KERALA TRANSPORT DEVELOPMENT FINANCE CORPORATION LIMITED

Construction of Disembarking Platform and Development of Yard and Approach Road to the KSRTC Garage at Thampanoor Bus Terminal Complex, Thiruvananthapuram

TENDER No. 32/BOTP/KTDFC/2015

TENDER DOCUMENTS

PART – II

GENERAL SPECIFICATIONS, ADDITIONAL CONDITIONS OF CONTRACT

KTDFC
Trans Towers
Thiruvananthapuram-14

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GENERAL SPECIFICATIONS AND ADDITIONAL CONDITIONS OF CONTRACT

ABSTRACT OF CONTENTS

SECTION - G

GENERAL SPECIFICATIONS AND ADDITIONAL CONDITIONS OF CONTRACT

G. 01 Scope and extent of the work

This contract is for the Interior Work for the Office of Kerala Road Safety Authority in Floor IV of Trans Towers at Vazhuthacaud, Thiruvananthapuram, as per the approved drawings and specifications. The items of works to be executed are as per the Tender Schedule attached as Part IV of the tender documents. The tender must be for the Interior Work for the Office of Kerala Road Safety Authority in Floor IV of Trans Towers at Vazhuthacaud, Thiruvananthapuram detailed in the tender documents herein. Part tender will not be considered. The rate quoted by the tenderer should be for the finished works as per specifications and conditions of contract covering the cost of all materials and labour required for the work including supplies and installations and all incidentals, scaffolding etc and all kinds of taxes including service tax as applicable.

G. 02 Location and Access

The work site is Trans Towers situated on the opposite side of Womens College - Thycaud road at Vazhuthacaud, Thiruvananthapuram. This site is about 3 km from Central Railway Station, 2 km from Statue and 1 km from Vellayambalam Jn. Thiruvananthapuram International Airport is within a distance of about 6 km from the site.

G. 03 General description of work

This tender is for the Interior Work for the Office of Kerala Road Safety Authority in Floor IV of Trans Towers at Vazhuthacaud, Thiruvananthapuram and all extras and incidentals for proper completion of the work as indicated in the accompanying Tender Drawings and as detailed in the Tender Schedule and Technical Specifications.

All component works are to be done in accordance with the latest Indian Standard Specifications unless otherwise specified in the tender documents and as per direction of the Engineer-in-charge.

G. 04 Construction Facilities

a) Power Supply:

Power will not be supplied by KTDFC. Contractor shall make arrangement for power at his own cost including standby generator, if required.

b) Other Facilities:

All facilities required for the construction, required for the work shall be arranged by the Contractor at his own cost.

G. 05 Tools and Plant

No tools and plant will be supplied by the KTDFC. The Contractor will have to bring his own tools and plant and all equipments required for the smooth and efficient execution of the work.

G. 06 Watching Arrangements

The contractor shall make his own arrangements for watching, lighting and protecting the work and materials, labour and staff at site by day and night on all days including Sundays and holidays at his own cost, till completion and taking over.

G. 07 Materials required for the Work

All materials required for the work shall be brought by the Contractor and shall be of good quality as per Indian Standards and the Specifications. Samples of materials shall be got approved by the Engineer before effecting the supply and using on the work. Test certificates shall be produced for ensuring the quality of materials by the Contractor along with samples, as and when required.

G. 08 Priority of completing the work

The work shall be completed in all respects within the period of completion of one month. Priority for various works shall be decided with approval of Engineer in charge so as to ensure proper sequence of work to enable all works to proceed smoothly without hindrance.

G. 09 Safeguard and protection of men, materials and equipments

All required precautions and safety measures shall be adopted by the Contractor for the safety of men, materials and machinery including general public. Where required insurance coverage shall be ensured by the Contractor. Responsibility for the safety mentioned above is entirely that of the Contractor and KTDFC will not be liable for any loss or damage that may be occasioned.

G. 10 Statutory clearances and requirements

Statutory clearance if any is required for any of the works the same shall be obtained by the Contractor. Statutory Payments made, if any, for obtaining such clearance, the same shall be reimbursed by the KTDFC against proper vouchers in respect of such payments.

The contractor shall possess all licenses and certificates as required, for carrying out the work, as per statutes in force.

G. 11 Shop drawings and As built drawings

Shop drawings for all fabrication works and general lay outs of various other works in respect of services if any, shall be prepared by the Contractor and got approved by Chief Engineer/ Architect before carrying out the work. 3 sets of As built (As installed) drawings of all installations and constructions shall be furnished, as per requirements, on completion of works. Quoted rates shall include all the expenses on these accounts. Security deposit will not be released until these requirements as well as terms and conditions in respect of the 'defect liability period' are satisfied.

SECTION – 'T'
TECHNICAL SPECIFICATIONS

T1-CIVIL CONSTRUCTION WORKS

EXCAVATION

GENERAL

The places where excavation is directed to be done shall be cleared of all shrubs, weeds, grass and vegetation including roots and other debrises of the demolished building materials if any, where necessary and if so directed the excavated earth must be deposited in layers of 15 cms and the clods should be broken. During excavation if so directed 'dead-men' (of volume not more than 5% of the excavation volume) shall be left at the places directed for verification of the dimensions of excavation. These 'dead-men' shall be removed and earth deposited at places shown before full rate is paid. Alternately, or in addition to dead-men if so directed block levels at intervals as directed will be jointly taken and recorded by the contractor's representative and client's / architect's representative before starting of excavation & after completion. Recording of block levels or leaving of dead-men may be avoided in the case of narrow foundations& trenches if so directed by the Engineer in charge till the debrises in the area shall be removed with in a distance of 5 Km lorry including the dismantled tarred, concreted and metalled surfaces. This will be measured its volume.

Measurement shall be taken and the quantities calculated in accordance with the IS 1200 (latest issue).

Excavation shall be to the exact length, width & depth shown or as per figures in the drawing or as directed by the Architects. If excavated to greater length, width or depth than shown or required the extra work occasioned thereby shall be done at contractor's expenses. However, extra width where necessary for providing working space for further work will be permitted & paid for. Such extra will be limited to the allowances provided in IS code 1200. Extra depth excavated shall be brought up by plain cement concrete filling of approximate proportion & extra length & width filled in by rammed earth or murrum or if it is found necessary for stability of the work by concrete as directed at contractor's cost. Water accumulated within the trenches during the progress of work from whatever causes shall be bailed or pumped out at contractors own expenses. Foundations or trenches shall be kept free of water while masonry or concrete works are in progress.

The rate quoted shall include bailing or otherwise removing all water which may accumulate in the excavation from all causes, trimming of all sides to plumb or as directed. Dismantling, removing & stacking as directed existing water pipes & or soil pipes within the excavated portion.

When the depth of Trench in soft / loose soil exceeds 1.5 meters, Stepping, Sloping, and / or Planking and Strutting of sides shall be done. Planking & Strutting shall be CLOSE or OPEN depending on the nature of the soil and the depth of trench. It shall be the responsibility of the contractor to take all necessary steps to prevent the sides of trenches from collapse. The contractor shall include the cost of Timbering to hold the sides of Excavation, Planking, Strutting or any other protection work done with the approval of the Engineer to keep trenches dry & protect the sides from caving in and protect the foundations from damage. The shoring /supporting materials shall not be measured and is included in the rates unless otherwise specified.

MODE OF MEASUREMENT AS PER IS: 1200:

Unless otherwise stated, herein after, all work shall be measured net in decimal system, as fixed in position as given below:

1) Each dimension shall be measured to the nearest 0.01 m, where any dimension is more than 25 m; it should be measured to the nearest 0.1 m

2) Areas shall be worked out to the nearest 0.01 square metre; and

3) Cubical contents shall be worked out to the nearest 0.01 cubic metre.

Excavation in SOFT / ORDINARY ROCK

Soft / Ordinary rock can be classified as Ordinary Rock comprising of Lime stone, Sand stone, Hard laterite, Fissured rock, Conglomerate or other soft or Disintegrated rock which may be quarried or split with crow bars.

Un-reinforced cement concrete and stone masonry in cement mortar below ground level may be broken up with crow bars or pick axe.

Boulders which do not require blasting having maximum diameter in any direction of not more than 300 mm or the overall size not exceeding one cubic meter, found lying loose on the surface or embedded in river bed shall be removed with the earth

In the case of soft rock / ordinary rock, if required by the Architect/Engineer, the excavated stuff shall be properly stacked in places as directed. If necessary, the quantity of these stacks shall be measured and payment will be based on the net quantities after deducting 35% for voids from the measured quantities. The rate for this item will be paid as per the rates as extra item of if required according to the site.

Excavation in HARD ROCK

HARD ROCK BY BLASTING

Where hard rock is met with and blasting operations are considered necessary, the contractors shall intimate about the same to the Engineer. The contractor shall obtain license from district / public authorities for carrying out blasting work as well as for obtaining transporting and storing explosives as per 'explosive rules 1940' or as amended, if required.

Blasting operations shall be carried out under supervision of a responsible licensed operator of the contractor during certain specified hours, preferably during lunch break as approved in writing by the Engineer in charge. The operator shall be conversant with the rules of blasting, and should have a valid blasting license.

Proper precautions for safety of persons shall be taken. Red flags shall be prominently displayed around the area to be blasted and all people on work except those who actually light the fuses shall be withdrawn to a safe distance of not less than 300 metres from the blast. Blasting shall not be done within 100 metres of an existing masonry or any other kind of structure unless special precautions are taken by heavy blanketing etc. on the special approval of Engineer in charge. Controlled blasting or chemical blasting may have to be resorted to, if safety considerations call for.

In the case of Hard rock, if required by the Architect/Engineer, the excavated stuff shall be properly stacked in places as directed. The quantity of these stacks shall be measured & payment will be based if necessary on the net quantities after deducting 40% for voids from the measured quantities. The rates for this item is also given as per the rules as extra item if required for the work. As per soil report these two items are not required.

HARD ROCK BY CHISELLING

Where blasting is not practicable or prohibited, excavation shall be done by wedging or chiseling or rock breakers & it shall be restricted to the quantity required to enable the necessary foundation etc. to be placed. In case, the dimension of trenches exceed those shown in drawings, the measurement by stacked volume with allowance for voids or volume calculated as per the drawing, including the working space as specified in the IS : 1200, which ever is less shall be paid for.

MODE OF MEASUREMENT AS PER IS: 1200:

The Hard Rock excavated shall be stacked & measured in stack. The quantity of the hard rock excavated shall be arrived at by applying pre-accepted deductions (stated as a

percentage) for voids. The rates for this items will be permitted as per the prevailing rules and rate of this Contract.

FILLINGS

FILL MATERIAL:

Fill materials required for fill and back fill shall be subject to approval. Fill material shall be free from all soft or spongy materials. Clods or rocks over 200 mm in size shall be placed in the upper 150 mm of fill. Fill under floors, terraces and concrete beds shall be free of Salt Peter, white ants, etc.

FILL COMPACTION:

The fill (red earth) shall be spread in layers not exceeding 150 mm thick and each layer shall be watered and thoroughly consolidated with a ten tonne roller. At locations where rolling is not possible, the filling shall be carried out in layers not exceeding 150 mm thick and each layer rammed with heavy rammers and thoroughly consolidated till the required level is reached. The fill shall then be flooded with water for at least 24 hours, allowed to dry & then rammed & consolidated again. The finished surfaces shall be formed to correct lines, levels, slopes, shapes, paths, etc. & shall not be executed until all foundations, footings, etc., have been inspected & approved. Return & fill around foundations, walls etc., shall be executed as described above and brought to grades up to either original ground level or as detailed in the drawings or as instructed when different from original grades. The filling of carriage way will be done to a minimum depth of 50cm layer by layer with compactor and power roller and consolidation test will be carried out through authorized agency like Highway research lab/ Engineering college as per (IRC – code).

FINISH GRADING:

Finish grading shall be done with fertile top soil over those areas noted as on the plans. Depth of top soil shall be 150 mm minimum. Approval shall be obtained before placement of top soil.

REMOVAL OF EXCAVATED MATERIALS

Removal of excavated material includes the separation of the useful from the useless portion (what is useful and what is useless is left to the sole discretion of the Architect) and depositing the former in regular heaps and removal of the latter. Surplus earth dismantled waste materials, if any and useless spoil shall be carted away, anywhere in the site and deposited as directed or at any nearest designated dumping area identified by the Corporation/Company or concerned authority.

GENERAL FOR ALL CONCRETE WORKS, MASONRY WORKS AND ALL WORKS WHERE MORTAR IS BEING USED

A) CEMENT:

Cement shall comply in every respect with the requirements of the latest publication of IS: 269 and unless otherwise specified, Pazalona Portland cement (43 Grade) shall be used. No other make of cement but that approved by the Architects / Engineer will be allowed on works & the source of supply shall not be changed without approval of the Architect/Engineer in writing. Test certificates to show that the cement used fully complies with the relevant IS specifications shall be submitted and not with- -standing this, the Architect/Engineer may at their discretion order that the cement brought to site and which they may consider damaged or of doubtful quality for any reasons whatsoever shall be retested in an approved testing laboratory and fresh certificate of its soundness shall be produced. Cement ordered for re-testing shall not be used for any work pending results of retest. Cement shall be stored and neatly packed in piles not exceeding 10 bags high, in weather proof sheds with raised wooden plank flooring to prevent deterioration by dampness or intrusion of foreign matter. It shall be stored in such a way as to allow the removal and use of cement in chronological order of receipt, i.e. the first received being first used. Cement deteriorated and / or clodded shall not be used on work but shall be removed at once from the site. Daily record of cement received & consumed shall be maintained by the contractor in an approved from and a copy submitted to the Architect/engineer once a week.

B) FINE AGGREGATES:

Sand shall conform to IS: 383. It shall pass through I.S sieve 4.75 mm (3/16 B.S) test sieve, leaving a residue not more than 5%. It shall be from a natural source or crushed stone screenings. It shall be washed if directed to reduce percentage of deleterious substances to acceptable limits. Sand shall not contain any trace of salt & sand containing any trace of salt shall be rejected. The fine aggregate for concrete shall be graded within limits as specified in IS: 383 & the fineness modules shall range between 2.60 to 3.20. The fine aggregate shall be stacked carefully on a clean hard dry surface so that it will not get mixed up with deleterious foreign materials. If such a surface is not available a platform of planks or corrugated sheets or brick floor or concrete floor shall be prepared. Sand shall be added in the desired proportion as required for the strength specified, with suitable correction for bulking.

C) COARSE AGGREGATES:

Coarse aggregate shall conform to the latest IS: 383 1970 and its later amendments. It shall consist of crushed or broken stone, 95% of which shall be retained on 4.75 mm in test sieve. It shall be obtained from crushed granite, trap, basalt or similar approved stones from approved quarry. Coarse aggregate shall be chemically inert when mixed with cement & shall be angular in shape and free from soft, friable, thin, porous, laminated or flaky pieces.

It shall be free from dust and other foreign matter. Gravel/shingle of desired grading may be permitted as a substitute in part or full in plain cement concrete if the Architect/Engineer is otherwise satisfied about the quality of aggregate.

D) WATER

Water used for all construction work shall be fresh, clean, free from oil, salts, acids, alkali & shall be in accordance with the clause 4.3 of IS 456 - 1978. The contractor shall produce test results for approval by the Engineer in charge, for the mixing of water proposed to be used on the job, before using it for any construction work.

MIXING OF CONCRETE:

1. MACHINE MIXED :

The concrete Mixer should comply with IS:1791-1968 (latest issue). Aggregates shall be accurately measured out in boxes and mixed dry along with required cement. Water shall then be added in measured quantity and mixing shall be continued until there is uniform distribution of the materials and the mass is uniform in colour and consistency but in no case shall the mixing be done for less than 2 minutes. Only hopper loading mixer shall be used. If there is segregation after unloading from the mixer, the concrete should be remixed

2. HAND MIXING:

When hand mixing is permitted with the approval of the Architect/Engineer, it shall be carried out on water tight mixing platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour & consistency. If required by the Architect/Engineer 10% extra cement has to be added if hand mixing is done. In no case hand mixing shall be done for concrete requirement of more than 4 cubic metres.

REINFORCED CEMENT CONCRETE

GENERAL:

Proportion of ordinary cement concrete will be expressed as 1:3:6, 1:2:4, 1:1.5:3 etc. in the specification. The first figure will be the quantity of cement by volume, the second figure will be dry coarse sand (fine aggregate) by volume and the third figure will be the quantity of course aggregate by volume. Cement shall be measured by weight. The weight is to be derived on the basis that 1 cubic meter of cement will weigh 1440 kgs., or one full bag of 50 kgs will be assumed to be 35 ltrs. When the sand is wet or moist suitable correction for bulking is to be considered while proportioning. Architect/Engineer may allow measuring cement by volume. Unless otherwise specified rates for all RCC will be exclusive of reinforcements. Reinforcements will be paid for separately. Unless otherwise stated, for all RCC work the size of course aggregate will be 20 mm and down size.

CEMENT CONCRETE PLAIN:

CONSISTENCY:

Normally for every 50 kg of cement total water including moisture content of aggregate should not be more than, as described in the table below,

PROPORTION	VOLUME OF WATER REQUIRED (LITERS)
1:3:6	34
1:2:4	30
1:1 1/2 :3	30

If difficulty is experienced in placing the concrete of specified mix & approved consistency between & below reinforcement bars, in the bottom of beams & similar situations, the concrete shall have improved workability by increasing the proportion of water & corresponding additional quantity of cement & using aggregates of smaller size than specified as directed by Architect/Engineer for which no extra price will be paid. The consistency shall be determined by making trial mixtures with dried aggregates at site, or when so instructed at an approved laboratory and tested. Consistency may be measured by slump test using a standard cone or the Architect/Engineer may direct the use of any other means of testing the consistency. If the apparatus used for the slump test is a standard cone, when filled, it shall be raised vertically clear of the concrete and the measurement of the slump shall be 300 mm minus the height of the slumped cone of concrete. Care shall be taken to prevent vibration of the samples being tested. The following slumps shall be adopted for different kind of works.

	WITH VIBRATOR	WITHOUT VIBRATOR
1. Mass concrete in RCC foundation, footings & retaining walls.	10 - 25 mm	80 mm
2. Beams, slabs & columns simply reinforced	25 - 40 mm	100 - 125 mm
3. Thin RCC section or section with congested steel	40 - 50 mm	125 - 150 mm

CONVEYING:

Concrete shall be conveyed from the place of mixing to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of any of the ingredients. If segregation does occur during transport, the concrete shall be remixed before being placed. Normally not more than 30 minutes shall lapse between mixing and consolidation in position. Concrete shall not be conveyed through pipe made of aluminium or aluminium alloy.

CHUTES:

Chutes shall be metal or metal-lined & shall have a slope not exceeding 1 vertical to 2 horizontal & not less than 1 vertical to 3 horizontal. Chutes more than 6 metres long & chutes not meeting the slope requirements may be used, provided they discharge into a hopper before distribution

PUMPING:

Pumping or pneumatic conveying equipment shall be of a suitable kind with adequate pumping capacity. Pneumatic placement shall be controlled so that segregation is not apparent in the discharged concrete. The loss of slump in pumping or pneumatic conveying equipment shall not exceed 50 mm.

PLACING AND COMPACTING:

Method of placing shall be such as to preclude segregation and as far as practicable the placing shall be continuous. Special care shall be taken in accordance with IS 456 while laying concrete under extreme weather. Concrete, during the operation of placing shall be thoroughly worked around the reinforcements, embedded fixtures, spaded against corners of formwork by punning, rodding, or by any other approved means & thoroughly compacted by mechanical vibrators.

Immersion vibrators shall have a minimum frequency of 8000 vibrations per minute and sufficient amplitude to consolidate the concrete effectively and shall comply to IS 3558. They shall be operated by competent workmen. Use of vibrator to transport concrete within the forms shall not be allowed. Vibrators shall be inserted and withdrawn at points approximately 450 mm apart. The duration shall be sufficient to consolidate the concrete & not cause segregation, generally from 5 to 15 seconds. A spare vibrator shall be kept on job site during all concrete placing operations.
Where the concrete is to have an as - cast finish, a full surface of mortar shall be brought against the form by the vibration process, supplemented if necessary by spading to work the coarse aggregate back from the formed surface.

Excessive vibration should not be done as it leads to honey combing. Honey combing is normally not accepted; if accepted then it shall be grouted with c.m 1:3(use only fine sand) under pressure as directed. Tolerance for leveling of concrete must not exceed 2 mm by depth.

ADMIXTURES:

Unless otherwise specified use of admixtures like, water proofing Acrylic polymer coating crystalline penetration, polymer pulverized mineral powder, Polymer binding agent will be allowed only after obtaining prior approval in writing. Architect's/Engineer's decision in this regard shall be final.

PRECAUTIONS:

Unless adequate protection is provided and approval is obtained, concrete shall not be placed during rain, sleet or snow. Rainwater shall not be allowed to increase the mixing water nor to damage the surface finish. Special precautions are to be taken during rainy season so that freshly placed concrete can be adequately covered and protected by keeping sufficient number of tarpaulins.

CURING:

Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures, and mechanical injury and shall be maintained with minimum moisture loss at a relatively constant temperature for the period necessary for hydration of cement & hardening of the concrete. The materials and methods of curing shall be subject to approval. Curing shall be continued for at least 10 days in case of all concrete except high early strength concrete for which the period shall be at least 3 days. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, moisture retention measures may be terminated when the average compressive strength has reached 70 % of the specified strength. If normal curing is not proper as per the specification, Contractor should provide and apply necessary curing compounds as directed at no extra cost.

STRENGTH OF ORDINARY CONCRETE:

The contractors have to see that proper materials are used and the proportion and the correct water cement ratio just sufficient for the workability are maintained to see that the following minimum strength of concrete are obtained.
To verify this, test cubes from the concrete used should be made and tested. The frequency of testing & the acceptability criteria will be according to IS 456-1978 and IS 516-1959.

Compressive strength of 15 cm cubes at 28 days after mixing in kgs/ sq.cm

RATIO	PRELIMINARY TEST	WORK TEST
1:3:6 (M 10)	135 kg/sqcm	100 kg/sqcm
1:2:4 (M 15)	200 kg/sqcm	150 kg/sqcm
1:11/2:3 (M 20)	260 kg/sqcm	200 kg/sqcm
(M 25)	325 kg/sqcm	250 kg/sqcm
(M 30)	380 kg/sqcm	300 kg/sqcm

Six cubes shall be taken from any mix selected at random by the Engineer in charge, three of them should be tested after 7 days and 3 after 28 days. The strength at 7 days must be 2/3 of the strength at 28 days. The criterion for acceptance is only the strength at 28 days.

ACCEPTANCE CRITERIA

The concrete shall be deemed to comply with the strength requirements if:

a) Every sample has test strength not less than the characteristic value; or

b) The strength of one or more sample though less than characteristic value, is in each case not less than the greater of:

1) The characteristic strength minus 1.35 times the standard deviation; and
2) 0.80 times the characteristic strength; and the average strength of all the sample is not less than the characteristic strength plus [1.65 - { 1.65 / Sq Rt (No. of Samples)}] times the standard deviation

The concrete shall be deemed not to comply with the strength requirements if:

a) The strength of any sample is less than the greater of :

1] The characteristic strength minus 1.35 times the standard deviation; and
2] 0.80 times the characteristic strength; or

b) The average strength of all samples is less than characteristic strength plus [1.65 - { 3 / SqRt (No. of Samples) }] times the standard deviation

Concrete of each grade shall be assessed separately. Concrete shall be assessed daily for compliance.

The contractor shall keep a record at site of all such tests identifying them with portion of work to which they relate. This record will be checked by the Engineer in charge, from time to time.

The said record shall give the following details and shall be initialed by the Engineer in charge,

a) Reference to specific structural member receiving the batch of concrete from which the cubes were cast.
b) Mark on cubes.
c) Mix of Concrete.
d) Date and time of casting.
e) Water cement ratio by weight and slump.
f) Crushing strength as obtained at the end of 7 days for 3 cubes out of a set of 6 cubes and at the end of 28 days for the remaining 3 cubes.
g) Laboratory in which tested and reference to test certificates.
h) The quantity of concrete incorporated in work that is represented by the quantity of concrete of the set of the cubes.
i) Any other information required by the Architect./Engineer

It is essential that the Engineer who is in-charge of the construction of all concrete work, whether plain or reinforced shall be well experienced in this class of work and shall superintend personally the whole construction and pay special attention to:-

a) Quality Control in respect of selection of materials, proportioning and mixing, etc.
b) Placing and consolidation of concrete.
c) Accuracy in cutting, bending, placing and binding of reinforcement.
d) Accuracy in fabrication, assembly and erection of form work.
e) Casting, handling, transportation and erection of pre-cast members.

CONSTRUCTION JOINTS

Construction joints in exposed concrete work shall be made only where shown on the drawings or directed by the Architect/Engineer & shall be in accordance with the details shown or as approved. The procedure given in clause 20.1.4.2 of IS: 456-1978 shall be followed for general guidance. All laitance shall be removed from the concrete before it is allowed to fully harden. The removal shall be effected by scrubbing the concrete surface with wire and with bristle brushes and washing down to expose clearly the aggregate. However care shall be taken to avoid dislodgement of particles of aggregate. If concrete has been allowed to harden excessively the surface shall be chipped over its whole surface to a depth of at least 10mm and thereafter thoroughly washed. Before fresh concrete is added

on the construction joints, the surface of the old concrete shall be thoroughly wetted and covered with a thin layer of cement mortar 1:2.

VERTICAL JOINTS:

At the end of any day's work or run of concrete, the concrete shall be finished of against temporary shutter stop which shall be vertical and securely fixed. This stop shall be removed as soon as weather permits. Construction joints in concrete floors and walls of basement, water tanks or any other structures in contact with water or earth (if specified in drawing or directed), shall be provided with PVC water stops of approved make coated on either side with hot asphalt. The longitudinal joints, in water stops, shall preferably be hot welded or overlapped at least 200 mm.

CONTROLLED CONCRETE:

Controlled concrete shall be taken to mean that there shall be full field control of

(1) Pre-determined grading of all aggregates that go into concrete

(2) Pre-determined proportion by weight of course aggregate, fine aggregate, cement & water for the required strength. Strength shall mean the acceptable field strength after 28 days of curing on the tests conducted on cubes from concrete taken during concreting in the manner set forth in IS : 456.

A statement of acceptable field strength is noted below:

Compressive strength of 15 cm, cubes at 28 days after mixing, conducted in accordance with relevant ISI code.

Grade Of Concrete	TEST MIN	PRELIMINARY MIN	WORKS TEST
(1)	(kg/sq cm)	(kg/sq cm)	
	(2)	(3)	
M 10	135	100	
M 15	200	150	
M 20	260	200	
M 25	320	250	
M 30	380	300	
M 35	440	350	
M 40	500	400	

To arrive at the proportion to be adopted to obtain the required grade of concrete the mix proportion should be designed based on laboratory tests conducted using the aggregates

actually available at site and which would be used for making concrete. The design mix should give suitable workability to enable it to be well consolidated to be worked into the corners of the shuttering and around the reinforcements. Where difficulty is likely to be encountered in placing and compacting concrete and where there is crowding of reinforcements a separate mix is to be designed for required strength & used without extra cost. The mix design along with the workability obtainable with the designed mix should be furnished to the Architect/Engineer before hand and their approval obtained. A laboratory is to be established at the site to asses the moisture content of aggregates as frequently as necessary and as instructed based on which correction is to be applied to the quantity of water to be used for mixing. All aggregate are to conform strictly to IS: 383 the aggregates will be tested as frequently as directed by the architects to see that their specification is the same as adopted in the mix design. They must be stored on clean platform made for the purpose. Concrete shall be weighed batched. The dials of weigh batching unit to be used shall be checked with standard weights periodically. The Conversion of weights to volume will be allowed under special circumstances. Despite the design for several mixes the following quantities of cement as per IS: 456, are the minimum to be used for the different grades of the concrete:-

M 15 - 280 Kg/m^3
M 20 - 320 Kg/m^3
M 25 - 350 Kg/m^3
M 30 - 390 Kg/m^3
M 35 - 425 Kg/m^3
M 40 - 460 Kg/m^3

DEFECTS IN CONCRETE:

Immediately on removal of form work, the surface of the concrete shall be examined & any honey combs or other imperfections shall be brought to the notice of Architect/Engineer. The acceptability or otherwise of such defective concrete shall be at the sole discretion of the Architect who may direct the contractor to repair the defective work or ask for demolition and replacement of such defective work at the risk and cost of the contractor.

PROTECTION OF CONCRETE :
All concrete shall be protected from damage by workmen, equipment, overload or any other cause. All edges, corners & projections of concrete members likely to be damaged shall be protected by means of cover fillets or as directed .

EQUIPMENT FOUNDATION:
The contractor shall provide concrete foundations for the various equipments in accordance with the drawings. All concrete for equipment foundations shall be of specified grade as per drawing. Bolts, inserts & other anchoring features shall be left in their

correctly assigned position to templates prepared for this purpose at the time of casting. Where it is not possible to leave bolts, etc., in position, pockets of suitable sizes shall be left in the concrete foundations to receive the bolts. Pockets shall be formed by suitable form work as directed. The cost for making pockets shall be paid separately. Bolts shall be grouted by expanding cement mortar, non-shrink grouting compound and finished neat.

PRECAST CONCRETE:

All pre-cast concrete shall be cast over vibrating tables or by using form vibrators. The concrete mix shall confirm in all respects to "Controlled Concrete" described in the appropriate paragraph under this section. Exposed surfaces of pre-cast members shall be finished as called for on the drawings. All jointing surfaces shall be wire brushed and hosed down until the aggregate is free from cement slurry. Castellations shall be provided wherever called for. Grouting holes, grooves, inserts, projections, reinforcements, lifting hooks, etc., shall confirm to the erection procedure. All edges and delicate projections likely to be damaged during handling & erection shall be protected by means of rubber pads or wooden cover fillets, until placed in position.

PRECAST ELEMENTS:

All pre-cast elements shall be exactly of the size & pattern shown on the drawings and shall be made face up in the following manner:

1) All units shall be integrally cast.
2) Steel form work shall be used.
3) Stiff plastic concrete 1: 1.5: 3 shall be used with coarse aggregate 12 mm and down size.

The pre-cast units shall not be removed from the forms for three days. Pre-cast work shall be cured under cover & shall be kept under water for fifteen days before placing in position. Samples of each part shall be approved by the Engineer in charge before proceeding with work. Unit may require wetting before bedding. The concrete base shall be wetted & coated with slurry & minimum of water shall be used in the bedding mortar which shall be OPC/PPC and sand 1:3.

STORAGE, HANDLING AND HOISTING OF PRECAST MEMBERS.

Pre-cast members are to be stored and handled in such a manner so not as to over stress the members beyond the design limits. Storage and handling procedures must be approved by the Engineer in charge before start of work The pre-cast members are to be stored very carefully in the immediate vicinity of the casting yard or in the moulds themselves, for a minimum period of 21 days. During the initial period of the storage these are to be

properly protected against radiation, heat of sun, drying air etc. by covering them with straw mats, hessian etc. which are to be kept continuously wet. For this purpose, the yard shall be provided with a mechanical water sprinkling system.

FORMWORK AND ITS TOLERANCES.

All form work for pre-cast design mix concrete work shall be in steel adequately stiffened and braced to give uniform exposed concrete finish. Only exterior form bracing is to be used for lateral tying of form work to ensure uniformity in appearance of the cast members, or units. Care should be taken so that the contact surfaces or forms or forms liners are of uniform quality and texture and joints in formwork are symmetrically located. Chemical shuttering release agents are to be used. If shuttering oil is used after approval then it shall be colourless, non-staining, and emulsifiable in water.

Tolerances: Forms for the pre-cast members shall be true to size & dimensions shown on plan & should be constructed and protected from warping so that the finished product will be within the limits given below:

a) Overall dimensions of members + 1 mm per meter, maximum of +/- 20 mm
b) Cross sectional dimensions,

Sections less than 150 mm	: +/- 3 mm
Sections over 150 mm, less than 450 mm	: +/- 5 mm
Sections 450 mm to 900 mm	: +/- 6 mm
Sections over 900 mm	: +/- 10 mm

c) Deviation from straight line in long section not more than 1mm per metre.
d) Deviation from specified counter +/- 0.5 mm per 1 meter of span.
e) Maximum differential between adjacent units in erected position 6 mm.

FORMWORK AND CENTERING:

GENERAL:

Forms shall be used, wherever necessary to confine the concrete, & shape it to the required dimension. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall have sufficient rigidity to maintain specified tolerances.

The selection of materials suitable for formwork shall be based on economy, consistent with safety & quality required in the finished work. Formwork shall be made of timber, plywood, steel, fiber glass, reinforced plastics or any other material as approved. Unless specified, form work shall be made out of the following materials for different elements of the buildings as follows:

SLAB BOTTOM	-STEEL PLATES
SLAB BOTTOM WITHOUT BEAMS (FLAT SLAB)	-MARINE PLY
BEAM SIDES	-STEELPLATES/WOOD PLANKS
BEAM BOTTOMS	WOOPLANKS / MARINE PLY
COLUMNS	-MARINE PLYWOOD/ STEEL BOX
WALL	-WALL FOR MEMBERS
EXPOSED FINISHES	-PLASTIC COATED PLYWOOD

Props & Shores shall be only of steel. Approval in writing should be obtained for use of ballies or any other material. Shuttering faces in contact with the concrete shall be free from adhering grout, projecting nails, splits or other defects that are likely to mar the concrete surface. The shuttering shall be erected on battens, beams & steel props properly cross braced so as to make the form work rigid. Form work shall be erected true to line and levels and to the required shapes as called for & shall be able to carry without deformation the full weight of wet concrete & live loads. It shall also withstand the effect of vibration without deflection, bulging, distortion or loosening of its component parts. Approval for shop drawings for formwork including location of props/shoring & re-shoring shall be obtained before commencing the work. The completed form work shall also be subject to approval by the Engineer in charge before placement of reinforcement. Contractor shall be responsible for sufficiency & adequacy of all form work centering & moulds. The form work shall be designed so that the soffits of slabs & the sides of beams may be removed first leaving the form work to the soffits of beams & their supports in position. Wedges shall be so provided as to allow accurate adjustment of form work and its easy removal. All joints shall be sufficiently tight to prevent leakage of grout. Chamfer fillets shall be provided at all corners wherever called for on the drawings or as directed. Clean-out holes shall be provided at the bottom of all columns, pier and wall formwork and care shall be taken to remove any rubbish, wood shavings or any other foreign material before concreting. Temporary supports shall be provided as required and/or ordered by Engineer in charge. Compressed Air shall be used if required for cleaning the formwork before concreting. Formwork for walls of water tanks, basements and other locations, for facias, parapets and similar vertical members shall be held together rigidly by means of form ties of suitable length. The form ties shall be of approved design and type and shall have a minimum working strength of 1500 kg. The ties shall be free from lugs, cones, washers, etc., which leave a hole larger than 20 mm dia or any depressions back of exposed surface of concrete. Openings may be given with the approval of Engineer in charge at convenient places for washing down all the rubbish. These are to be closed before concreting where necessary to maintain the specified tolerances; the formwork shall be cambered to compensate the anticipated deflection in the formwork prior to the hardening of concrete.

TOLERANCE:

Unless otherwise specified by the Architect/Engineer, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits as mentioned below,

1) Variation from plumb:

a) In the lines and surfaces of columns, piers, walls and in sharp edges formed at meeting of two surfaces 6mm per 3.0 m but not more than 25 mm.

b) For exposed corner columns and other conspicuous lines - In any 6 M height - 6 mm. Maximum for entire height - 12 mm

2) Variation from the level or from the grades indicated on the drawings after allowing for specified cambers

a) In slab soffits, ceiling beam soffits, and in horizontal sharp edges formed at meeting of two surfaces,(measured before removal of supporting shore)

In 3 m - 6 mm
In any bay or in any 6 m length - 10 mm
Maximum for entire length - 20 mm

b) For exposed lintels, sills parapets, horizontal grooves and other conspicuous lines,

In any bay or in 6 m length- 6 mm
Maximum for entire length - 12 mm

3) Variation of the linear building lines from established position in plan and related position of columns, wall and partitions,

In any 6 m length - 12 mm
Maximum for entire length - 25 mm

4) Variation in the sizes and locations of sleeves, openings in wall and floors - 6 mm

5) Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls,

Minus - 6 mm
Plus - 12 mm

6) Footings ;

a) Variation in dimension in plan

Minus - 12 mm
Plus - 50 mm

b) Misplacement or eccentricity 2% of footing width in the direction of misplacement but not more than - 50 mm

c) Reduction in thickness - 50% of specified thickness subject to maximum of 50 mm

7) Variation in Steps;

a) In a flight of Stairs

Riser - 3 mm

Tread - 5 mm

b) In consecutive Steps

Riser - 1.5mm

Tread - 3 mm

SURFACE TREATMENT OF SHUTTERING:

The surfaces of shuttering coming into contact with concrete shall be plastic coated of approved make wherever specified. The shuttering shall be thoroughly cleaned and coated before each use. The surface shall also be coated with shutter releasing compounds as per the manufacturer's directions.

REMOVAL OF FORM WORK:

All formwork shall be removed without shock or vibration and shall be eased off carefully in order to allow the structure to take up its load gradually. Forms shall not be disturbed until concrete had adequately hardened to take up its own weight and superimposed load coming on it and in no circumstance shall forms be struck until the concrete reaches a strength of at least twice the stress to which the concrete may be subjected at the time of striking. The side forms shall be so fixed that while removing them the supporting forms & posts are not disturbed.

All the form work shall be kept in position until the expiry of a minimum period after completion of concreting as specified below:

1) Forms supporting sides of beams, walls & columns -24 to 48 Hours
2) Bottoms of slabs up to 4.5 m span - 7 days
3) Bottoms of slabs above 4.5 m span - 14 days
4) Bottoms of beams up to 6 m span - 14 days
5) Bottoms of beams over 6 m span - 21 days
6) Bottoms of beams over 9 m span - 28 days

BACK PROPPING:

The number of props left under, their sizes & disposition shall be such as to be able to safely carry the full dead load of the slab, beams or arch as case may be together with any live load likely to occur during curing or further construction. Intermediate props shall be

left for full setting time. In the case of beam less slabs (Flat slab), folded plates & shell roofs the contractors should take approval for the pattern of centering & shuttering along with program for de-shuttering. The tolerances of shuttering and stripping time will be as set forth in ISI 456. If directed, forms shall be given an upward camber to ensure that the beams and slabs do not have any sag. Any honeycombing of minor nature shall be repaired neatly by grouting cement mortar 1:2. Any work showing signs of damage through premature or careless removal of centering or shuttering, shall be reconstructed by the contractor at his own cost. Surface that has to remain exposed after removal of forms shall be carefully examined and any fins, burrs, projections etc. that are detected shall be removed.

REINFORCEMENT:

Steel reinforcement shall be either TMT high yield strength deformed bars of grade Fe-415 conforming to IS:1786-1966 or as called for on the drawings. Fabric reinforcement where called for shall be of hard drawn mild steel wire mesh conforming to IS:1566-1967. Bars shall be free from deleterious materials, mill scale, loose rust, oil or paint. The contractor shall submit bar bending schedules for approval of the Architect/Engineer prior to commencement of fabrication. These shall indicate the accurate dimensions and bending of bars as called for on the structural drawings. Fabrication shall be accurately done to the dimensions, spacing and ensuring minimum cover as called for on structural drawings. All steel shall be rigidly held in place with 18 gauge annealed steel wire. Cement mortar (1:2) blocks of required shape, M.S. chairs and spacer bars shall be used in order to ensure accurate positioning of reinforcement. All reinforcing steel within the limit of a day's pour shall be in place and firmly wired at least one day prior to the date of pour to permit inspection. The contractor shall also ensure that all conduits and inserts are in position before placing concrete. Hooks where indicated shall be either a complete semi-circular turn with a radius of not less than four and not more than six bars diameters, plus an extension of at least four bar diameters at the free end, or a 90 degree bend having a radius of not less than 4 bar diameters plus an extension of 12 bar diameters. Unless otherwise shown or specified on the drawings, all splices (joints) in bars shall be lapped by 50 times the lower diameter of bar. Not more than 33% (Thirty Three Percent) of the bars shall have lapped joints at the same location. Reinforcement shall have welded joints only where specifically shown on the drawings. Welding if specified shall be paid separately.

BRICK WORK GENERAL:

A) All brick work including solid block should be carried out as shown on the drawings with set backs, projections, cuttings, toothings etc. Wherever the proportion of cement mortar has not been specifically mentioned, cement mortar in the proportion of 1:6 shall be used. Flat brick arches shall be provided wherever required without any extra cost. Brick work shall be kept wet while in progress till mortar has properly set. On holidays or when the work is stopped, the top of all unfinished masonry shall be kept wet. Should the mortar

be dry, white or powdery, for want of curing, work shall be pulled down and rebuilt at the contractor's expense.

B) Table moulded bricks shall conform to IS: 1077. Country bricks shall be of the best quality & approved by the Architect/Engineer. Bricks shall be thoroughly cleaned and well wetted. Table moulded bricks shall be soaked for at least 12 hours in fresh water before being used on the work. Country bricks shall be thoroughly soaked in water till the bubbles cease to come.

C) Samples of each type of brick picked at random from the load shall be deposited for approval before being used in the work. All subsequent deliveries shall be up to the standard of the sample approved.

D) Unless otherwise specified, brickwork shall be done in English bond with frog upwards. The bricks shall be bedded & joined with mortar in such a manner as not to leave voids. Each brick shall be correctly bedded into position by tapping with the handle of the trowel, grouting of mortar slurry will not be allowed, except where necessary for special reasons and in such cases, prior permission shall be obtained.

Care shall be taken that each course of brick work is truly horizontal & perfect in bond and the face of the wall is straight, plumb and even. The mortar joints shall be 10mm in thickness, except where extra thickness is required for the purpose of bringing the brick work to the required height or level. Half bricks or bats shall not be used except for obtaining the bond & where absolutely necessary.

E) Mortar on all brick work shall consist of cement & clean sand. Pazalona Portland cement of grade 43 confirming to IS 269-1967 shall be used unless otherwise specified. Cement shall be fresh when delivered at site. Sand shall be clean, not too fine nor too coarse & shall fall within the grading zones I to IV given in Table III of IS 383:1C7C. The silt content of sand shall not exceed 5% by volume.

Water used for mixing mortar shall be in accordance with clause 4.3 of IS:456-1978.
F) All junctions of walls & cross walls shall be carefully bonded into the main walls. The rate of laying masonry will be up to a height of 100 cm per day if cement mortar is used. Greater heights may be built only if permitted.
G) During rains, the work shall be carefully covered to prevent mortar from being washed away, should any mortar or cement be washed away, the work shall be removed & rebuilt at the contractor's expense.

MIX PROPORTION:
Unless other wise specified the mortar shall consist of one part cement and six parts of sand for brick work 230 mm thick and above and solid block 20cm or above. For brick

piers, half brick walls, honey combed brickwork & hollow (cavity) walls, the mortar mix shall consist of one part of cement and four parts of sand.

MORTAR MIXING:
Mixing of mortar shall be done in a mechanical mixer. Hand mixing shall be resorted to only when specifically permitted . Cement & sand shall be mixed dry thoroughly & then water shall be added gradually. Wet mixing shall be continued till mortar attains the consistency of a stiff paste and uniform colour. Only the quantity of mortar which can be used within thirty minutes of its mixing shall be prepared at a time.

Mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within thirty minutes after the water is added to the dry mixture. Mortar left unused for more than thirty minutes after mixing shall be rejected and removed from the site of work

Compressive Strength of brick or designated class should be as mentioned below:

CLASS	AVERAGE COMPRESSIVE STRENGTH(Kgs/cm2)
7.5	75
5.0	50
3.5	35

Tests to be carried:
A) Dimension Test:

All the blisters, loose particles of clay and small projections shall be removed from the surface of bricks. Each specimen of 20 bricks shall then be arranged upon a level surface successively in contact with each other and in straight line. The overall length of the assembled bricks (20 Nos) shall be measured with a steel tape sufficiently long to measure the whole row at one stretch.

The actual dimensions of bricks when tested as described above shall be within the following limits per 20 bricks:
For Modular Bricks

Length -3720 to 3880mm (3800 +/- 80 mm)
Width -1760 to 1840mm (1800 +/- 40 mm)
Height -1760 to 1840mm (1800 +/- 40 mm) for 90mm high bricks.
-0760to 0840mm (0800 =/- 40 mm) for 40mm high bricks.

Nor Non - Modular Bricks (F.P.S) (for class 10)

Length	-4410 to 4590 mm
Width	-2180 to 2260 mm
Height	-1380 to 1420 mm for 70 mm high bricks.
	-0860 to 0900 mm for 44 mm high bricks.

For other classes

Length	-4320 to 4680 mm
Width	-2130 to 2310 mm
Height	-1340 to 1460 mm for 70 mm high bricks.
	-0840 to 0920 mm for 44 mm high bricks.

B) Test for Compressive Strength:

Five whole bricks shall be taken from the samples as specimen for this test. Length and width of each specimen shall be measured correct to 1 mm. A lot shall be considered having satisfied the requirements of average compressive strength if the average compressive strength does not exceed by 20 percent of the minimum average compressive strength for the corresponding class of brick.

C) Water Absorption Test:

Five whole bricks shall be taken from samples as specimen for this test. It shall be considered having satisfied the requirements of water absorption if the average water absorption is not more than 20 % by weight.

BRICK WALLS:
BRICK WORK IN 230 mm WALL

In the case of 230mm thick walls, if bricks are of size such that the width of the header course does not come equal to the width of the stretcher course. The difference shall be made up during construction of brick work itself by the same mortar as used for construction of masonry to provide a plane vertical surface. The surface should also be scarified to receive plaster.

HALF BRICK WORK

This shall be set in cement mortar as specified. Unless otherwise specified the walls shall be reinforced with 2 nos. of 6 mm mild steel bars with tie bars at 1 metre interval on top of

the first course and at every fifth course thereafter. The cost of half brick work shall include the cost of reinforcement where reinforcement of half brick walls is specified.

CURING:

All fresh brick work shall be protected from the effects of sun, rain, etc., by suitable covering. All brick works shall be kept constantly moist on all the faces for at least 10 days.

SCAFFOLDING FOR BIRCK & STONE WORKS:

Unless otherwise instructed, double scaffolding having two sets of vertical supports preferably 'H' frames shall be provided for all brick & stone masonry works. The supports shall be sound, strong and tied together with horizontal pieces over which scaffolding planks shall be fixed.

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

STONE GENERAL:

SIZE STONE / COURSED RUBBLE MASONRY:

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

Height of course, shall not be less than 150mm & 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 5 mm and 35 mm respectively.

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 at least half the height of the course. Faces of stones shall be hammer dressed and bushing not be more than 25 mm. Thickness of joints shall not be more than 20 mm. Edges of face stones of exposed faces shall be chiseled true to both longitudinal and vertical lines. Exposed faces of corner stones shall be 2 line dressed 50 mm 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 walls up to 600 mm thick the bond stones shall be in one piece and for walls over 600 mm thick they shall either be in one piece (if available locally) or be in the series of headers; each header

overlapping the adjoining one by not less than 150 mm. Bond or through stones shall be marked as directed to enable their being easily detected even after having been built in position. The interior or filling shall be with flat bedded stones laid in mortar. Chips/ spells shall be used to avoid thick mortar joints and shall not exceed 10% of the quantity of stone masonry. Care is to be taken that no dry work or hollow spaces shall be left any where in the masonry.

UNCOURSED RUBBLE MASONRY:

The stones as received from quarry are to be set in work after knocking off weak corners and edges with mason's hammer. They are to be laid carefully so as to break joint as much as possible and shall be solidly bedded in mortar. No joint shall exceed 20 mm chips of stone and spalls shall be wedged into the work wherever necessary to avoid thick beds or joints of mortar. No dry work or hollow spaces shall be allowed, every stone whether large or small shall be set flush in mortar, smaller stones used in filling being carefully selected to fit snugly the interstices between the larger ones. The face stone shall be selected from the mass of quarry stones for proper size good beds & uniform colour and shall be laid as far as possible without pinning in front. One through stone shall be provided for every sq.mtr of facing & shall run back into work at least 600 mm or full depth of the work if it is less than 600 mm. The quoins for exposed corners unless otherwise specified shall be of selected stone neatly dressed with hammer and chisel to form required angle and laid header and stretcher alternatively. The masonry has to be kept wet for 10 days. In the case of cement mortar the proportion specified is on volumetric basis. But cement shall be weighed on the assumption that one cubic meter of cement weighs 1440 kgs. The cement may also be measured by volume if called for, but on the same assumption. All cantilever long walls with buttress and cross walls at more then 6 m centers , should have a expansion joint of 25 mm from the plinth (mainly for compound walls).

RANDOM RUBBLE MASONRY:

The face stone shall be laid absolutely without pinnings on the face. Every stone shall be carefully fitted so as to form neat and close joints and if necessary the edges shall be dressed with chisel so as to ensure close joints work. The thickness of joint will be as specified for each work and in no case more than 20 mm. The thickness of joint should be uniform on the face variation being within 25%. Mortar in joints should be scraped 12 mm deep for pointing.

The stones shall be roughly chisel dressed to ensure equal size on face as far as possible. They shall be of uniform colour and they shall be carefully laid and solidly bedded in mortar & shall tail back and bond well into the backing & shall not be of greater than either breadth of face or length of tail into the work.

One header or through stone shall be inserted for every square meter of face & shall run right through the wall if it is not more than 600 mm thick. If more than 600 mm a line of

headers shall be laid from face to back which shall overlap each other at least 150 mm. Stones shall be arranged to break joints as much as possible and long vertical lines of joining shall be avoided in face work. The quoins unless otherwise specified shall be of selected stones neatly dressed with hammer chisel to form required angle and laid header and stretcher alternatively. The masonry has to be kept wet for 10 days.

In the case of cement mortar, the proportion specified is on volume basis. But cement shall be weighed on the assumption that one cubic meter of cement weighs 1440 kgs.

Architect/Engineer may also require the cement to be measured by volume but on the same assumption.

GRANITE WORKS:

Granite shall be hard, sound, dense and homogeneous in texture with crystalline and course grains. It shall be free from stains, cracks, decay and weathering. The place of quarrying, colour and quality and thickness should be as specified. Every stone must be cut to required size and shape by using proper cutting tools, on all beds and joints, so as to be free from waviness and to give truly vertical, horizontal, radial & circular joints as required. Proper cutting tools should be used for dressing, done on exposed faces to remove any waviness. The sides and top surfaces of Granite slabs shall be machine polished.

Granite slabs in borders, joints and soffits of entrances, openings and skirting shall be in full width. Granite slabs in treads and risers of steps shall be in single pieces with rounded edges or angular edges as may be described. Rounding of edges will be paid extra.

The exposed edges of these are to be cut, by using proper cutting tools and polished smooth along with exposed faces. In all cases samples should be got approved. Flooring slabs will be set in cement mortar 1:4 proportion 20-25 mm thick and cement slurry applied at the rate of 2.5 kg per square meter. In other places slabs will be set in CM 1:3, 12 mm - 20 mm thick. Slabs shall be soaked in water for 15 minutes and allowed to dry. The slabs shall then be fixed as per approved pattern with thin coat of cement paste on back of each slab. They will be tapped with a wooden mallet till the entire slab is properly bedded in level with adjoining slabs. Joints shall not be more than 1.5 mm wide. The surplus cement grout that may have come out of the joints has to be wiped off gently and joints cleaned. The joints shall be filled up with grey or white cement with an admixture of pigments to match the shade of the slab. The flooring shall be cured for 14 days. Finishing will be done as per IS 1443.

STEEL WORK GENERAL :

The contractor shall furnish all materials, labour, operations, equipments, tools & plant and incidentals necessary and required for the completion of all metal work in connection with steel doors, windows and other glazings, railings, flashings, inserts, hangers & other items of metal works as called for in the drawings, specifications and bill of quantities. The

supply and installation of additional fastenings, accessory features and other items not specifically mentioned, but which are necessary to make a complete functioning installation shall form a part of this contract. All metal work shall be free from defects, impairing strength, durability and appearance and shall be of the best quality for purposes specified, made with structural properties to withstand safely, strains and stresses to which they shall normally be subjected.

SHOP DRAWINGS :

The contractor shall submit shop drawings and / or samples of each type of doors, windows, railings and other items of metal work called for to the Architect/Engineer for his approval, prior to procurement, considering lead time and to comply with the accepted time schedule / C.P.M. Chart. The shop drawings shall show full size sections of doors, windows and other components, thickness of metal, details of construction, hardware as well as connection of doors, windows and other metal work to adjacent work/supports. Samples of all joints and methods of fastening and joining shall be submitted to the Architect/Engineer for approval well in advance before commencing the work.

SAMPLES :

Samples of all typical metal work such as,doors, windows, railings and other metal components as called for shall be fabricated, assembled & erected or submitted to Architect /Engineer as directed by him, for his approval.

APPROVED MANUFACTURER :

All doors, windows, railings and other metal works as called for shall be manufactured by a manufacturer/ fabricator approved by the Architect/Engineer. The entire work shall be carried out by workmen skilled in the kind of work as called for in a shop fully equipped to carry out all phases of fabrication in accordance with the best accepted practices and as approved.

STRUCTURAL STEEL WORKS :

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 these general specifications and IS:800-1962, IS:806, IS:1161 and supplementary drawings to be supplied to the contractors during execution of the work.

FABRICATION DRAWINGS :

The contractor shall prepare all fabrication and erection drawings on the basis of design drawings supplied to him and submit the same in triplicate to the Engineer/ Architect for review, the Architects/ Engineer, shall review and comment, if any of the same. Such review, if any, by the Engineer/ Architec/ does not relieve the contractor of any of his required guarantees/ responsibilities. The contractor shall however be responsible to fabricate the structure strictly conforming to specifications and revised drawings.

Fabrication drawings shall include the following :

- member sizes and details

- types and dimensions of welds and bolts

- shapes and sizes of edge preparation for welding.

- details of shop & field joints, splices including sub-assemblies.

BILL OF MATERIALS :

Quality of structural steels, welding electrodes, bolts, nuts and washers etc. to be used, erection assemblies, identifying all transportable parts and sub-assemblies, shall be associated with special erection instructions if required. Calculations, splices etc. and other details not specifically detailed in design drawings shall be suitably given on fabrication drawings considering normal detailing practices and developing full member strengths. Where asked for calculations for the same it shall be submitted for approval. Any alternate design or chanage in section is allowed when approved in writing by Architect/Engineer. However, if any variation in the scheme is found necessary later, the contractor will be supplied with revised drawings. The contractors shall incorporate these changes in his drawings at no extra cost and resubmit for review. Architect's/ Engineer's review shall not absolve the contractor of his responsibility for the correctness of dimension, adequacy of details and connections. One copy will be returned reviewed with or without comments to the contractor for necessary action. In the former case further three copies of amended drawings shall be submitted by the contractor for final review. The contractor shall supply three prints each of the final reviewed drawings to the architects within a week since final review, at no extra cost for reference and records. The Architect/Engineer will verify the correct interpretation of their requirements. If any modification is made in the design drawing during the course of execution of the job, revised design drawings will be issued to the contractor. Further changes arising out of these shall be incorporated by the contractor in the fabrication drawings already prepared at no extra cost and the revised fabrication drawings shall be duly got reviewed as per the above clauses.

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:226. Whenever welded construction is specified plates of more than 200 mm thickness will generally conform to IS : 2062. Steel tubes for tubular structure shall conform to IS:1161.

WELDING MATERIALS :

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

BOLTS, NUTS AND WASHERS :

Bolts & nuts shall be as per IS : 1367 & 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 (on original cross sectional area of the gauge length). Washers shall be as per IS: 2016. All materials shall conform to 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 / Architect in writing.

RECEIPT & 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 & arranged by grades & qualities in stores. Structures with surface defects such as pitting, cracks, laminations etc. shall be rejected if the defects exceed the allowable tolerances specified in relevant standards or as directed by the Engineer/ Architects . Welding wire and electrodes shall be stored separately by qualities and lots inside a dry & enclosed room in compliance with IS:816-1968 & as per instructions given by the Engineer / Architects. Electrodes shall be perfectly dry. 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. The contractor may use alternative materials as compared to the design specification only with the written approval of the Engineer / Architects .

MATERIAL TESTS

The contractor shall be required to produce manufacturer's quality certificates for materials supplied by the contractor. Not withstanding the manufacturer's certificates, the Engineer / Architects 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 / Architects 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 drawings 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 Aarchitect/Engineer 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 l/1000 but limited to 10 mm

Surface of members that are to be joined by lap or fillet welding or bolting shall be even so that there is no gap between over lapping 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 -3 mm.

The edge preparation for welding of members more than 12mm 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 enlarging of holes filling 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 -1 mm. 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 centers and distances of hole centers 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 etc 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/ handsaw 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 beveling 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 circumstances 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 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 got checked & approved by the Architect/Engineer 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 full trained and experienced welders as tested and approved by the Architect/Engineer. Any test carried out either by the architects or their representative 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 on this job as judged by the Engineer / Architects . 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 & preparation of members for welding have been carried out and welding procedures and tests for welder's skill have been conducted as per IS:823 and approved by the Engineer /

Architect . The welder shall mark with his identification on each element welded by him. When welding is carried out on 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, 1/2 V or U) and double butt welds (in K, double U etc.) the re-welding of the root is mandatory but only after the metal deposit of the root has been cleaned by back gauging 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 &wire brushing. Packing strips shall not be allowed. The order & method of welding shall be so that no unacceptable deformation appears in the welded parts. Due margin is provided to compensate for contraction due to welding in order to avoid any high permanent stresses. The defect in welds must be rectified according to IS:823 & as per instruction of Engineer / Architects .

WELD INSPECTION :

The weld seems shall satisfy the following :

Shall correspond to design shapes & dimension. Shall not have any defects such as cracks, incomplete penetration & fusion, under cuts, rough surfaces, burns, blow holes and porosity etc. beyond permissible limits. During the welding operations and approval of finished elements, inspections & tests shall be made as per specifications 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 & bending. Before assembly all sharp edges, shavings, rust, dirt etc. shall be removed. Before assembly 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 co-axiality 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 got approved by the Engineer / Architect . The difference in thickness of the sections that are butt assembled shall not be more than 3% or maximum 0.8mm 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 other bolts are set.

BOLTING UP :

Final bolting of the members shall be done after the defects have been rectified and approval of the joints obtained. The bolts shall be tightened starting from the center of joint towards the edge.

PLANNING 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 differences of planed surface, maximum 0.3mm deviation between planed surface and member's axis maximum 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 & reamed onsite after erection on approval by the architect/Engineer. For bolted steel structures, trial assembly in shop is mandatory.

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

TOLERANCES :

All tolerances regarding dimensions, geometrical shapes & sections of steel structures shall be as per specifications

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 coloured paint. The size and thickness of the members shall be chosen so as to facilitate the identification of members. For the small members that are delivered in bundles or crates the required marking shall be

done on small metal tags securely tied to bundle 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 in 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 & 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 Architect/Engineer 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 architects 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 architects. The contractor shall furnish necessary tools, gauges, instruments etc. and technical and non-technical personnel for shop tests by the architects, free of cost.

SHOP ACCEPTANCE :

The architects shall inspect and approve at the following stages

The following approval may be given in shop.

- Immediate approval of work that cannot be inspected later.

- Partial approvals.

- Final approval.

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 filed joints
Approval of parts with planed surfaces.
Test erection.
Approval of members.
Approval of markings.

Inspection & 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 comprises of :

Partial approvals

Approval of shop primer coat.

Approval of mode of loading and transport.

Approval of storage (for materials stored).

PAINTING & 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 : Surface have been wire brushed, cleaned of dust oil, rust etc. Erection

gap between members, spots that can not be painted or where moisture of other aggressive agents may penetrate have been filled with approved type of oil and putty. The surface 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 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.

Planned 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 the ground, gravel or brickwork and subject to moisture, shall be given bituminous coat. The 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 item against warping during loading and unloading. Lifting devices shall be used for loading in order to protect item 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 architects. Items must be carefully loaded on platforms of transportation means to prevent warping, bending or falling, during transportation. The small parts such as fish plates, plates, 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 Architect/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 Architect/Engineer 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 got approved by the Architect/Engineer 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 up to receipt of material at site :-

- For quality certificates regarding materials & 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 limit.

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 symbol and markings so that these may be taken out in order of erection. The parts shall be at least 150 mm clear from ground on wooden or steel locks 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 required and approved by architects. Positioning and leveling of the structure, alignment & plumbing of the stanchion & fixing every member of the structure shall be in accordance with the relevant drawings and to complete satisfaction of the architects.

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

- Damage during transportation.

- Accuracy of alignment of structure

- Erection according to drawings & specifications

- Progress and workmanship.

In case there be any deviations regarding positions of foundations or anchor bolts, which would lead to erection deviations, the ArchitectEngineer 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. The 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 & final erection joints completed after plan & elevation positions of the structural members have been verified with corresponding drawings and approved by the Architect/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 slopping surfaces tapered washers shall be used.

FINAL ACCEPTANCE AND HANDING OVER THE STRUCTURE :

At acceptance, the contractor shall submit the following documents
- Shop and erection drawings - either in tracings or reproducible.
- 4 copies of each of the following :

Shop acceptance documents, Quality certificate for structural, plates, etc. (electrodes, welding wire, bolts, nuts, washers etc.) List of certified welders who worked on erection of structures. Acceptance & intermediate control procedure of erection operation.

Approval by the Architect/Engineer at any stage of work does not relieve the contractor of any of his required guarantees of contract.

METHOD OF PAYMENT :

Payment for steel work shall be made on the basis of admissible area of work and also as per weight of the structure accepted, the weight being determined as described below :-
The rate for supply, fabrication & erection shall include cost of all handling & transportation to owner's store/site of work where supply & fabrication only are involved, trimming, straightening, edge preparation, preparation and getting reviewed of fabrication drawings and providing one coat of red oxide zinc chromate primer & two coats of anti corrosive enamel painting permitted coating. 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, re-handling, 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 will be assessed from the approved fabrication drawings and the respective bill of material prepared by the contractor and approved by the Architect/Engineer. 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 structural 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, racing 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. For detailed specifications reference shall be made to clause 14.

Tolerances allowed in the erection of plant building Without Cranes:-

The maximum tolerances for line and level of the steel work shall be + or - 3.00 mm on any part of the structure. The structure shall not be out of plumb more than 3.5mm on each 10 m section of height and not more than 7.00 mm per 30 m section. The tolerances shall apply

to all parts of the structure unless the drawings issued for erection purposes state otherwise.

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, or 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 not more than 0.6 mm.

PROTECTION OF WORK :

The contractor shall be responsible for the temporary doors and closing in openings necessary for the protection of work during progress. He shall also provide & maintain any other temporary covering required for the protection of finished wood work if any, that may be damaged during the progress of work if left unprotected.

MAKE GOOD DEFECTIVE WORK :

The contractor shall be responsible for any shrinkages or warping or any other defects which may appear in any joinery work. All defective or damaged work shall be taken down and renewed or repaired to the entire satisfaction of the Architect/Engineer.

FLOORING

GENERAL :

Before the operation for laying any floor is started, the surface of base concrete shall be thoroughly cleaned of all dirt, loose particles, caked mortar droppings, by scrubbing with coir or steel wire brushes. If so directed the surface shall be roughened by chipping or backing 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 topping is laid and minor trimming and leveling of the base to remove undulations.

:CEMENT CONCRETE FLOORING, DADOOING & SKIRTING:

Cement Concrete Flooring :

Cement concrete flooring shall be laid in thickness & with cement concrete proporion as specified in the schedule of quantities, laid in panels with wooden removable forms. Before laying floor concrete the sub-grade shall be properly cleaned, trimmed to give required thickness of floor and neat cement slurry applied to give proper bond of floor with the subgrade. The cement concrete shall be laid and finished with trowels and finished with a coat of neat cement on top to give a smooth and homogeneous surface . No extra mortar shall be laid over the concrete to make the floor in level or for drying the concrete for

applying the cement slurry. The joints shall be straight both ways i.e along the length and width. No surplus mortar on the adjoining panel shall be allowed to spill from the other panel. The measurement shall be of exact length and breadth from wall face to wall face.

Cement Skirting and Dados :

Shall consist of 20 mm thick cement plaster 1:3, or as specified in the schedule of quantities, applied to wall face and finished with a floating coat of neat cement including rounding of junctions with floors as directed. The measurement shall be from inside of skirting to inside of skirting and height above floor vertically measured.

: GLAZED/CERAMIC/ VITRIFIED TILE FLOORING, DADO AND SKIRTING :

Glazed or ceramic tiles from an approved manufacturer conforming to IS : 777 shall be of specified size and thickness and colour. All specials viz. coves, internal and external angles, corners, beads etc. shall be used wherever directed. Under layer of 20 mm average thickness of cement mortar 1:4 proportion shall be laid. In other places 12 mm to 15 mm thickness in cement mortar 1:3 shall be used. For flooring, a neat cement paste of honey like consistency shall be spread over mortar bed at the rate of 2.5 Kg per Sqm and 3.3 Kg per Sqm for dadooing and skirting, over such area at a time as would accommodate about 20 tiles.
Tiles shall be soaked in water for at least 15 minutes and allowed to dry for the same duration. Tiles shall then be fixed with a thin coat of cement paste on back of each tile and then each tile gently tapped with a wooden mallet till the entire slab is properly bedded and in level with adjoining tiles. Joints shall be fine and as imperceptible as possible (not more than 1.5 mm wide).
After tiles have been laid in a room or a day's fixing work is completed, surplus cement grout that may have come out of the joints may be wiped off gently and joints cleaned. A thick slurry of coloured cement, matching the colour of tiles shall be spread over it and rubbed so as to seal even the thinnest joint between the tiles and make it impervious and the floor/dado shall then be cured for 14 days. After curing, the surface shall be washed with mild hydrochloric acid and clean water. The finished floor/dado shall not sound hollow when tapped with a wooden mallet. The rate will include the cost of under layer of cement mortar. No traffic shall be allowed for at least 2 days after final flooring. The floor tile near the wall shall enter 10 mm under the skirting or dado finish.

GRANITE WORKS AND NATURAL STONE WORKS :

: GRANITE WORKS :
Granite shall be hard, sound, dense and homogeneous in texture with crystalline and course grains. It shall be free from stains, cracks, decay and weathering. The place of quarrying, colour and quality and thickness should be as specified. Every stone must be cut

to required size and shape by using proper cutting tools, on all beds and joints, so as to be free from waviness and to give truly vertical, horizontal, radial & circular joints as required. Proper cutting tools should be used for dressing, done on exposed faces to remove any waviness. The sides and top surfaces of the slabs shall be machine rubbed with course sand before using.

Granite slabs in borders, joints and soffits of entrances, openings and skirting shall be in full width. The slabs in treads and risers of steps shall be in single pieces with rounded edges or angular edges as may be described. Rounding of edges will be paid extra.

The exposed edges of these are to be cut, by using proper cutting tools and polished smooth along with exposed faces. In all cases samples should be got approved. Flooring slabs will be set in cement mortar of the proportion as per schedule 20-25 mm thick and cement slurry applied at the rate of 2.5 kg per square meter. In other places slabs will be set in CM 1:3, 12 mm - 20 mm thick. Slabs shall be soaked in water for 15 minutes and allowed to dry. The slabs shall then be fixed as per approved pattern with thin coat of cement paste on back of each slab. They will be tapped with a wooden mallet till the entire slab is properly bedded in level with adjoining slabs. joints shall not be more than 1.5 mm wide. The surplus cement grout that may have come out of the joints has to be wiped off gently and joints cleaned. The joints shall be filled up with grey or white cement with an admixture of pigments to match the shade of the slab. The flooring shall be cured for 14 days.

1) The first polishing with course grained carborandum shall not be done.

2) Cement slurry with or without pigments shall not be applied before first polishing.

:GRANITE TILE WORKS :
The tiles must be of uniform thickness as specified. They shall be of uniform texture & colour and free of any veins & streaks. All the edge shall be cut with proper machine tools true to line, square and shape. The brushes in the joints are not more than specified thickness. The surface should be rough dressed/one line dressed/two lines dressed/three line dressed pulmane finish/mirror polish/flame polish/wax polish as specified.

ROUGH DRESSING :
The stone surface to be chisel dressed to one plane by removing all bushings so that the maximum depression is not more than 6 mm.

ONE LINE DRESSING :
This is done after the rough dressing is completed by point chiselling so that the variations are not more than 4 mm. Work includes rough dressing also.

TWO LINE DRESSING :

This is done after one line dressing is done by chiselling so that variations are not more than 2.5 mm. Work includes rough and one line dressing also.

THREE LINE DRESSING :

This is done after two line dressing is over by chiseling so that the variations are not more than 1.5 mm. Work includes rough, one line & two line dressing also.

PALMANE DRESSING :

After the three line dressing is over the surface is smoothened by using a special palmane tool to further even out the 3 line dressed surface so that the maximum variation in surface evenness is not more than 1.0 mm. Work includes rough, one line, two line & three line dressing also unless otherwise stated.

FIXING, POLISHING AND FINISHING :

Slabs shall be soaked in water for 15 minutes and allowed to dry. The slabs shall then be fixed as per approved pattern with thin coat of cement paste on back of each slab. They will be tapped with a wooden mallet till the entire salb is properly bedded in level with adjoining slabs. Joints shall not be more than 1.5 mm wide. The surplus cement grout that may have come out of the joints has to be wiped off gently and joints cleaned. The joints shall be filled up with grey or white cement with an admixture of pigments to match the shade of the slab. The flooring shall be cured for 14 days.

Slight unevenness at the meeting edges of slabs shall be removed by using proper cutting tools. The surface then shall be ground evenly with machine fitted with coarse grade grit blocks No.60. The second cutting shall be done by machine fitted with fine grade grit blocks No. 120. The final grading with machine fitted with finest grade grit block No. 320. shall be carried out the day after the 2nd grinding is done. Then oxalic acid shall be dusted over the surface at 33 gm per Sq m, sprinkled with water and rubbed hard with a pad of woollen rags. The next day floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

The polished surface should reflect light like a mirror and must be free from scratches and depressions and should be as per IS : 1443.

FINISHING

GENERAL

EXTENT AND INTENT

The contractor shall furnish all materials, labour, scaffolding equipments, tools, plant & incidentals necessary and required for the completion of all plaster & wall finishes, subject to approval by Architect/Engineer.

GENERAL

Plaster as herein specified shall be applied to all internal and external surfaces where called for. Glazed tile dado, terrazzo dado and other wall finishes shall be provided where indicated on drawings and schedule of finishes. Areas called for on drawings as typical shall be considered to apply to appropriate adjoining areas whether shown on same drawings or not and whether indicated or not.

All plaster work and other wall finishes shall be executed by skilled workmen in a workmanlike manner and shall be of the best workmanship & in strict accordance with the dimensions on drawings subject to the approval of the Architect/Engineer.

CEMENT MORTAR

Cement mortar shall be of proportion specified for each type of work. It shall be composed of cement and sand. The ingredients shall be accurately gauged and shall be evenly mixed together in a mechanical mixer. Care should be taken not to add more water than necessary. If hand mix is allowed it shall be done on firm water proof platform. The gauged materials shall be put on platform, and thoroughly mixed dry. Water shall then be added and the whole mixed toroughly until the mix is homogenous and of uniform colour, quantity of mortar mixed should not be more than what can be consumed within half an hour of mixing.

Cement mortar mix are specified as 1:2, 1:3, 1:4, 1:5 etc. The first figure will mean one part of cement by volume, the second figure will mean so many parts of sand by volume. Cement & sand must conform to relevant I.S specification.

PLASTER WORK

The primary requirement of plaster work shall be to provide absolutely water tight enclosure, dense, smooth & hard and devoid of any cracks on the interior and/or exterior. The contractor shall do all that is necessary to ensure that this objective is achieved. All plastering shall be finished to true plane,without any imperfections and shall be square with adjoining work and form proper foundation for finishing materials such as paint etc. When suspending work at the end of the day, the plaster shall be left, cut clean to line both horizontally & vertically. When commencing the plastering, the edge of the work shall be scrapped cleared and wetted with lime putty before plaster is applied to the adjacent areas, to enable the two to properly joint together.

All horizontal lines & surfaces shall be tested with a level & all jambs and corners with a plumb bob as work proceeds. Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the Engineer.

Masonry & concrete surfaces which call for applications of plaster shall be clean, free from efflorescene,damp & sufficiently rough & keyed to ensure proper bond,subject to the approval of the Architects.

Wherever directed, by the Architect/Engineer, all joints between concrete frames and masonry in filling shall be expressed by a groove cut in the plaster. The said groove shall coincide with the joints beneath as directed. Where grooves are not called for,the joints between concrete members and masonry in filling shall be covered by 24 gauge galvanized chicken mesh strips / mortar mesh, 400 mm wide or as called for on drawings/documents, which shall be in position before plastering

CHASING & BREAKAGES

All chasings, installations of conduits, inserts, boxes etc.,shall be completed before any plastering or other wall finish is commenced on a surface. No chasing or cutting of plaster or other finish on a surface shall be permitted. Broken corners shall be cut back not less than 150 mm on both sides & patched with Plaster of Paris as directed. All corners shall be rounded to a radius of 8 mm or as directed by the Architect/Engineer.

SAMPLES

Samples of each type of plaster & other wall finish shall be prepared well in advance before undertaking the work for approval by the Architect/Engineer.

PREPARATION OF SURFACES

The joints in all walls, both existing and freshly built shall be raked to a depth of 15 mm, brush cleaned with wire brushes, dusted and thoroughly wetted before starting plastering work. Concrete surfaces to receive plaster shall be roughened by hacking over the entire surface so that the skin of the concrete is completely removed to ensure proper bonding for the plaster.

PAINTING

GENERAL

The specification covers the various types of painting & finishing all surfaces throughout the interior & exterior of the building. The number of coats required in various situations and also the types of finish required for the several items of work such as cement based paint, plastic emulsion paint, Renova finishes etc., are specified in the schedule of quantities & specifications.

Before the commencement of the painting work the surfaces to be painted shall be thoroughly cleaned and free from dust. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be removed. Surfaces that become inaccessible after erection

shall be painted before erection. Unless otherwise specified all timber works shall be painted with two coats of synthetic enamel paint over a coat of zink primer, except the surfaces in contact with or buried in brickwork / concrete / plaster.

Tarring:
For mild steel articles (except reinforcement bars) and wooden surfaces which are buried in masonry / concrete / plaster apply 2 coats of tar. Tarred surfaces of hold fast shall be embeded.

In painting doors and windows, the putty around the glass panes must also be painted but care should be taken to see that no paint stains are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left without painting.
Before the commencement of the work the contractor shall provide sample panels of painting at his own cost for the approval to enable him to keep an accurate check on the materials supplied and final shade to be painted. It is however the express responsibility of the contractor to provide the desired shade. Any difference in shade and deviations and defects shall be rectified by the contractor at his own cost.
Contractor shall protect not only his own work at all times but also all the adjacent work and materials by suitable covering, protection or other methods acceptable during progress of painting. It is the responsibility of the contractor upon completion of painting work to remove all paint and varnish spots from floors, walls, glass panes and other surfaces and restore them to the original conditions. The work generally to be touched up shall be attended to, after all other works are completed. All accumulated material, rubbish etc. have to be cleared and the premises left in clean, orderly and acceptable conditions.

Contractor shall provide scaffolding(made of H- frames) wherever necessary erected on double supports tied together by horizontals. No ballies, bamboos or planks shall rest on or touch the surface which is being painted. Contractor is deemed to have considered the following while rendering and no extra claim on account of these will be entertained .

A) Supplying the paint and other materials of approved color and brand.

B) Preparing the surfaces to be painted.

C) Providing and erecting scaffolding and removing the same after completion of the work.

D) Lifting of materials to any height and painting at all levels.

E) Application of paint as per the specification & to manufacturers instructions.

F) Curing, protecting the painted surface, adjacent work and thorough cleaning of the premises.

MATERIAL :

The paint shall generally conform to the chemical composition and other characteristics laid down in the relevant Indian standard specification. The entire materials required for painting work shall be obtained direct from approved manufacturers or their authorized agents and brought to site in original manufacturer's containers with seals unbroken.
All paints used for the work of any type shall be ready mixed and of 1st quality of the approved brand and manufacture. Mixing of paint by the contractor at site will not be allowed, except with preparation of ingredients and their quality shall be strictly maintained as per manufacturer's instructions and as directed. All the materials shall be kept properly protected when not actually in use. Lids of containers shall be kept closed. Materials which have become stale or flat (in the opinion of the Architect/Engineer) shall not be permitted to be used on the works and shall be removed from site forthwith. Any materials found not conforming to the relevant specification shall have to be removed by the contractor from the site at his own expenses.

WHITE WASHING WALLS AND CEILINGS
White wash shall be done with white cement with just enough water to make a thick paste. At the time of using, the paste shall be diluted with just sufficient water and strained through cloth. The number of coats shall be specified in the schedule of quantities and shall be applied by using flat brushes or spray pumps, on prepared surface. Each coat shall be allowed to dry before next coat is applied.

PREPARATION OF SURFACE

All rust and scales shall be removed by scraping or brushing with steel wire brushes & then smoothened with sand paper. The surface shall be thoroughly cleaned of dust.

APPLICATION
The number of coats to be applied shall be as given in the item. Each coat shall be allowed to dry for 24 hours and lightly rubbed down with fine grade sand paper and dusted off before the next coat is applied. The finished surface shall present an even and uniform appearance.

MEASUREMENT
Measurements shall be as per actual length and breadth being measured correct to a mm.

PLASTER OF WALLS :
WALL PLASTER :
Plaster to internal faces of walls shall be 15 mm or less thick comprising of one part cement and four part clean fine sand. The external surfaces of external wall shall have plaster of 12 mm thickness CM 1:4, respectively.

MORTAR MIXING

Mortar shall be prepared as specified under 'brick work' or any other relevant section. It shall be made in small quantities, as required and applied within 30 minutes of mixing.

APPLICATIONS

Plaster application shall be commenced only after the preparatory work is approved. Correct thickness of plaster shall be obtained by laying plaster screads (gauges) at intervals of 1.5 mtrs. as directed.

Mortar shall be firmly applied, well pressed into the joints, rubbed, and finished as approved by the Architect/Engineer smooth and even surface.

CURING

Finished plaster shall be kept wet for at east 10 days after completion. In hot weather, walls exposed to such weather shall be screened with matting kept constantly wet or by any other approved means.

KEN MESH/MORTAR MESH FOR WALL PLASTER.

Galvanized chicken mesh (24 gauge, 12 mm size)/ mortar mesh shall be provided at junctions of brick masonry and concrete members, to be plastered and other locations 150 mm on either sides of the junction in double fold or as called for, properly stretched and nailed, ensuring equal thickness of plaster on both sides of the mesh.

CEILING PLASTER :

Plaster to ceilings, soffits or stairs flight slabs and similar locations, where called for, shall be 9 mm thick and comprise of one part cement and four parts of clean fine sand. Only when the plastering of ceiling is complete in all respect, plastering of walls should start.

APPLICATIONS

Mortar shall be applied firmly, pressed to the surface, rubbed and finished to a smooth and even surface.

SYNTHETIC ENAMEL PAINT :

Provide two coats of synthetic enamel paint of approved make and colour over one coat of primer on plastered surfaces, wooden surfaces and steel surfaces. A filler putty coating has

to be given after primer coat in the case of wooden surfaces. The putty shall be made from pure whiting mixed to the proper consistancy with new linseed oil. A little white lead being mixed to help hardening of putty. On no account putty is to be used before primary coat .

Primers to be used shall be according to the manufacturer's specification. Synthetic enamel paint shall conform to IS: 2932 Part I