall be carried out along the junction of the walls and earth filling at 150 mm intervals down to or slightly lower than the level of the termite proof course at earth fill level i.e., the chemical barrier described above. Emulsion shall be sprayed along the wall junction at one liter per linear meter so that it mixes intimately with broken up soil and seeps below the chemical barrier thus establishing continuity of the anti-termite layer. The

disturbed earth shall then be tamped back in place.

After the earth filling is completed in the plinth area before the sub-grade of sand filling is laid, the entire surface of the filled earth shall be treated with the chemical emulsion at the rate of 5 liters per sqm. Light ramming with iron rods shall be carried out in the soil surface to facilitate absorption of the emulsion.

Finally the earth around the external perimeter of the building up to a depth of 300 mm shall be treated at the rate of 4.5 liters per running meter of the plinth wall. To facilities treatment,

solid M.S. rods shall be driven as close as possible to the plinth wall at intervals of 150 mm and up to a depth of 300mm and the rods moved backward and forwards in a direction parallel to the wall to break up the earth so that the chemical emulsion mixes intimately with the soil.

When pipes, wastes and conduits enter the soil inside the area of the foundation, the soil surrounding the point of entry, must be loosened around each such pipe, waste or conduit for a distance of 150 mm and up to a depth of 75 mm before treatment is commenced. When pipes enter the soil external to the foundations, it shall be similarly treated unless it stands clear of the walls of the building by about 75 mm for a depth of over 300mm.

A pressure pump shall be used to carry out spraying operation to facilitate proper penetration of chemical into the earth.

The Agency will take whatever additional precaution that is necessary to make the building termite proof.

The Contractor shall give a 10-years service guarantee in writing supplemented by a separate and unilateral guarantee from the specialized agency for the job to keep the building free of termites for the specified period.

10.5.1 SUPPLYING AND FILLING CINDER

CINDER used in the works shall be obtained from furnace of steam boiler using coal fuel only Cinder shall be clean and free from clay, wood ashes or other deleterious matter. Cinder shall pass through IS Sieve designation 3.35 mm with atleast 50% of it passing through IS Sieve designation 1.70 mm. Cinder obtained from brick kilns shall not be used. On the site, the cinder shall be protected from dirt collecting on it.

Cinder required to be used for extent work such as plastering and foundation concrete when it is likely to be affected by dampness, shall not contain more than 10% of unburnt carbon (combustible matter) and not more than 0.5% of acid soluble sulphate (expressed as SO₃). For cinders required to be used in internal work such as mortars for walls and base concrete for floors, the allowable percentage soluble sulphate (expressed as SO₃) as one percent except that the cinder shall be 12.5 mm nominal size i.e., passing through IS

sieve designation 212 and 70 to 90 percent retained on a IS sieve designation 106 micron. Cinder obtained from brick kilns shall not be used.

The cinder shall be of sufficiently hard clinker that it shall not get powdered, when rammed with wooden thappies. The cinder should be well wetted with water before use.

The top surface of the area to be laid shall be thoroughly cleaned before filing. The cinder shall then be filled to the requisite depths and slopes and rammed with light wooden reamers to get a uniform surface with the slopes as required.

10.5.2 CEMENT CINDER CONCRETE TERRACING/FILING IN SUNKEN PORTION

The specifications for cinder shall be as described earlier except that the cinder shall be 12.5mm nominal size i.e., passing through IS sieve designation 212 micron and 70 to 90 percent retained on an IS sieve designation 106 micron. Cinder obtained from brick kilns shall not be used.

Before laying cinder concrete the bottom and sides of the sunken area shall be treated by Specialists for water tightness to the required slope with a small outlet "weep hole" at the end of the slope to drain out water if any does enter later. Cement and cinder shall be measured separately by volume in the ratio of 1:15 unless otherwise stipulated. Cement need not however be actually measured but a bag of cement of 50 kgs shall be taken as equivalent to 0.35 cum in ingredients. It shall be thoroughly mixed together to ensure that the cinders are uniformly and completely coated with neat cement.

The top surface of the roof slab bottom and sides of the sunken area shall be thoroughly cleaned of all dust, dirt and other foreign matter. The cinder concrete shall then be laid (spread to the required slope if laid on terrace) and well rammed with wooden thappies to give a uniform spongy concrete, correct to slopes and levels.

The finished surface shall be cured for at least 7 days. During this period it shall be protected from sun, rain and other damage.

11.SPECIFICATIONS FOR STRUCTURAL STEEL WORK

The contractor shall consider the following points while quoting the rates for structural steel work:

All structural fabrication shall be done at contractor's own workshop.

The fabricated structures shall be finished upto the final coat of enamel painting and transported to the site for erection.

The final coat of enamel painting shall be applied before erection at site.

In case of any welding to be done at site, the contractor shall arrange his own power supply/generator at his own cost.

1. Structural materials shall be tested if necessary and all test certificates shall be submitted to the employer before commencement of fabrication.
2. Welding samples for each welder shall be submitted to the Architects and only the welders whose samples are approved shall be employed in the work.
3. All joints for either fillet or butt welding shall be prepared as per the instructions of the Architects/details given in the drawings before proceeding with the welding work.

SSS – 1 STRUCTURAL STEEL WORK

GENERAL:

This specification covers the supply, fabrication, transportation to site and erection on prepared foundations, structural steel work consisting of beams, columns, vertical trusses, bracings, shear connections etc.

Fabrication, erection and approval of steel structures shall be in compliance with the general specifications and IS: 800 – 1962, IS: 806, IS: 1161 and supplementary drawings to be supplied to the contractors during execution of the work.

Providing shop primer coat for steel structures, grouting, shall be to the complete satisfaction of the Engineer-in-charge/Architect/Consulting engineer.

MATERIALS:**ROLLED SECTIONS:**

The following grades of steel shall be used for steel structures.

Structural steel will generally be of standard quality conforming to IS: 2062. Steel tubes for tubular structure shall conform to IS: 1161.

WELDED MATERIALS:

Welding electrodes shall conform to IS: 814. Approval of welding procedures shall be as per IS: 823.

BOLTS, NUTS AND WASHERS:

Bolts and nuts shall be as per IS: 1367 and tested as per IS: 1608. It shall have a minimum tensile strength of 44 Kg/sqmm and minimum elongation of 23% on a gauge length of 5.6 mm (an original cross sectional area of the gauge length). Washers shall be as per IS: 2016.

All materials shall conform to their respective specifications. The use of equivalent or higher grades or alternate materials will be considered only in very special cases subject to the approval of the Engineer-in-charge/Architect/Consulting engineer in writing.

RECEIPT AND STORING OF MATERIALS:

Steel materials supplied by the contractor must be marked for identification and each lot should be accompanied by manufacturer's quality certificate, conforming chemical analysis and mechanical characteristics.

All steel parts furnished and supplied shall be checked, sorted out, straightened and arranged by grades and qualities in stores.

Structural with surface defects such as pitting, cracks, laminations etc. shall be rejected if defects exceed the allowable tolerance specified in relevant standards or as directed by the Engineer-in-charge/Architect/Consulting Engineer.

Welding wire and electrodes shall be stored separately by qualities and lots inside a dry and enclosed room in compliance with IS: 816-1968 and as per instructions given by the Engineer-in-charge/Architect/Consulting Engineer. Electrodes shall be perfectly dry and drawn from an electrode even, if required. Checking of quality of bolts of any kind as well as storage of same shall be made conforming to relevant standards.

Each lot of electrodes, bolts, nuts etc. shall be accompanied by manufacturer's test certificate. Bolts and nuts shall be procured from approved manufacturers.

The contractor may use alternative materials as compared to the design specification only with the written approval of the Engineer-in-charge/Architect/Consulting Engineer.

MATERIAL TESTS:

The contractor shall be required to produce manufacturer's quality certificates for materials supplied by the contractor. Notwithstanding the manufacturer's certificates, the Engineer-in-charge/Architect/Consulting Engineer may ask for testing of materials in approved test houses. The test results shall satisfy the requirements of the relevant Indian Standards.

Whenever quality certificates are missing or incomplete or when material quality differs from standard specifications, the contractor shall conduct all appropriate tests as directed by the Engineer-in-charge/Architect/Consulting Engineer at no extra cost.

Materials for which test certificates are not available or for which test results do not tally with the relevant standards specifications, shall not be used.

FABRICATION:

Fabrication shall be in accordance with IS: 800 section V and IS: 806 in addition to the following.

Fabrication shall be done as per approved fabrication drawing adhering strictly to work points and work lines on the same. The connections shall be welded or bolted as per design drawing. The work shall also include fabricating built up sections.

Any defective material used shall be replaced by the contractor at his own expenses, care being taken to prevent any damage to the structure during removal.

All the fabricated and delivered items shall be suitably packed to be protected from any damage during transportation and handling. Any damage caused at any time shall be made good by the contractor at his own cost.

Any faulty fabrication pointed out at any stage of work shall be made good by the contractor at his own cost.

PREPARATION OF MATERIALS:

Prior to release for fabrication, all rolled sections warped beyond allowable limit shall be pressed or rolled straight and freed from twists, taking care that a uniform pressure is applied.

Minor warpings, corrugations etc. in rolled sections shall be rectified by cold working.

The sections shall be straightened by hot working where the architects so direct and shall be cooled slowly after straightening.

Warped members like plates, and flats may be used as such only if wave like deformation does not exceed 1/1000 but limited to 10 mm.

Surface of members that are to be joined by lap of fillet welding or bolting shall be even so that there is no gap between overlapping surfaces.

MARKING:

Marking of members shall be made on horizontal pads of appropriate racks or supports in order to ensure horizontal and straight placement of such members.

Marking accuracy shall be at least + or -1 mm.

CUTTING:

Members shall be cut mechanically (by saw or shear) or by oxyacetylene flame. However, all tubes for structural purposes shall be cut by saw only.

All sharp, rough or broken edges, and all edges of joints which are subjected to tensile or oscillating stresses, shall be ground.

No electric metal arc cutting shall be allowed.

All edges cut by oxyacetylene shall be cleaned off impurities prior to assembly.

Cutting tolerance shall be as follows:-

- A. For members connected at both ends + or – 1 mm.
- B. Elsewhere + or – 3mm.

The edge preparation for welding of members more than 12 mm thick shall be done by flame cutting and grinding. Cut faces shall not have cracks or be rough.

Edge preparation shall be as per IS: 823.

DRILLING:

Bolt holes shall be drilled.

Drillings shall be made to the diameter specified in drawings.

No enlargement of bolt holes by oxyacetylene flame shall be allowed.

Allowed variations for holes (out of roundness, eccentricity, plumb line

deviation) shall be as per IS: 800

- Maximum deviation for spacing of two holes on the same axis shall be + or – 1mm.
- Two perpendicular diameters of any oval hole shall not differ by any more than 1 mm.

Drilling faults in holes may be rectified by reaming holes to the next upper diameter, provided that spacing of new hole centres and distances of hole centre to the edges of members are not less than allowed and that the increase of hole diameter does not impair the structural strength.

Hole reaming shall be allowed if the number of faulty holes does not exceed 15% of the total number of holes for one joint.

PREPARATION OF MEMBERS FOR WELDING:

Assembly of structural members shall be made with proper jigs and fixtures to ensure correct positioning of members (angles, nodes etc.)

Sharp edges, rust of cut edges, notches, irregularities, fissures due to faulty cutting shall be chipped or ground or filled over the length of the affected area, deep enough to remove faults completely. All steel tubes required for fabrication shall be cut only by a hacksaw/band saw and shall not be gas cut except where permitted by the Engineer- in-charge.

Edge preparation for welding shall be carefully and accurately made so as to facilitate a good joint.

Generally no special edge preparation shall be required for members under 8 mm thick. Edge preparation bevelling denotes cutting of the same so as to result in V, X, K or U seam shapes as per IS: 823.

The members to be assembled shall be clean and dry on the welding edges. Under no circumstance shall wet, greasy, rust or dirt covered parts be assembled. Joints shall be kept free from any foreign matter, likely to get into the gaps between members to be welded.

Before assembly, the edges to be welded as well as the areas extending for at least 20 mm shall be cleaned (until metallic polish is achieved).

When assembling members, proper care shall be taken of welding shrinkage and distortions, as the drawing dimensions cover finished dimensions of the structure.

The elements shall be checked and approved by the consulting engineer or their authorized representative before assembly.

The permissible tolerance for assembly of members preparatory to welding shall be as per IS: 823 – 1964. After the assembly has been checked, temporary tack welding in position shall be done by electric welding keeping in view finished dimension of the structure.

WELDING PROCEDURE:

Welding shall be carried out only by fully trained and experienced welders as tested and approved by the consulting engineer. Any test carried out either by the consulting engineer or their representatives or the inspectors shall constitute a right by them for such tests and the cost involved thereon shall be borne by the contractor himself.

Qualification tests for welders as well as tests for approval of electrodes will be carried out as per IS: 823. The nature of test for performance qualification of welders shall be commensurate with the quality of welding required of this job as judged by the Engineer-in-charge/Architect/Consulting Engineer.

The steel structures shall be automatically, semi automatically or manually welded.

Welding shall begin only after the checks mentioned under preparation of materials, marking, cutting, drilling and preparation of members for welding have been carried out.

Welding procedures and tests for welder's skill have been conducted as per IS: 823 and approved by the Engineer-in-charge/Architect/Consulting Engineer.

The welder shall mark with his identification on each element welded by him.

When welding is carried out in open air, steps shall be taken to protect the place of welding against wind or rain. The electrodes wire and parts being welded shall be dry.

Before beginning the welding operation, each joining shall be checked to assure the parts to be welded are clean and root gaps provided as per IS: 823. For continuing the welding of seams discontinued due to some reason, the end of the discontinued seam shall be melted in order to obtain a good continuity. Before resuming the welding operation, the groove as well as the adjacent parts shall be well cleaned for a length of approximately 50 mm.

For single butt welds (in V, $\frac{1}{2}$ V or U) and double butt welds (in K, double U etc.) the rewelding of the root is mandatory but only the metal deposit of the root has been cleaned by back gouging or chipping.

The welding seams shall be left to cool slowly. The contractor shall not be allowed to cool the welds quickly by any other method.

For multi-layer welding, before welding the following layer, the formerly welded layer shall be cleaned metal bright by light chipping and wire brushing. Packing strips shall not be allowed.

The order and method of welding shall be so that:

No unacceptable deformation appears on the welded parts. Due margin is provided to compensate for contraction due to welding in order to avoid any high permanent stresses.

The defects in welds must be rectified according to IS: 823 and as per instruction of Engineer-in-charge/Architect/Consulting Engineer.

WELD INSPECTION:

The weld seams shall satisfy the following:

- Shall correspond to design shapes and dimension.
- Shall not have any defects such as cracks, incomplete penetration and fusion, under-cuts, rough surfaces, burns, blowholes and porosity etc. Beyond permissible limits.

During the welding operations and approval of finished elements, inspections and tests as shall be made as shown in annexure B.

The mechanical characteristics of the welded joints shall be as in IS: 823.

PREPARATION OF MEMBERS FOR BOLTING:

The members shall be assembled for bolting with proper jigs and fixtures to sustain the assemblies without deformation and bending.

Before assembly, all sharp edges, rust, dirt, etc shall be removed and the contacting surfaces of the members shall be cleaned and given a coat of primer as per IS: 2074. The members which are bolt assembled shall be set according to drawings and temporarily fastened with erection bolts (minimum 4 pieces) to check the coaxiality of the holes.

The members shall be finally bolted after the deviations have been corrected, after which there shall not be any gaps.

Before assemblies, the members shall be checked and approved by the Engineer-in-charge/architect/Consulting Engineer.

The difference in thickness of the sections that are butt assembled shall not be more than 3% or maximum 0.8 mm whichever is less. If the difference is larger, it shall be corrected by grinding or filling.

Reaming of holes to final diameter or cleaning of these shall be done only after the parts have been check assembled.

As each hole is finished to final dimensions (reamed if necessary), it shall be set and bolted up. Erection bolts shall not be removed before the other bolts are set.

BOLTING UP:

Final bolting of members shall be done after the defects have been rectified

and approval of the joints obtained.

The bolts shall be tightened starting from the centre of joint towards the edge.

PLANING OF ENDS:

Planning of ends of members like column ends shall be done by grinding when so specified in the design.

Planning of butt welded members shall be done after these have been assembled, the spare edges shall be removed with grinding machine or files.

The following tolerance shall be permitted on members that have been planed:

On the length of the member having both ends planed, maximum + or -2 mm with respect to design.

Level difference of planed surface – maximum of 0.3 mm and deviation between planed surface and member's axis – maximum of 1/1500.

HOLES FOR FIELD JOINTS:

Holes for field joints shall be drilled in the shop to final diameters and tested in the shop with trial assemblies.

When three dimensional assembly is not possible in the shop, the holes for field joints may be drilled in shop and reamed on site after erection on approval by the consulting engineer.

For bolted steel structures, trial assembly in shop is mandatory.

TOLERANCES:

All tolerances regarding dimensions, geometrical shapes and sections of steel structures shall be as per annexure 'B' if not specified in the drawing.

The tolerance for spacing of holes shall be + or -1 mm.

MARKING FOR IDENTIFICATION:

All elements and members prior to dispatch for erection shall be shop marked. The members shall be visibly marked with a weather proof light colored paint. The size and thickness of the numbers shall be chosen as to facilitate easy identification of members.

For small members that are delivered in bundles or crates, the required marking shall be done on small metal tags securely tied to bundles while the crates shall be marked directly.

Each bundle or crate shall be packed with members for one and same

assembly in the same bundle or crate general utility members such as bolts, gussets etc. may be packed.

All bill of materials showing weight, quality and dimensions of contents shall be placed on the crates.

The members shall be marked with a durable paint, in visible location, preferably at one end of the member so that these may be easily checked during storage and erection.

All members shall be marked in the shop before inspection and acceptance. When the member is being painted, the marking area shall not be painted but bordered with white paint.

The marking and job symbol shall be registered in all shop delivery documents (transportation, for erection etc.).

SHOP TEST PRE – ASSEMBLY:

For steel structures that have the same type of welding the shop test pre-assembly shall be performed on one cut of every 10 members minimum.

For bolted steel structures, shop test pre-assembly is mandatory for all elements as well as for the entire structure in conformity with 'holes for field joints'.

SHOP INSPECTION AND APPROVAL:

GENERAL:

The consulting engineers or their representatives shall have free access at all responsible times to the contractor's fabrication shop and shall be afforded all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with drawings and specifications.

Technical approval of the steel structure in the shop by the consulting engineer is mandatory.

The contractor shall not limit the number and kinds of tests, final as well as intermediate ones, or extra tests required by the consulting engineer.

The contractor shall furnish necessary tools, gauges, instruments, etc. and technical and non-technical personnel for shop tests by the consulting engineer, free of cost.

SHOP ACCEPTANCE:

The consulting engineer shall inspect and approve at the following stages:

The following approval may be given in the shop.

- Immediate approval of work that cannot be inspected later.
- Partial approvals.
- Final approvals.

Intermediate approval of work shall be given when a part of the work is performed later.

- Cannot be inspected later.
- Inspection would be difficult to perform and results would not be satisfactory.

Partial approval in the shop is given on members and assemblies of steel structures before the primer coat is applied and includes:-

- Approval of materials.
- Approval of field joints.
- Approval of parts with planed surfaces
- Test erection.
- Approval of members.
- Approval of markings.

Inspection and approvals of special features like rollers, loading, platform mechanism etc.

During the partial approval, intermediate approvals as well as all former approvals, shall be taken into consideration.

FINAL APPROVAL IN THE SHOP:

The final approval refers to all elements and assemblies of the steel structures, with shop primer coat, ready for delivery from shop to be loaded for transportation or stores.

The final approval consists of:

- Partial approvals.
- Approval of shop primer coat
- Approval of mode of loading and transport.
- Approval of storage (for materials stored).

PAINTING AND DELIVERY:

PREPARATION OF PARTS FOR SHOP PAINTING:

Painting shall consist of providing one coat of red oxide zinc chromate primer to steel members before dispatch from shop. Final painting shall be done with two coats of approved brand of enamel paint of required shade prior to erection.

Primer coat shall not be applied unless:

- Surfaces have been wire brushed, cleaned of dust, oil, rust etc.
- Erection gaps between members, spots that can not be painted or where moisture or other aggressive agents may penetrate have been filled with approved type of oil and putty.
- The surfaces to be painted are completely dry.
- The parts where water or aggressive agents may collect (during transportation, storage, erection and operation are filled with putty and provided with holes for drainage of water).
- Members and parts have been inspected and accepted.
- Welds have been accepted.

The following are not to be painted or protected by any other product.

- Surfaces which are in the vicinity of joints to be welded at site.
- Surfaces bearing markings.
- Other surfaces indicated in the design.

The following shall be given a coat of hot oil or any approved resistant lubricant only.

- Planed surfaces.
- Holes for links.

The surfaces that are to be embedded or in contact with the concrete shall be given a coat of cement wash.

The surfaces which are in contact with ground, gravel or brickwork and subject to exposure to moisture shall be given a bituminous coat.

Other surfaces shall be given a primer coating.

Special attention shall be given to locations not easily accessible, where water can collect and which after assembly and erection cannot be inspected, painted and maintained. Holes shall be provided for water drainage and inaccessible box type sections shall be hermetically sealed by welds.

If specified elsewhere in the schedule of quantities, the contractor shall paint further course of red oxide after erection and placing in position of the steel structures.

PACKING, TRANSPORTATION, DELIVERY:

After final shop acceptance and marking, the items shall be packed and loaded for transportation.

Packing must be adequate to protect items against warping during loading and unloading.

After-lifting devices shall be used for loading in order to protect items against warping.

Slender projecting parts shall be braced with additional steel bars before loading for protecting against warping during transportation.

Loading and transportation shall be done in compliance with transportation rules.

If certain parts cannot be transported in the lengths stipulated in the design, the position and type of additional splice joints shall be approved by the consulting engineer.

Items must be carefully loaded on platforms of transportation with means to prevent warping, bending or falling during transportation.

Small parts such as fish plates, plate gussets etc. shall be securely tied with wire to their respective parts.

Bolts, nuts and washers shall be packed and transported in crates.

The parts shall be delivered in the order stipulated by the consulting engineer and shall be accompanied by document showing:-

- Quality and quantity of structure or members.
- Position of members in the structure.
- Particulars of structure.
- Identification number/job symbol.

FIELD ERECTION:

The erection work shall be permitted only after the foundation or other structure over which the steel work will be erected is approved and is ready for erection.

The contractor shall satisfy himself about the levels, alignment etc. for the foundations well in advance, before starting the erection. Minor corrections shall be carried out by the contractor on his own expense.

Any faulty erection done by the contractor shall be made good at his own cost.

Approval by the consulting engineer or their representatives at any stages of work does not relieve the contractor of any of his required guarantees of the contract.

STORAGE AND PREPARATION OF PARTS PRIOR TO ERECTION:

The storage place for steel parts shall be prepared in advance and got approved by the architects before the steel structures start arriving from the shop.

Platform shall be provided by the contractor near the erection site for

preliminary erection work.

The contractor shall make the following verifications upto the receipt of material at site:

- For quality certificates regarding materials and workmanship according to these general specifications and drawings.
- Whether parts received are complete without defects due to transportation, loading and unloading defects, if any are well within the admissible limits.

For the above work, sufficient space must be allotted in the storage area. Steps shall be taken to prevent warping of items during unloading.

The parts shall be stored according to construction symbols and markings so that these may be taken out in order of erection.

The parts shall be at least 150mm clear from the ground on wooden or steel blocks for protection against direct contact with ground and to permit drainage of water.

If the rectification of members like straightening etc. are required, these shall be done in a special place allotted which shall be adequately equipped.

The parts shall be clean when delivered for erection.

ERECTION AND TOLERANCES:

Erection in general shall be carried out as approved by the consulting engineers.

Positioning and levelling of the structure alignment and plumbing of the stanchion and fixing every member of the structure shall be in accordance with the relevant drawings and to complete satisfaction of the consulting engineer.

The following checks and inspection shall be carried out before, during and after the erection:

- Damage during transportation.
- Accuracy of alignment of structure.
- Erection according to drawings and specifications.
- Progress and workmanship.

In case there are any deviations regarding positions of foundations or anchor bolts, which would lead to erection deviations, the consulting engineer shall be informed immediately. Minor rectifications in foundations, orientation of bolts, holes etc. shall be carried out as a part of the work at no extra cost.

Various parts of the steel structure shall be so erected as to ensure stability against inherent weight, wind and erection stresses.

The structure shall be anchored and final erection joints completed after plan and elevation positions of the structural members have been verified with corresponding drawings and approved by the consulting engineer.

The bolted joints shall be tightened so that the entire surface of the bolt heads and nuts shall rest on the member. For parts with sloping surfaces, tapered washers shall be used.

METHOD OF PAYMENT:

Payment for steel work shall be made on the basis of admissible weight of the structure accepted, the weight being determined as described below:-

The rate for supply, fabrication and erection shall include cost of all handling and transportation to owner's store/site of work, trimming, straightening, edge preparation and providing one coat of red oxide zinc chromate primer and two coats of approved brand of enamel painting.

In case owner supplies materials, the rate shall include the cost of steel materials, taking delivery of the materials from owner's store, all handling and rehandling, loading and unloading, transport to site of work, returning of surplus materials to owner's stores etc. complete as well as the cost of all handling and transport, scaffolding, temporary supports, tools and tackles, touching up primer coat grouting etc.

The weight for payment shall be assessed from the approved fabrication drawings and the respective bill of materials. The weight of structural materials/plate shall be calculated wherever necessary on the basis of IS handbook. If sections are different from IS section, then manufacturer's handbook shall be adopted. No allowance in weights shall be made for rolling tolerance.

Sections built out of plates shall be paid on the actual weight incorporated except for gussets which will be paid on the weight of the smallest rectangle enclosing the shape. No deductions shall be made for skew cuts in rolled steel sections.

Welds, bolts, nuts, washers etc. shall not be measured. Rates for structural steel work shall be deemed to include the same.

No other payment either for temporary works connected with this contract or for any other item such as welds, shims, bracing plates etc. shall be made. Such item shall be deemed to have been allowed for in the rate quoted for steel work.

GROUTING OF POCKETS:

Grouting of pockets and under base plates will be done only after the steel work has been leveled and plumbed, and the base of stanchions are

supported by steel shims. The space below the base plate and pockets shall be thoroughly cleaned.

The mortar used for grouting shall not be lesser than 1:2 (1 cement: 2 sand, grade 300 in case of concrete) and shall be mixed to the minimum consistency required, it shall be poured under a suitable head and tamped until the space has been completely filled.

Tolerances allowed in the erection of plant building without cranes:-

The maximum tolerances for line and level of the steel work shall be + or - 3.00mm on any part of the structure. The structure shall not be out of plumb more than 3.5 mm on each 10 m section of height and not more than 7.0 mm per 30 m section.

The tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

INCORPORATE ALL THE CLAUSES RELATED TO LABOUR FROM THE TENDERDOCUMENTS OF CIVIL CONSTRUCTION- APPLICABLE FOR THE WORK EXECUTED IN THE PREMISES OF BBAN

ANNEXURE 'A'

Inspection or test defects	Coverage	Procedure	Evaluation findings and remedy for
Inspection of weld seam	All welds	Naked eye or lens	All faulty welds shall be rectified.
Checking of sizes	At least one for each weld.	Ordinary measuring instruments (rule, templates)	Should faulty welds be found, all welds shall be checked and all defects shall be rectified.
Mechanical tests for welding procedure, performance and electrodes.		As per IS: 823.	As per IS: 823.

ANNEXURE 'B'

Defects	Detailing of sketching of defect	Allowed tolerances and remedy of defects	Cause of defects.	Mode of finding defects.
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Unsatisfactory appearance	Uneven width, rugged seam	At discretion, cut weld and reweld.	Uneven welding progress, voltage fluctuations, varying arc length, negligence, inexperienced welder.	External (visual) inspection.
Unsatisfactory shape, shape shall be allowed	Shallow or jutting welds.	No variance from design checking.	Negligence.	Visual inspection, template.
Incomplete weld		Not allowed fill in weld		Template checking.
Molten metal flow		Not allowed fill in weld.	Excessive melting, wrong handling of electrodes.	Visual inspection.
Pits		Not allowed cut & reweld.	Wrong welding technique.	Visual inspection.
Surface cracks.		Not allowed cut & reweld	Great stresses, sudden cooling, wrong type of electrodes.	Visual inspection.
Incorrect sectional dimensions		B1=+/-2mm B2=+/-2mm B=+/-1mm	Negligence.	Template checking
Depth weld		C=+/-1mm Chisel & grind		
Insufficient	For weld lengths 11+5 mm, for 12+10 mm for shorter seams cut & reweld or complete to length.		Negligence.	Rule checking.
Defects	Detailing of sketching of defect	Allowed tolerances and remedy of defects	Cause of defects.	Mode of finding defects.
Back cuts.	If 0.5 mm for 10 mm,		Burnt material, excessive melting.	Visual inspection.

	& c 1 mm for 10 mm, replace relevant members.		
Surface porosities.	Max.5% of seam area cut and ruled.	Frequent interruptions welding electrodes inadequately covered.	Visual or inspection.
<p>Inadequate appearance of weld may be allowed if no other defects that might diminish weld strength are present. Sectional weld shape must comply with design indications. No concave welds shall be allowed for specified convex welds, vice versa. Tolerance for concavity or convexity of welds shall be 1 x A ('A' being the height of the triangle within the section shown), but more than 0.6 mm.</p>			