



::GUJARAT HIRA BOURSE::

Gem & Jewellery Park, Ichchhapore, Surat.

TENDER DOCUMENTS FOR

**CONSTRUCTION OF COMPOUND WALL AT VILLAGE
ICHCHHAPORE, TALUKA: CHORYASI, DIST: SURAT ON TURNKEY
BASIS**

Volume-II

TECHNICAL BID

Construction of Compound Wall for M/s. Gujarat Hira Bourse

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Part - II Technical Bid

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Section - I

NOTE: - All Indian Standards mentioned are to be considered as latest version available on the date of submission of financial bid"

Specification for Civil Materials & Workmanship

1.0 Scope

This specification provides general requirements regarding quality, testing, handling, storing of materials required for civil construction.

All materials used in the construction shall conform to relevant Indian Standards or shall be of an approved quality equal to an approved sample manufactured by renowned concerns and shall bear prior approval of the engineer.

If any material is found defective or of non standard quality, the responsibility of risk shall devolve on the tenderer who shall replace such material with material of approved quality at his own cost.

2.0 Cement

General

20 bags of cement shall be taken to weigh one tonne.

The cement used shall be ordinary, low heat Portland cement to IS: 269 or Portland pozzolana cement to IS: 1489 or Portland blast furnace slag cement to IS: 455.
(With latest amendment)

High alumina cement of approved specifications, when specified for use as high alkali resisting cement, shall be used only in accordance with the manufacturer's recommendations and as directed by the Engineer. Its use shall conform to the relevant clause given for concrete in alkali soils and alkaline water in IS: 456. It shall not be mixed with either of the other kinds of cement.

Samples shall be taken from time to time for tests at an approved laboratory.

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Cement		
Properties of Cement	The type of cement selected should be appropriate to the intended use. The different types of cements are generally made by the adjustment in relative proportions of chemical compounds and fineness to suit the particular requirement.	
Physical requirement	Following are the physical and chemical requirement of the cement shall be satisfied.	IS:269/8112/12269
Fineness	When tested for fineness the 33, 43 & 53 grade cement by blaines Air permeability with the method given in IS:4032-1985, the specific surface shall not be less than 225m ² /kg.	IS:269/8112/12269
Soundness	When tested by Le-chatelier and autoclave test as per the IS:4031 (part 3)-1988 33, 43 & 53 grade cement, unaerated cement shall not have an expansion of more than 10 mm and 0.8 mm.	IS:269/8112/12269
Setting time	The setting time of cements 33,43 & 53 when tested by the Vicat apparatus method described in IS:4031(Part-5)-1988 shall conform to the following requirements:	IS:269/8112/12269
	(a) Initial setting time in minutes, not less than 30.	
	(b) Final setting time in minutes, not more than 600.	
Compressive Strength	The Average Compressive strength of atleast 3 mortar cubes (Area of face 50 cm ²) composed of one part of cement, three parts of standards sand (conforming to IS 650: 1966) by mass and P/4+3%(of combined mass of cement plus sand) water and prepared, stored and tested in the manner described in IS 4031 (Part – 6): 1988 shall be as follows: -	IS:269/8112/12269

Sr. No.	Time after which test is done	33 grade	43 grade	53 grade
(a)	72 ± 1 hrs.	16 MPA	23 MPA	27 MPA
(b)	168 ± 2 hrs	22 MPA	33 MPA	37 MPA
(c)	672 ± 4 hrs.	33 MPA	43 MPA	53 MPA

Tensile Strength	Minimum tensile strength of standard briquettes. 1 day 20 kg/cm ² for rapid hardening cement 3 days 20 kg/cm ² for ordinary Portland cement 30 kg/cm ² for rapid hardening cement 7 days 25 kg/cm ² for ordinary cement.	
Delivery	The Cement shall be packed in bags (Jute jacking bag conforming to IS 2580:1982, double hessian bituminized (CRI) type, multi wall paper conforming to IS 11761 : 1986, polythene lined (CRI type) Jute, light weight jute conforming to IS 12154:1987, woven, HDPE. Conforming to IS 11653:1986, jute synthetic union conforming to 12174:1987.	IS:269/8112/12269
	The cement shall be packed in bags 50 kg. The permissible tolerance on the weight of supplied in bags shall be 2.5% per bag with an overall tolerance of ± 1/2 % per wagon load of 20/25 metric tonnes.	
Chemical require-ment for ordinary Portland cement	The chemical requirement of the Cement is given in the table.	IS:269/8112/12269

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Chemical Properties of Cement

Sr. No.	Characteristic	33 grade	43 grade	53 grade
(i)	Relevant IS codes	IS 269:1989	IS 8112:1989	IS 12269:1987
(ii)	Ratio of Percentage of lime to percentage of silica, alumina and iron oxide, when calculated by formula. CaO – 0.7 SO ₃ (2.8SiO ₂ + 1.2 Al ₂ O ₃ + 0.65Fe ₂ O ₃)	Not greater than 1.02 and not less than 0.66	*Not greater than 1.02 and not less than 0.66	1.024 not less than 0.8
(iii)	Rates of percentage of alumina to that of iron oxide.	Not less than 0.66	Not less than 0.66	Not less than 0.66
(iii)	Insoluble residue, percent by mass	Not more than 4%	*Not more than 4%	Not more than 2%
(iv)	Magnesia percent by mass	Not more than 6%	Not more than 6%	Not more than 6%
(v)	Total sulphur content calculated as sulphuric anhydride SO ₃ , Percent by mass	Not more than 2.5% and 3 when tricalcium aluminate percent by mass is not less and greater than 5% respectively.	Not more than 2.5% and 3 when tricalcium aluminate percent by mass is not less and greater than 5% respectively.	Not more than 2.5% and 3 when tricalcium aluminate percent by mass is not less and greater than 5% respectively.
(vi)	Total loss on ignition	Not more than 5%	Not more than 4%	Not more than 4%
	Total chloride content in cement shall not exceed 0.05% by mass for cement used in prestressed concrete structure and long span reinforced concrete structures (method of test for determination of chloride content in cement is given in IS 12423:1988).	IS:269/8112/12269		
	The limit for total chloride content in cement for use in plain and reinforced concrete structures is being reviewed. Till that time, the limit may be initially agreed to between Railways and the supplier/contractor.	IS:269/8112/12269		
Rejection	Cement may be rejected if, it does not comply with any of the requirements of the specification.	IS:269/8112/12269		

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Storage on the Site

The cement shall be stored in suitable weather tight building and in such a manner as to permit easy access for proper inspection. The cement shall be stored in such a manner as to prevent deterioration due to moisture and to minimize warehouse deterioration. cement of different type and brands shall be kept in separate storage / stacks. Not more than 12 bags shall be stacked in one stack.

All accepted cement stored on the site shall be arranged in batches with the dates of receipts marked prominently and used in the same order as received from the manufacturer. The tenderer shall maintain a register of cement in which all entries shall be completed daily showing the quantities received, date of receipt, source of dispatch, type of cement etc. and also the daily cement consumption on site. This register shall be accessible to the engineer for his verification.

Rejection of Cement

The engineer may reject any cement which has deteriorated owing to inadequate protection from moisture or due to intrusion of foreign matter or other causes. Any cement which is considered defective by the engineer shall not be used and shall be promptly removed from the site of work by the tenderer at his own cost. The tenderer shall bear and will not be entitled for any compensation.

3.0

Aggregates

General:

Coarse and fine aggregates shall conform in all respects to IS: 383 - Specification for Coarse and Fine Aggregates from Natural Sources.

Aggregates shall be obtained from a source known to produce these satisfactory for concrete. Aggregates shall consist of naturally available sand and gravel or stone crushed or uncrushed -or-a combination thereof. They shall be chemically inert, hard, strong, dense, durable, clean and free from veins and adherent coatings and with permissible porosity. Flaky and elongated pieces shall not be used. Whenever required by the Engineer-in-Charge the aggregates shall be washed by the tenderer before use in the work.

The source of aggregates shall be approved by the engineer and shall not be changed during the course of the job without his approval.

Deleterious Materials

Aggregates shall not contain any harmful material, such as iron pyrites, coal, mica, shale or similar laminated material, clay, alkali, soft fragments, sea shells, organic impurities, etc., in such quantities as to affect the strength or durability of the concrete and in addition to the above, for reinforced concrete any material which might cause corrosion of the reinforcement. Aggregates which are chemically reactive with alkalis of cement shall not be used.

The maximum quantities of deleterious materials in the aggregate, as determined in accordance with IS: 2386 (Part II) for method of Test for Aggregates for Concrete shall not exceed the limits given in Table-I of IS: 383.

The sum of the percentages of all deleterious materials shall not exceed five. Deleterious materials also include material passing 75 micron IS sieve.

Coarse Aggregates

Coarse aggregates is aggregate most of which is retained on 4.75 mm IS sieve the structure. Potable water shall generally be considered satisfactory for mixing and curing concrete.

It shall comply with the permissible limits of solids as mentioned in IS: 456.

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In case of doubt, the engineer may require the tenderer to prove, at latter's expense, that the concrete mixed with water proposed to be used should have a compressive strength not lower than 90% of the total strength of concrete mixed with distilled water.

The engineer may require the tenderer to get the water tested from an approved laboratory at his own expense and in case the water contains any sugar or an excess of acid, alkali, any injurious salts etc. the engineer may refuse to permit its use.

Water shall be arranged by the tenderer. The tenderer shall make his own arrangement for distribution, subject to prior approval of Engineer-in Charge, to avoid interference with other facilities. He shall make his own arrangement of storing water by leak proof tanks sufficient for at least 24 hours.

Sand/Fine Aggregates

1. For masonry work, sand shall conform to the requirements of IS: 2116.
2. For plain and reinforced cement concrete (PCC and RCC) or prestressed concrete (PSC) works, fine aggregate shall consist of clean, hard, strong and durable pieces of crushed stone, crushed gravel, or a suitable combination of natural sand, crushed stone or gravel. They shall not contain dust, lumps, soft or flaky, materials, mica or other deleterious materials in such quantities as to reduce the strength and durability of the concrete, or to attack the embedded steel. Motorized sand washing machines should be used to remove impurities from sand. Fine aggregate having positive alkali-silica reaction shall not be used. All fine aggregate shall conform to IS: 383 and test for conformity shall be carried out as per IS: 2386 (Part I to VIII). The Contractor shall submit to the Engineer the entire information indicated in Appendix A of IS: 383. The fineness modulus of fine aggregate shall neither be less than 2.0 nor greater than 3.5.
3. Sand/fine aggregate for structural concrete shall conform to the following grading Requirements:

Table 1.3: Grading Requirement

IS Sieve Size	Percent by Weight Passing the Sieve		
	Zone I	Zone II	Zone III
10 mm	100	100	100
4.75 mm	90-100	90-100	90-100
2.36 mm	60-95	75-100	85-100
1.18 mm	30-70	55-90	75-100
600 micron	15-34	35-59	60-79
300 micron	5-20	8-10	12-40
150 micron	0-10	0-10	0-10

4.0 Water Stops (Water Bars)

The water stops shall be made of PVC Rubber Sheets as called out in drawings. Water stops wherever called for in the drawings shall be preformed trips of impermeable material. It shall provide a permanent watertight seal along the entire joint against a maximum pressure of five (5.0) M water column. It shall retain its stiffness, flexibility and tensile strength between wide limits of temperatures and pressure.

PVC Water Stops

Material used for water stops shall be polyvinyl chloride. Water CALIPLAST or approved equivalent.

Rubber Water Stops

They shall be of standard make such as AZP, Copper stop past or approved equivalent and of type and width as described in Bill of Quantities. The work shall be done as directed by the Engineer-in-Charge.

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The jointing of two water stop lengths where necessary shall be one strictly by vulcanizing as per manufacturer's specifications.

Water Stops

Where carted out on the drawings, the water bars shall be "20" gauge OJ. Sheets of required width and shall be bent, folded to shape, soldered and fixed as per the drawings and the directions of the Engineer-in-Charge. The galvanized sheets shall have medium coating of zinc as per IS: 277.

5.0 Reinforcement

All reinforcement shall be free from loose mill scales loose rust and coats of paints, oil, mud or other coatings.

Only tested steel reinforcement shall be use. The grade of steel shall be Fe:415 conforming to IS 1786.

Mild Steel Reinforcement

Mild steel and medium tensile steel bars conforming to IS:432

Part-I

Twisted Steel Bars

Cold twisted steel bars, plain or deformed conforming to IS: 1786. Hot rolled mild steel and medium tensile steel deformed bars conforming to IS: 1139.

Hard Drawn Steel Wire Fabric

Hard drawn steel wire fabric for concrete reinforcement shall conform to IS: 1568.

Storage

Reinforcing bars shall not be kept in direct contact with the ground but stacked on suitable platforms. Such stacking shall preferably be done diameter wise.

In case reinforcing bars have to be stored for longer duration, they shall be stored under covered shed.

Fabricated reinforcement shall be carefully stored to prevent damages.

The mild steel binding wire shall be 16 gauge annealed conforming to IS:280.

Mechanical characteristic of Structural steel:

Grade Description	Yield Strength N/MM2 (min.)	Ultimate Tensile Strength N/MM2 (Min.)	Total Elongation % (Min.)
Fe415 SRMB Thermex TMT	415	500	22.0
Fe415 HSD Steel Bar IS 1786	415	485	14.5

6.0 Water

Water shall be arranged by the Tenderer at his own cost.

Water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Potable water is generally considered satisfactory for mixing concrete.

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Mixing and curing with sea water shall not be permitted. As a guide, the following concentrations represent the maximum permissible values:

In case of doubt, the suitability of water for making concrete shall be ascertained by compressive strength and initial setting time test specified in I.S 456. The sample shall not receive any treatment before testing other than envisaged in the regular supply of water proposed for use in concrete or other items.

Average 28 days compressive strength of at least three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90 % of the average strength of three similar concrete cubes prepared with distilled water.

1. To neutralize 200 ml sample of water, using phenolphthalein as an indicator, it should not require more than 2 ml of 0.1 normal NaOH.
2. To neutralize 200 ml sample of water, using methyl orange as an indicator, it should not require more than 10 ml of 0.1 normal HCl.
3. The permissible limits for solids shall be as follows when tested in accordance with IS:3025:
 1. Organic 200 mg/lit
 2. Inorganic 3000 mg/lit
 3. Sulphates (SO₄) 500 mg/lit
 4. Chlorides (Cl) 500 mg/lit *
 5. Suspended matter 2000 mg/lit

* In case of structures of lengths 30m and below, the permissible limit of chlorides may be increased up to 1000 mg/lit. All samples of water (including potable water) shall be tested and suitable measures may be where necessary to ensure conformity of the water to the requirements stated herein.

4. The pH value shall not be less than 6.

Water shall be stored in containers / tanks covered at top and cleaned at regular intervals in order to prevent intrusion by foreign matter or growth of organic matter. Water from shallow, muddy or marshy surface shall not be permitted. The intake pipe shall be enclosed to exclude silt, mud, grass and other solid materials and there shall be a minimum depth of 0.60 m of water below the intake at all times.

7.0 Bricks

Bricks shall be of first class quality conforming to IS: 1077 and sound, hard, well burnt with uniform size, shape and colour, homogenous in texture and free from flaws and cracks. The standard size of the bricks shall be 9" x 4" x 3" and no dimension shall vary more than 3 mm from these standard dimensions. A brick shall give a metallic ring when struck with a light mallet or dropped flat from a height of 1.2m on the ground and shall have compressive strength of 35 kg/cm² minimum. No brick shall absorb more than 20% of its weight when dry after immersion and stacked directly from the vehicle. They shall be unloaded by tipping.

If locally available bricks do not meet the stipulated standards, Tenderer may use locally available bricks subject to the necessary tests and approval of the Engineer-in-Charge.

8.0 Stone

Building stone shall conform to IS: 1127. Stone shall be strong, dense, and compact, close grained and uniform in texture and colour. The stone shall be properly dressed after quarrying before they are put to use. Stone newly quarried containing quarry sap shall be protected from frost until the quarry sap evaporates.

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9.0 Structural Steel

Material for various purposes shall conform to the relevant Indian important standards of them is as noted hereunder.

Structural Steel	IS: 226
Steel Tubes	IS: 1161
Bolts and Nuts	IS: 1367
Electrodes for welding	IS: 814 & 815

All materials shall be new and of unused stock. In case the steel supply is in tenderer's scope, manufacturer's test certificate shall be made available to the engineer when asked for. Storage shall be similar to that for reinforcement.

Section II

Specification for Earthwork in Excavation and Filling

1.0 Scope

This specification provides general requirements of earthwork in excavation in all types of soils and rock and filling the areas with suitable earth for grading and site leveling, backfilling in foundations and transporting and disposal of surplus spoils or stacking them in suitable area.

2.0 Earthwork in Foundation, Basements, Drains, Sewers, Culverts etc.

All excavation shall be neatly cut to lines, curves, and slopes and grades shown in the drawings or as directed by the Engineer with plus or minus tolerance of 25mm. Where excavations are made in excess of the limits delineated on the drawings, either by error or accident, the extra excavation shall be made good at tenderer's cost by refilling to the proper grade with thoroughly compacted suitable fill or by 1:4:8 P.C.C where it is meant for foundations.

In excavation for foundations, a bottom layer of 150mm in thickness shall be left undisturbed and subsequently removed only when the concrete is about to be placed in order that softening or deterioration of the surface on the bottom of the excavation area by exposure may be avoided.

The tenderer shall make allowances for the working space required to carry out the subsequent construction portion where the excavation is carried out in reusable material. The materials recovered may be stacked nearby for back filling purposes, as directed by the Engineer. All excavation work shall be properly protected against subsidence, slip or caving in to avoid injury to workmen. The tenderer may with the approval of the engineer, carry-out excavation without any side protection, i.e. with sides of the excavation formed by the natural slope of the earth instead of using timber shoring etc. In this case, the payments will be made only for the net quantities of excavation required for carrying out the construction work.

The tenderer shall at his own cost provide, maintain and operate pumping equipment of required capacity and keep the area of construction free of water during concreting. Pumping shall be controlled and necessary care to dispose of the water through drainage, ditches without causing any inconvenience to construction operation shall be made.

All water from any source whatsoever getting accumulated in excavated areas, trenches, etc. shall be properly diverted in approved manner or bailed out or pumped by the tenderer at his own cost so that the areas and trenches are kept free of water.

The material obtained from excavation which is not considered suitable for filling operations shall be disposed off within the plot at a place and in a manner indicated by the Engineer.

The surplus suitable material obtained from excavation shall be used for back filling and for filling as directed by the Engineer. Filling shall be evenly laid in layers not exceeding 230mm in thickness. Each such layer shall be consolidated with sufficient watering and tamping. Each layer shall be watered to the optimum moisture content to achieve a density of 95%.

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Whenever required, the tenderer shall demonstrate adequately at his own cost, by field and laboratory tests that the specified density has been obtained. The tenderer shall make well at his expense all settlements of filling that may occur up to the end of defect liability period. The tenderer, if so directed by the Engineer shall remove the excavated material from the place of construction to a storage / disposal area and bring back part / full for back filling or for other filling.

If the filling material is to be brought from outside, it shall be good sand, free from clay and plastic material, mud, vegetable and organic matter likely to decay. The actual filling operations shall be the same as described above.

The tenderer shall take precautions not to disturb or damage the existing permanent work while excavating or filling. If underground utilities are met during excavation, they shall be properly supported and slinger.

Should the bottom of any excavation appear to be unstable and unsound, the tenderer shall excavate further as per directions from Engineer. In case of such extra excavations, the extra depth shall be filled up with suitable materials as the Engineer shall direct. Such extra excavations and fillings shall be valued and paid for as an authorized work.

The tenderer shall strictly follow the latest Statutory Laws and Regulations regarding the safety precaution for storage, handling, and use of explosives and blasting operations involved in rock blasting. The tenderer shall take prior permission of local authority before commencing blasting.

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Section III

Specification for Cement Concrete Works

1.0 Scope

This specification provides general requirements regarding mixing, placing, curing, testing of all grades of cast-in-situ and pre-cast cement concrete works including formwork, reinforcement, embedment, additives, etc.

2.0 Material

For specification of materials. section VII

3.0 Codes

Concreting shall be performed as per relevant Indian Standards; the more important of them are as follows:

IS:456 for Plain and Reinforced Concrete.

IS:1199 for sampling concrete.

IS:516 for methods of testing concrete.

IS:4990 for plywood formwork.

IS:2751 for welding of reinforcement.

IS 2911-1983 part 3 for under reamed pile construction.

IS:2502 for bending and fixing of reinforcement.

4.0 Grades

The designation of structural concrete grade shall be as follows, based on design mix.

Table-1

Grade designation	Specified characteristic compressive strength of 15 cm cube at 28 days.
M15	150 kg/cm ²
M20	200 kg/cm ²
M25	250 kg/cm ²
M30	300 kg/cm ²
etc.	etc.

5.0 Proportioning of Concrete

The Engineer-in-Charge shall verify the strength of the concrete mix, before giving his sanctions of its use. However, this does not absolve the tenderer of his responsibility for achieving the prescribed strength of the mix. If during the execution of the work, cube tests are showing lower strengths than the required one, the Engineer-in-Charge shall order fresh trial mixes to be made by the tenderer. No claim to alter the rates of concrete work shall be entertained due to such changes in mix variations. Any variation in cement consumption shall be taken into consideration for material reconciliation.

Preliminary mix designs should be established well ahead of start of work.

Minimum cement Content

Minimum cement Content shall be as per table given below.

Grade	Cement content
M-10	225 kgs. Per cumt.
M-15	300 kgs. Per cumt.
M-20	350 kgs. Per cumt.
M-25	375 kgs. Per cumt.
M-30	400 kgs. Per cumt.

How ever the tenderer shall pay as per the actual consumption of cement at site as per design.

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Note: Chemical admixture (Fosroc, Fairmate, Sika, or equivalent) can be use to get required work ability at tenderer's own cost.

Maximum Density

Suitable proportions at sand and the several sizes of coarse aggregates for each grade of concrete shall be selected to give as nearly as practicable the maximum density. This is to be determined by mathematical means, laboratory tests, field trials and suitable changes in aggregate gradation.

Proportion at W / C Ratio

Once a mix, including its W / C ratio has been determined and specified for use by the Engineer-in-Charge, that W/C ratio shall be maintained the tenderer will determine the water content at the aggregate frequently as the work progresses and the amount at mixing water entered at the mixer shall be changed as directed by the Engineer-in Charge so as to maintain the specified W/C ratio.

Slump

The slump for concrete as determined by slump test as per IS: 456 shall not exceed maximum slump indicated in Table-2.

Table 2

Degree of Workability	Slumps in mm		Type at Construction
	Min.	Max.	
1. Medium	40	80	Reinforced foundation walls and footings.
2. Medium	25	75	Plain footings, substructure walls etc.
3. Medium	50	100	Reinforced beams, columns, walls, etc.

The tenderer shall at place concrete having a slump outside be limits specified without the approval at the Engineer-in-Charge.

6.0 Batching

In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Where the weight of cement is determined on the basis of weight at cement per bag, a reasonable number of bags shall be weighed separately from the aggregates. Water shall be either measured by volume in calibrated tanks or weighed. Any solid admixture that may be added may be measured by weight, liquid and paste admixtures by volume or weight. Batching plant where used shall conform to. IS:4925 -1968. All measuring equipment shall be maintained in a dean serviceable condition and their accuracy periodically checked.

Except where it can be shown to the satisfaction of the Engineer-in-Charge that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportion when required, different sizes being stocked in separate stock piles. The grading of coarse and fine aggregate shall be checked frequently for a given job being determined by the Engineer-in Charge to ensure that the specified grading is maintained.

Change from weigh batching to volume batching may be done only after obtaining the specific permission of Engineer-in-Charge in writing.

The amount of the added water shall be adjusted to compensate for any observed variations in the moisture contents. For the determination of moisture content in the aggregates, IS: 2386 (Part III) may be referred to. To allow for the variation in weight of aggregates due to variation in their moisture content, suitable adjustments in the weights of aggregate shall also be made. In the absence of exact data, only in the case of nominal mixes, the amount of surface water may be estimated from the values given in Table -3.

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Table -3 Surface Water carried by Aggregate

Aggregate	Approx. qty of surface water	
	Percent by mass	Litre/M3
Very wet sand	7.5	120
Moderately wet sand	5.0	80
Moist sand	2.5	40
Moist gravel or crushed rock	1.25 – 2.5	20 - 40

No substitutions in materials used on the work or alterations in the established proportions, except as permitted in above shall be made without additional tests to show that the quality and strength of concrete are satisfactory.

7.0 Mixing

The mixing of concrete shall be strictly carried out in an approved type of mechanical concrete mixer. The mixing equipment shall be capable of combining the aggregates, cement and water within the specified time into a thoroughly mixed and uniform mass and of discharging the mixture without segregation. The entire batch shall be discharged before recharging. Mixing period shall be measured from the time when all of the solid materials are in the mixer drum; provided that all of the mixing water shall be introduced before one - fourth of the mixing time has elapsed.

Mixer

The mixers shall be maintained in satisfactory operating condition and mixer blades shall be kept free of hardened concrete. Mixer blades shall be replaced when worn down more than ten percent (10%) of their depth. Should any mixer at any time produce unsatisfactory results, leak mortar or cause waste of materials, its use shall be promptly discontinued until it is repaired.

Mixing time shall be as indicated in following table. Excessive mixing requiring additions of water shall not be permitted. Time shall start when a solid materials are in mixer drum, provided that all of the mixing water shall be introduced before one - fourth of the mixing time has elapsed. The Engineer-in-Charge may, however, direct change in mixing time, if he in his opinion considers such change necessary.

Capacity of mixer	Min. mixing time for stationary item
1 cum. or less	1½ minutes.
2 and 3 cum	2½ minutes.
4cu.m.	3 minutes.

Stationary mixers shall be provided with a suitable device to lock the discharge mechanism until the required mixing time has elapsed. Provision also shall be made to ensure that each batch is discharged completely before the mixer is recharged.

The complete plant assembly shall include provisions to facilitate the inspection at all times.

All records and charts for the batching and mixing operations shall be prepared as specified herein and as per the instructions of the Engineer-in-Charge and promptly turned over to the Engineer-in-Charge.

Admixtures

Admixtures such as CICO Grade - 1 or Puddle or equivalent may be used in concrete only with the approval of Engineer-in-Charge.

Hand Mixing

Normally, hand mixing of concrete shall not be permitted. However, this may be allowed by the Engineer-in-Charge in special cases (such as far away, isolated, small concreting). Ten percent (10%) extra cement shall have to be added to the normal mixes when mixed by hand. It shall be carried out on a water tight platform and care shall be taken to ensure that mixing is

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continued until the mass is uniform in colour and consistency. No extra payment shall be made to the tenderer for mixing by hand or for using extra cement due to hand mixing. However, cement consumed extra shall be considered for reconciliation purposes.

8.0 Placing and Compaction

Engineer's approval for equipment and methods

Before any concrete is placed, the entire placing programme consisting of equipment, layout, proposed procedures and methods shall be submitted in writing to the Engineer-in-Charge, 24 hours prior to concreting for approval and no concrete shall be placed until his approval has been received.

Engineer-in-Charge's approval for pouring concrete shall be taken as conveyed when the concrete pour card is signed.

Transportation before placing All concrete shall be conveyed from the mixer to the place of final deposit in suitable buckets, dumpers, containers or conveyers which shall be mortar leak tight.

During hot or cold weather, concrete shall be transported in deep containers. Other suitable methods to reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted.

The Concrete shall be deposited as nearly as practicable in its final position to avoid rehandling. Concrete shall be placed and compacted in its final position within the initial setting time for the particular cement used or as directed by the Engineer-in Charge after the addition of water to the cement and aggregate, except that in hot weather or conditions that contribute to quick stiffening of the concrete maximum allowable time may be reduced by the Engineer-in-Charge.

Concrete that has been left standing and which has become stiffened so that it cannot be placed in satisfactory condition shall not be deposited in the work.

Placing

The concrete shall in no case be dropped from a height of over 1.5m and it shall be carefully laid in position. Before depositing the concrete, all debris and dirt shall be removed from the space to be occupied by concrete. Concreting shall not be done unless the form work conforms to the shapes, lines and dimensions as shown in the drawings. The form work shall be sufficiently rigid. During the placing and compaction of concrete, care shall be taken to ensure that there is no loss of liquid from concrete and no segregation of aggregates takes place. The method of placing and compaction employed in any particular section of the work shall be to the entire satisfaction of the Engineer-in-Charge.

To ensure bond and water tightness between old concrete surfaces and be placed, surface shall be cleaned and roughened by "initial green brushing or chipping. The initial green cutting may be done after 6 hours of placing concrete in order to facilitate the work. Before plastering, the surface shall be thoroughly hacked. The bonding of old and new concrete shall be done by applying the cement slurry after thoroughly watering the old concrete surface and removing all free particles.

Unless otherwise approved, concrete shall be placed in single operation to the full thickness of slabs, beams and similar members and shall be placed in horizontal layers not exceeding 0.5 m deep in walls, columns and similar members. Concrete shall be placed continuously until completion of the part of the work between construction joints or as directed by Engineer-in-Charge.

Items embedded in concrete

Concreting shall not be started unless the electrical conduits or any other piping wherever required, are laid by the concerned agency.

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The control of placing shall begin at the mixer discharge. Concrete shall be discharged by the vertical drip into the middle of the bucket dumper or hopper and this principle of vertical discharge of concrete shall be adhered to throughout all stages of delivery until the concrete comes to rest in forms, Struts, stays and braces serving temporarily to hold the forms in correct shape-and alignment, pending and placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. The temporary members shall be entirely removed from the forms and not buried in the concrete.

Cutting

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement and embodiments. The use of long troughs, chutes and pipes for conveying concrete from the mixer to the forms shall be permitted only on written authorization from the Engineer-in-Charge. In case an inferior quality of concrete is produced by the use of such conveyors, the Engineer-in-Charge may order discontinuance of their use and the substitution of a satisfactory method of placing. Open troughs and chutes shall be equipped with baffles or be in short lengths that reverse the directions of movement. The addition of water at any point in the system of transportation, to facilitate the movement of concrete shall not be permitted. All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing them with water after each run, water used for flushing shall be discharged clear of the structure. Concrete shall not be permitted to fall freely from a height of more than 1.5m nor to strike the forms at an angle. Where drop chutes are used, a sufficient number must be provided so that the concrete discharged from the chute is not required to flow laterally more than 1.0m. Where a drop chute is swung from the vertical, the bottom two sections must be maintained in a vertical position to avoid segregation.

Bonding mortar

Immediately before concrete placement, the areas of prepared rock surfaces or previously placed concrete which will be in contact with the concrete to be placed shall be covered with a bonding mortar or grout. The bonding medium shall have the same cement-sand content as the concrete which will be placed on it. The water-cement ratio shall be determined by conditions of place to be concreted and as approved by the Engineer-in-Charge.

Avoiding Segregation

Concrete placed by barrows, buggies cars, short chutes or hand shoveling in restricted forms shall be subjected to the requirement for vertical delivery of limited height to avoid segregation. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling of flowing. For locations where direct placement is not possible and in narrow forms, suitable drop chutes and "elephant trunks" shall be provided to confine the concrete in movement.

Thickness of layers

Concrete shall be placed in successive horizontal layers ranging in thickness not exceeding 500 mm or as directed by the Engineer-in-Charge. The bucket loads, or other units of deposit, shall be spotted progressively along the face of the layer with such overlap as will facilitate spreading the layer of uniform depth and texture with a minimum of hand shoveling. Any tendency to segregation shall be corrected by shoveling stones into mortar rather than mortar on the stones. Such a condition shall be corrected by redesign of mix, change in process or other means, as directed by Engineer-in-Charge.

Bedding planes shall be approximately horizontal.

Each layer of concrete shall be thoroughly compacted and fully worked around the reinforcement, around embedded fixtures and into corners of the form work with suitable type of equipment until the concrete has been consolidated to the maximum practicable density.

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Type of vibrators

Concrete shall be compacted with mechanical vibrating equipment supplemented, if necessary to obtain consolidation by hand spading and tamping. The vibrators shall be the internal or immersion type high-frequency vibrators with speeds of not less than 7000 rpm when immersed in concrete. Vibrators shall be used in sufficient number of units and power to properly consolidate all concrete.

Internal vibrators shall be inserted in a vertical position at intervals of about 600 mm, depending upon the mix, the equipment used, and continued experience on work. The vibrators shall be withdrawn slowly. The spacing shall provide some overlapping of the area vibrated at each insertion. In no case shall vibrators be used to transport concrete inside the forms. Over vibrating shall not be permitted. Hand tamping in some cases may be allowed subject to the approval of the Engineer-in-Charge.

In placing concrete in layers which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, bonding and molding of the concrete between the succeeding batches.

The vibrator shall penetrate the layer being placed and also penetrate the layer below while the under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

The use of form attached vibrators shall not be permitted without specific authorization of the Engineer-in-charge.

Care shall be taken to prevent contact of vibrators against reinforcement steel. Vibrators shall not be allowed to come in contact with forms of finished surfaces.

The use of surface vibrators will not be permitted for consolidation of concrete under ordinary conditions. However, for thin slabs, surface vibration by vibrators by specially designed vibrators may be permitted, upon approval of the Engineer-in-Charge.

9.0 Construction Expansion Joints

When the work is to be interrupted, horizontal and vertical construction joints and bonding keys shall be located and shall conform in detail to the requirements on the plans unless otherwise directed by the Engineer-in-Charge. Construction joints shall be provided in position as shown or described on the drawings. Where it is not described, the joints shall be in accordance with the following.

In a column, the joint shall be formed about 75 mm below the lowest soft fit of the beams framing into it. Concrete in a beam shall be placed throughout, without a joint but if the provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span. Before fresh concrete is placed, the cement skin or any looser or porous material of partially hardened concrete shall be thoroughly removed and cut back until the solid face is exposed and surface made rough by hacking or any other method as directed by the Engineer-in-Charge. The rough surface shall be thoroughly wetted for about two hours and shall be dried and coated with 1: 1 freshly mixed cement sand slurry immediately before placing the new concrete. Special care shall be taken to see that the first layer of concrete placed after a construction joint is thoroughly rammed against the existing layer, before the slurry sets.

Treatment of suspension of work

When the work has to be resumed on a surface which has hardened, such surface shall be roughened. It shall then be swept clean and then thoroughly wetted. For vertical joints, neat cement slurry shall be applied on the surface before it is dry. For horizontal joints the surface shall be covered with a layer of mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in concrete mix. Mixed and applied immediately before placing the concrete.

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Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgment of particles of aggregate. The surface shall be thoroughly wetted and all free water removed. The surface shall then be coated with neat cement slurry. On this surface, a layer of concrete not exceeding 150 mm in thickness shall first be placed and shall be well rammed against old work, particular attention being paid to corners and close spots, work thereafter shall proceed in the normal way.

Separation joint

Separation joint shall be obtained by using a tough alkathene sheet 1 mm thick or equivalent as approved by the Engineer-in-Charge stuck on the surface against which concrete will be placed. Adequate care shall be taken to cause no damage to the sheet.

Expansion joints.

Permanent expansion joints in structures shall be formed in the positions and to the shapes shown in the relevant drawings. When joints are to be filled with joint filling material as stipulated in the drawings, the permanently exposed, edges of joints shall be sealed with an approved sealing compound.

10.0 Water Stops

The water stops shall be located and embedded at construction / expansion / construction joints as indicated in drawing and as per manufacturer's recommendations.

Water stops shall be accurately cut, fitted and integrally joined at sectional joints and angular junctions to provide continuous, watertight diaphragm at all points as per manufacturer's specifications.

Adequate provisions shall be made for the support and protection of water stops during the progress of the work.

11.0 Curing

Curing of concrete shall be in accordance with IS: 456. Concrete shall be cured by keeping it moist for the period of time specified herein to ensure that complete hydration and hardening takes place.

All concrete shall be cured by use of water which shall be continuously (not periodically) maintained on all exposed surfaces.

Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliances of hose, sprinklers and spraying devices. Continuous fine-mist spraying or sprinkling shall be used, unless otherwise specified or approved by the Engineer-in-Charge.

Wherever, in the judgment of the Engineer-in-Charge it may be necessary, the continuous spray method may be omitted and a covering of sand or other approved material such as burlap which will hold moisture for long periods and prevent loss of moisture from the concrete shall be used. Type of covering which would stain disfigure or damage the concrete during and after the curing period shall not be approved. Approved covering shall be kept continuously wet during the specified curing period.

Concrete shall be maintained in moist condition for at least the first seven days after placing except that high early strength concrete shall be so maintained for at least the first three days. Other curing period may be used with the permission of the Engineer-in Charge, if the specified strengths are obtained.

For curing of concrete in pavements, side walls, floors, flat roofs or other level surfaces the ponding method of curing shall be adopted. The ponded areas shall be kept continuously filled with water and leaks shall be promptly repaired.

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Commencement of curing

Curing of concrete shall start after 8 hours of placement and in hot weather within 4 hours of placement for exposed faces. During the first 24 hours, the concrete shall be cured by use of wet burlap or such other means to cover the concrete surfaces. In very hot weather, precaution shall be taken to see that the temperature of wet concrete does not exceed 38 deg. C while placing.

Concrete placed below the ground level shall be protected from falling earth during and after placing, surface shall be kept free from contact with such ground or with water draining from such ground during placing of concrete for a period of at least 3 days unless otherwise directed by the Engineer-in-Charge. The ground water around newly poured concrete shall be kept to an approved level by pumping or other approved means of drainage and adequate steps shall be taken to prevent floatation and flooding. Steps shall be taken to protect immature concrete from damage by debris, loading, vibration, abrasion, mixing with deleterious materials that may in the opinion of the Engineer-in-Charge impair the strength and / or durability of the concrete.

Approved curing compounds may be used in lieu of moist curing with the permission of Engineer-in-Charge. Such compounds shall be applied to all exposed surfaces of the concrete as soon as possible after the concrete has set.

12.0 Testing

Slump test of concrete

At least one slump test shall be made for every compressive strength test carried out. More frequent test shall be made if there is a distinct change in work conditions or if required by the Engineer-in-Charge.

Strength test of concrete

Samples from fresh concrete shall be taken as per IS: 1199 and cubes shall be made, cured and tested at 28 days in accordance with IS: 516.

In order to get a relatively quicker idea of the quality of concrete, optional tests on beams for modulus of rupture at 72 + 2 hours or at 7 days or compressive strength tests at 7 days may be carried out in addition to 28 days compressive strength tests. For this, purpose, the values given in Table-4 may be taken for general guidance in the case of concrete made with ordinary port land cement. In all cases, the 28 days compressive strength specified in Table-1 shall alone be the criterion for acceptance or rejection of the concrete. If, however, from tests carried out in a particular work over a reasonably long period, it has been established to the satisfaction of the Engineer-in-Charge that a suitable ratio between 28 days compressive strength and the modulus of rupture at 72 + 2 hours of compressive strength at 7 days may be accepted, the Engineer-in-Charge may suitably relax the frequency of 28 days compressive strength values in table below provided the expected strength values at the specified early age are consistently met.

Table -4 Optional Test Requirements for Concrete

Grade of concrete	Compressive strength on 10 cm cubes min. at 7 days kg/ cm2	Modules of rupture by beam test, min.	
		At 72+2hours kg/cm2	At 7 days kg/ cm2
1	2	3	4
M-15	100	15	21
M-20	135	17	24
M-25	170	19	27
M-30	200	21	30

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Procedure - A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested, that is the sampling should be spread over the entire period of concreting and cover all mixing units.

Estimated standard deviations =

Where

= Deviation of the individual test strength from the average strength of n samples.

N = number of sample test results.

When significant changes are made in the production of concrete batches (for example, changes in the materials used, mix design, equipment or technical control), the standard deviation value shall be separately calculated for such batches of concrete.

Assumed standard deviation - Where sufficient test results for a particular grade of concrete are not available, the value of standard deviation given in Table-5 may be assumed:

Table-5 Assumed Standard Deviation	
Grade of Concrete	Assumed standard deviation kg/cm ²
M-15	35
M-20	46
M-25	53
M-30	60

However, when adequate past records for a similar grade exist and justify to the designer a value of the standard deviation different from that shown in Table-5, it shall be permissible to use that value.

Acceptance Criteria

(A) The concrete shall be deemed to comply with the strength requirements if; every sample has a test strength not less than the characteristic value; or the strength of one or more samples though less than the characteristic value, is in each case not less than the greater of the characteristic strength minus 1.35 times of standard deviation; and 0.80 times the characteristic strength; and the average strength of all the samples is not less than the characteristic strength plus

(1.65 -----) times the standard

(1.65 -----) deviation.

(/ -----)

(V Number of samples)

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

The characteristic strength minus 1.35 times the standard deviation; and

0.80 times the characteristic strength; or

The average strength of all the samples is less than the characteristic strength plus

(3) times the standard

(1.65 -----) deviation.

(/ -----)

(V Number of samples)

Concrete which does not meet the strength requirements as specified in (A) but has a strength greater than that required by (B) may, at the discretion of the designer, be accepted as being structurally adequate without further testing.

If the concrete is deemed not to comply pursuant to above, the structural adequacy of the parts affected shall be investigated and any consequential action as needed shall be taken.

Concrete of each grade shall be assessed separately.

Concrete shall be assessed daily for compliance.

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Concrete is liable to be rejected if it is porous or honey-combed; its placing has been interrupted without providing a proper construction joint; the reinforcement has been displaced beyond the tolerances specified; or construction tolerances have not been met. However, the hardened concrete may be accepted after carrying out suitable remedial measures to the satisfaction of the Engineer-in-Charge.

13.0 Inspection

Immediately after stripping the form work, all concrete shall be carefully inspected and any defective work or small defects their removed or made good before concrete has thoroughly hardened.

In case of doubt regarding the grade of concrete used either due to poor workmanship or based on results of cube strength tests, compressive strength tests of concrete on the basis of core test and / or load test may be carried out.

Core test

The points from which cores are to be taken and the number of cores required shall be at the discretion of the Engineer-in-Charge and shall be representative of the whole of concrete concerned. In no case, however, shall fewer than three cores be tested.

Cores shall be prepared and tested as described in IS: 516.

Concrete in the member represented by a core test shall be considered acceptable if the average equivalent cube strength of the cores is equal to at least 85 percent of the cube strength of the grade of concrete specified for the corresponding age and no individual core has strength less than 75 percent.

In case the core test results do not satisfy the requirements of above para or where such tests have not been done, load test may be resorted to.

Failure to meet strength requirement

In the event that concrete tested in accordance with the requirements of this specification fails to meet the requirement, the Engineer-in-Charge shall have the right to require anyone or all of the following; which shall be carried out by the tenderer at his own expense.

Curing and load testing of the concrete member concerned represented by the tests which failed. The method and manner of load test shall be as under load test mentioned below.

Replacement of any such portions of the structure. No payment for the dismantled concrete, relevant form work and reinforcements shall be made. Embedded fixtures and reinforcement or adjoining structures damaged during dismantling shall be made good by the tenderer at his own expense.

Extended curing of the concrete represented by the specimen.

Load test on parts of structures

The Engineer-in-Charge may instruct for a load test to be carried out on any structure if in his opinion such a test is deemed necessary for any of the following reasons:

The work site-made concrete test-cube failing to attain the specified strength.

Suspected overloading during construction of the structure under review.

Shuttering being prematurely removed and not as per the specifications.

The concrete being improperly cured.

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There being a reasonable doubt by the Engineer-In-Charge as to the adequacy of the strength of the structure.

If the results of the load test be unsatisfactory, the Engineer-in-Charge may instruct the tenderer to demolish and reconstruct the structure or part thereof at the tenderer's cost.

The load test of structures shall be carried out as given below:

Load tests shall be carried out as soon as possible after expiry of 28 days from the time of placing of concrete.

The structure shall be subjected to a load equal to full dead load of the structure plus 1.25 times the imposed load for a period of 24 hours and then the imposed load shall be removed.

The deflection due to imposed load only shall be recorded. If within 24 hours of removal of the imposed load, the structure does not recover at least 75 percent of the deflection under super imposed load, the test may be repeated after a lapse of 72 hours. Structures shall be deemed to be unacceptable.

If the maximum deflection in mm, shown during 24 hours under load is less than $40 \times L/21D$, where L is the effective span in M and D the overall depth of the section in mm, it is not necessary for the recovery to be measured and the recovery provisions given above will not apply.

Other non-destructive test methods may be adopted, in which case the acceptance criteria shall be agreed upon between the Engineer-in-Charge and the tenderer and the tests shall be done under expert guidance.

14.0 Finishing Concrete

On striking the form work, all blowholes and honey combing observed shall be brought to the notice of the Engineer-in-Charge. The Engineer-in-Charge may, at his discretion allow such honey-combing or blow holes to be rectified by necessary chipping and packing or grouting with concrete or cement mortar. If mortar is used, it shall be 1:3 mix or as specified by the Engineer-in-Charge. However, if honey-combing or blow holes are of such extent as being undesirable, the Engineer-in-Charge may reject the work totally and his decision shall be binding. No extra payment shall be made for rectifying these defects. **All burrs and uneven faces shall be rubbed smooth with the help of carborundum stone.**

The surface of non-shuttered faces shall be smoothened with a wooden float to give a finish equal to that of the rubbed down shuttered faces. Concealed concrete faces shall be left as from the shuttering except that honey-combed surface shall be made good as detailed above. The top faces of slabs not intended to be surfaced shall be leveled and floated to a smooth finish at the levels or falls shown on the drawings or elsewhere. The floating shall not be executed to the extent of bringing excess fine materials to the surface.

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

Repair and replacement of unsatisfactory concrete

Concrete which is unsatisfactory shall be repaired by cutting out the unsatisfactory material and by replacing it with new concrete. Voids to be so filled shall be provided with anchors, keys or dovetail slots wherever necessary to attach the new material securely in place. Surface of prepared voids shall be wetted for 24 hours immediately before the patching material is placed. Repair of concrete shall be made by skilled workmen. Repairs shall be made as soon as practicable after removal of the forms and in a manner to meet the requirements for the finish specified for the particular location.

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The use of an epoxy for bonding fresh concrete used for repairs will be permitted on written approval of the Engineer-in-Charge. Epoxies shall be applied in strict accordance with the instructions of the manufacturer.

Method of repair

"Dry-pack" filling shall be used for small size holes having surface dimension nearly equal to the depth of the hole, for holes left after removal of form ties, grout insert holes and slots cut for repair of cracks. Mortar filling by cement gun shall be used for repair of areas and holes too large for dry-pack and too shallow for concrete filling. For holes extending entirely through the concrete section, for areas greater than 0.1 sq m. and deeper than 100 mm and holes in reinforced concrete which are greater in area than 0.05 sq m. and which extend beyond the reinforcement, the repair shall be made by making a complete filling of the void with broken stone and liquid port land cement. Grout shall be placed through filler pipes under pressure. Pipe nipples shall be placed through the forms at bottom of the void so that the grout rises upward through the aggregate to spill through a vent at the top edge of the void.

Matching of patch surface

Filling material used in repair of surfaces which will be exposed after completion of the project shall be made with cement from the same source as that used in concrete and blended with a sufficient amount of white portland cement to produce the same colour as in the adjoining concrete. Patched surfaces shall be given a final treatment as required to make the texture of the patch to match with that of the surrounding material.

Curing of patched work

Immediately after patching is completed, the patched area shall be covered with an approved non-staining, water saturated material which shall be kept wet and protected against sun and wind for a period of 12 hours. Thereafter, the patched area shall be kept continuously wet by a fine spray or sprinkling for not less than 10 days.

All materials, procedures and operations used in the repair of concrete and also the finished work shall be subject to the approval of the Engineer-in-Charge. All filling shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks or dummy areas after the fillings have been cured and dried.

15.0 Form Work (Normal Finish)

Form for concrete shall be of plywood or steel or as directed by the Engineer-in-Charge and give smooth and even surface removal thereof.

If it is desired by the Engineer-in-Charge, the tenderer shall prepare, before commencement of actual work, design and drawings for formwork and centering and get them approved by the Engineer-in-Charge. The formwork shall conform to the shapes, lines and dimensions as shown on the drawings within the tolerances given below:

As Per IS 456-2000 Cl.11.1 Page 25.

Deviation from specified dimensions	-06mm
of cross section of columns. and beams	+12mm
Deviation from dimensions of footings (see note)	
Dimension in plant	-12mm
Eccentricity	+50mm
0.02 times the width of the footing in the direction of deviation but not more than 50mm.	
Thickness	+0.05 times the specified thickness.

Note: Tolerances apply to concrete dimension only not to positioning of vertical reinforcing steel or dowels. Form requirement.

The centering shall be true and rigid and adequately braced both horizontally and diagonally. The forms shall be sufficiently strong to carry without deformation of the dead weight of the concrete as a liquid as well as the working load, wind loads etc. Where the concrete is vibrated,

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the form work shall be strong enough to withstand the effect of vibrations practically without any deflection, bulging, distortion or loosening of its components. All columns and floor slabs form work shall be of plywood or as specified finish. Form work for removable batch ways and plugs shall be installed in place wherever possible. All floor and beam centering shall be crowned not less than 8 mm in all directions for every 5m span.

Unless prior approval in writing has been received from the Engineer-in-Charge all vertical wall forms may be constructed for the following minimum pressure. The pressures listed in Table-6 are intended as guide only and the tenderer shall ensure that the construction of the forms is adequate for all concrete.

Table-6

Rate of pour in M per hour	Pressure in kg / sq.m	
	10 deg.C	24 deg.C
0.6	3600	2900
0.9	4000	3200
1.2	4400	3500
1.5	4600	3700

All horizontal forms shall be constructed for pressures from the dead load of the concrete and embedments and a minimum live load of 200-kg / sq.m.

Inspection of forms

Temporary openings shall be provided at the base of columns and wall forms and other places necessary to facilitate cleaning and inspection. Immediately before concrete is placed, all forms shall be carefully inspected to ensure that they are properly placed, sufficiently rigid and tight, thoroughly cleaned, properly treated and free from foreign material.

When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the Engineer-in-Charge shall order all work stopped until the defects have been corrected.

Cleaning and treatment of forms

All rubbish, particularly chippings, shavings and saw-dust, shall be removed from the interior of the forms before the concrete is placed and the form work in contact with the concrete shall be cleaned and thoroughly wetted or treated with an approved composition. Care shall be taken that such approved composition is kept out of contact with the reinforcement.

Tie rods

Metal tie rods shall be used for supporting all forms. Provisions shall be made for removal of a section of each rod at surface of the concrete to a depth of approximately 50mm. All holes left by the removal of conical nuts or other removal fixtures embedded in the face of the concrete shall be filled and finished with cement mortar in a manner specified in the sections of "Finishing". Threaded inserts embedded on each face of the wall shall be used for attaching the forms to previously placed concrete.

Tie wires

Wire ties will be permitted only upon approval of the Engineer-in-Charge and when permitted, shall be cut off flush with the face of the concrete or counter sunk, filled and finished, as required by the Engineer-in-Charge in the manner specified under the sections of "Finishing".

Chamfers and fillets

All corners and angles shall be formed with 45 deg. moulding to form chamfers or fillets on the finished concrete. The standard dimensions of chamfers and fillets, unless otherwise detailed or specified, shall be 25 x 50 mm. For heavier work chamfers or fillets may be 40 x 50 mm. Care shall be exercised to ensure accurate moulding. The diagonal face of the moulding shall be planed or surfaced to the same texture as the form to which it is attached. Unit rates quoted shall include providing the chamfers as specified or as shown on the drawings.

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Construction joint chamfers

Vertical construction joints on faces which will be exposed at the completion of the project, shall be chamfered as above except where not permitted by the Engineer-in- Charge.

Joints

Joints in form shall be horizontal or vertical unless otherwise specified and shall be sufficiently tight to prevent any leakage. Suitable devices shall be used to hold adjacent edges together in accurate alignment. All forms shall be such that they can be removed without hammering or prying against the concrete.

Reuse of forms

Before reuse, all forms shall be thoroughly scrapped, cleaned, examined and when necessary, repaired and reoiled before resetting. Formwork shall not be used / reused, if declared unfit or un-serviceable by the Engineer-in-Charge/Architect/TPI Agency.

Clean out provisions

Forms with limited working space within shall be provided with temporary cleanout doors or openings for cleaning, washing, blowing and removal of water, wood, chips, dirt, trash, etc.

Removal of forms

In the determination of time for removal of forms, consideration shall be given to the location and character of the structure, the weather and other conditions including the setting and curing of the concrete and materials used in the mix.

Forms and their supports shall not be removed without the approval of the Engineer-in- Charge. Methods of form removal likely to cause overstressing or damage to the concrete shall not be used. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stress due to its own weight.

In normal circumstances (generally where temperatures are above 20 deg. C), and when ordinary port land cement is used, forms may be struck after expiry of following periods.

Walls, columns and vertical faces of all structural members	24 to 48 hours as may be decided by the Engineer-in-charge.
Slabs (props left under)	3 days.
Beam soffits (props left under)	7 days.
Removal of props under slabs:	
Spanning up to 4.5m	7 days.
Spanning over 4.5m	14 days.
Removal of props under beams & arches:	
Spanning up to 6m	14 days.
Spanning over 6m	21 days.
Cantilever construction	Not until adequate fixity is developed subject to minimum of 10 days.

The number of props, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slab, beam or arch as the case may be. Where the shape of the element is such that the form work has re-entrant angles, the form work shall be removed as soon as possible after the concrete has set, to avoid shrinkage, cracking occurring due to the restraint imposed.

16.0 Exposed Concrete Work

Form work

Other things remaining same as per C1.15, formwork shall be with plywood or steel only. Care shall be taken to arrange the shutters so that the joints between shutter boards correspond with the pattern indicated in the drawings. The shuttering boards shall be butting with each other in straight lines. The joints between the boards shall cross in the two directions at right angles.

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The size of boards shall be so selected as to exactly match with the pattern of shuttering impression on the concrete face indicated in the drawings. Maximum care shall be taken to make the formwork water tight. Burnt oil shall not be used. The tenderer shall be permitted reuse of concrete shuttering brought new on the work for exposed concrete work as per the following table.

Such reuses shall be permitted only if forms are properly cared for, stored and repaired after each use.

Plywood shuttering - 8-10 reuses.

Steel shuttering -100 reuses.

The tenderer shall not be permitted to reuse any old shuttering, already used in work other than those covered under contract, for the purpose of exposed Concrete work.

Engineer-in-Charge/Architect may in their absolute discretion order removal of any forms be considers unfit for use in the work and order rejection of any form stored or erected, he considers unfit for use irrespective of the number of uses specified above.

Finishing

On striking the form work, the exposed surface shall be cleaned of extra mortar, grit, etc. by carefully chipping or rubbing by carborundum stone. Uniform texture and smooth surface shall be ensured. In case of honey-comb, the same shall be immediately brought to the notice of the Engineer-in-Charge. If it is allowed to be rectified, concrete in the affected area shall be carefully chipped off up to the depth of the concrete cover. The chipped off area shall be in rectangular shape enclosing the affected part. Cement concrete grout of 1: 1 1/2:3 or as specified by Engineer-in-Charge shall be used to patch up the chipped off area carefully using metal trowel to rub down the finished surface. Care shall be taken to use the same colour of cement as was used for the rest of the work, so that the repaired work merges with the rest of the concrete surface. If necessary, white cement in the ratio of 1:8 or as directed by the Engineer-in-Charge be mixed with the cement to obtain the matching colour.

The repaired patch shall be kept wet by covering with a piece of gunny bag from 2 hours after the work for 14 days, ensuring gunny bag piece remaining wet throughout the period.

Rendering or plastering the exposed concrete surface shall not be done.

17.0 Cement Wash

If so desired by the Engineer-in-Charge the tenderer shall provide one coat of cement wash over the concrete surfaces of foundations, pipe racks, columns, walls, etc. which are not covered. Cement used by the tenderer for providing the Cement wash shall be taken into account for material reconciliation. Cost of providing cement wash is deemed to have been included in the rate for various items of concreting in the Bill of Quantities.

18.0 Reinforcement

Bent bar Reinforcement shall be cold bent gradually by machine or other approved means without the use of heat to the shapes shown on the Drawings except, in case of bars larger in dia than 28 mm. If approved by the Engineer-in-Charge, bars can be bent hot by heating the bar gradually. Bars bent hot shall not be heated beyond cherry red colour and after bending, allowed to cool gradually without quenching. Bars which develop high strength due to cold working shall not be hot bent. Bars having cracks or splits on the bends shall be rejected. An bars shall be bent in accordance with the Drawings.

Bars shall be properly tagged for easy identification.

An Reinforcement shall be furnished in the full length indicated on the Drawing. Splicing of the bars except where shown on the Drawings will not be permitted without the written permission of the Engineer-in-Charge.

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At a tension splice the minimum clear distance between bars shall be maintained. Splices in adjacent bars carrying tension shall be staggered.

At a compression splice each pair of lapped bars may be in contact but the minimum clear spacing between the splice and the adjacent splice shall be that specified for adjacent single bars.

In no case shall the clear distance between bars be less than the diameter of the bar nor less than one third of the max. size of Coarse Aggregate.

Reinforcement shall be bent in accordance with procedure specified in IS: 2502 code of practice for Bending and Fixing of Bars for Concrete Reinforcement and shall not be straightened in a manner that will injure the material.

Exposed portions of Reinforcement bars must not be subjected to impact or rough handling and workmen will not be permitted to climb on bar extensions until the Concrete has sufficient strength so that no movement of the bar in the Concrete is possible.

Where Reinforcement bars are bent aside at construction joints and afterwards bent back into their original positions, care should be taken to ensure that at no time is the radius of the bend less than 4xbar diameters for plain mild steel or 6xbar diameters for deformed bars. Care shall also be taken when bending back bars, to ensure that the Concrete around the bar is not damaged.

Welding

Field welding of Reinforcing bars will not be permitted without the written consent of the Engineer-in-Charge. Where welding is permitted it must be at suitable staggered locations. Tests shall be made to prove that joints are of the full strength of bars connected. Welding of Reinforcement shall be done in accordance with the recommendation of IS:2751. This clause applies to main and distribution steel only.

Miscellaneous Reinforcement Welding

In those places where welded reinforcement chairs, spacer trusses etc. are necessary like in chimney Raft, deep raft, etc. and have been detailed in the Drawing, any welding necessary for fabrication of such trusses, chair, etc. is deemed to have been covered under the rates for Reinforcement and such spacer, chairs, trusses, etc. shall be measured and paid under the relevant reinforcement item.

If any steel plates are used as gussets in fabrication of these chairs, trusses the same shall be payable under insert item.

Cleaning, placing and fastening

All reinforcement shall be cleaned to ensure freedom from loose mill scale, loose rust, oil and grease or other harmful matter immediately before placing the concrete. Dowel bars will be provided where shown on drawings or where required. All steel reinforcement shall be accurately placed in position shown in the drawing and firmly held during the placing and setting of concrete. Bars shall be tied with annealed iron wire at all intersections except where spacing is less than 300 mm in each direction, when alternate intersections shall be tied.

Tolerances on placing of reinforcement

Unless otherwise specified by the Engineer-in-Charge, reinforcement shall be placed within the following tolerances As per IS 456-2000 Page 26, Cl-12.3:

For effective depth 200 mm or less	+10mm
For effective depth more than 200 mm	+ 15 mm

The cover shall in no case be reduced by more than one-third of specified cover or 5 mm whichever is less.

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Substitution

When specified diameter reinforcement is not available tenderer shall diameter use other reinforcement written approval of the Engineer-in-Charge.

Cover to reinforcement

Cover to reinforcement shall be as indicated on the drawings and in their absence as directed by the Engineer-in-Charge. Where concrete mortar blocks are used for giving necessary cover, strength shall correspond to the strength of concrete proposed for the structure where such cover blocks are used. All cover spacers shall be secured firmly so that they are not disturbed during vibration.

19.0 Damp Proof Course (D.P.C.)

The Damp Proof Course shall consist of cement concrete of M 200 grade or as specified with 10 mm and down size graded aggregate unless otherwise specified.

The damp proof course shall be laid at plinth level of brick walls, flush with the floor surface and shall not be carried across door ways. The finishing layer of flooring shall be continued over such openings and shall be laid at the same time as flooring.

Before laying, the top surface of the wall shall be thoroughly cleaned and watered. The D.P.C. shall be laid in two layers of 20 mm thickness each, retaining the edges by necessary shuttering and shall be well tamped and troweled to a smooth finish. The first layer shall be cured by keeping the surface wet for 40 hours and after it has dried two coats of bitumen (80/100) shall be applied over it. Over this, the second layer of 20 mm thick concrete shall be laid and cured as described in case of the first layer and two coats of hot bitumen shall be applied in the similar manner and dry sharp sand sprinkled over it.

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Section IV

Structural Steel Work

1.0

Tenderer to provide

General

- 1.1 The tenderer shall provide all materials and equipments required to complete the works in every respect, whether such materials are required as part of the permanent structures or temporarily for fabrication or erection or maintenance including specifically structural steel plates, flats, bars, welding rods, rivets, bolts and nuts, paint, welding sets in the shop and at site, all workshop facilities, derricks, cranes, pulley blocks, wire ropes, hemp or Manila ropes, winches, erection cleats and temporary braces or supports and all other materials required to deliver the works complete in every respect.
All labour required for fabrication and erection, for any cleaning, making good, rectifying, hauling, and painting and for any other ancillary work required to complete fabrication and erection.
- 1.2 All taxes imposed by local, Municipal, State Customs, Central Government or other authorities on the fabricated, or erected material for the works, or on transport of the material or materials or equipment required temporarily for the works shall be borne by the tenderer and shall be held to be included in the Contract Rates.
- 1.3 The tenderer shall make his own arrangements to obtain permission to transport fabricated material from the concerned Regional Transport Officer and delay on this account shall not be considered as justifying an extension of the time stipulated for completion of the works.
- 1.4 The tenderer shall observe all safety requirements for erection of structural steel work as covered in IS: 7205.

2.0 Drawings

- 2.1 The engineer will supply to the tenderer profile drawings showing sizes of all structural members and typical connection details.
- 2.2 Should there be any discrepancy in the drawings; the tenderer is to refer the matter to the Engineer. The tenderer shall further provide a drawing showing the accurate setting out to line and level of all the anchor bolts intended for the work in sufficient time for their inclusion in the work so as to maintain the building programme.
- 2.3 The tenderer is to prepare all the necessary fabrication drawings and these shall be submitted to the Engineer in charge in duplicate and be approved by him before fabrication is commenced. All such drawings shall show the dimensions of all parts, method of construction, welding and bolting. A further set of all approved fabrication drawings shall be supplied by the tenderer for use of the Engineer in charge as required.
- 2.4 Approval by the Engineer in charge of drawings or any other particulars submitted by the tenderer shall not relieve the tenderer of full responsibility for any discrepancies, errors or omissions therein. The tenderer shall at his own expense supply such additional copies of his working drawings as are required for the use of the interested parties.

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2.5 Figured dimensions on drawings shall supersede measurements. by scale and drawings to a smaller scale shall take precedence over those to a larger scale. Special dimensions or directions in the specification shall supersede all else. All dimensions shall be checked on site. The tenderer shall take full responsibility for these and for the dimensions of component members.

2.6 The dimensions where stated do not allow for waste, laps, joints, etc. but the tenderer shall provide at his own cost sufficient labour and materials to cover waste, laps, joints etc.

3.0 Material

3.1 **Structural Steel:** All Structural steel shall be tested quality and shall conform to one of the following standards, IS: 226 structural steel (Standard Quality). IS: 2062 structural steel (Fusion Welding Quality). IS: 961 High Tensile Structural Steel ST:44-0 of IS:977-1962 Structural Steel (Ordinary).

The tenderer shall supply to the Engineer, copies of the Manufacturer's Certificate that the steel brought to the site for incorporation in the works is of a quality fully complying with specification. If required by the Engineer the tenderer shall arrange for testing of the steel samples as per IS: 1608 and IS: 1599.

Chemical composition of steel: The ladle analysis of steel when made as per relevant parts of JS : 2284 shall be as follows:(IS 1786-1985)

Constituent	Percent ,Maximum		
	Fe 415	Fe 500	Fe 550
Carbon	0.30	0.30	0.30
Sulphur	0.060	0.055	0.055
Phosphorus	0.060	0.055	0.050
Sulphur and Phosphorus	0.11	0.105	0.10

TOLERANCES ON DIMENSIONS AND NOMINAL MASS:

Specified Lengths - If bars/wires are specified to be cut to certain lengths, each bar/wire shall be cut within deviations of 2 l: mm on the specified length, **but** if minimum lengths are specified, the deviations shall be +50 mm and -0 mm.

Nominal Mass

6.2.1 For the purpose of checking the nominal mass, the density of steel shall be taken as 0.007 85 kg/ mm² of the cross-sectional area per metre run.

6.2.2 Unless otherwise agreed to between the manufacturer and the purchaser, the tolerances on nominal mass shall be as in Below Table For bars/wires whose effective cross-sectional areas is determined as above the nominal mass per metre run shall correspond to the gross mass and the deviations in Table 2 shall apply to the nominal mass (IS1786-1985)

TABLE TOLERANCES ON NOMINAL MASS

Nominal size mm	Batch	Individual sample	Individual Sample for coils only
Upto and including 10	+/- 7	-8	+/- 8
Over 10 upto and including 16	+/- 5	-6	+/- 6
Over 16	+/- 3	-4	+/- 4
For individual sample plus tolerance is not specified.			

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- 3.2 **Welding Electrodes:** Welding electrodes used for the works shall conform to IS: 814(Latest) and shall be supplied by manufacturer approved by the Engineer and shall be of the grade approved by the Engineer. All Electrodes shall be kept under dry conditions. Any electrode which has part of its flux coating broken away or is damaged shall be rejected.
- 3.3 **Bolts and Nuts:** Bolts and nuts used for the works shall unless otherwise specified be black bolts and nuts supplied by manufacturer and approved by the engineer in charge and shall conform to IS: 1367.
- 3.4 For all other material required for the works, the approval of the Engineer in charge shall be obtained by the tenderer prior to the use of the material in the works.
- 3.5 All structural material shall be stored properly off the ground. It shall be kept clean. The handling of the members shall be such that they are not subjected to excessive stresses and damage. Girders and beams shall be stored upright. Long members shall be supported on closely spaced skids to prevent damage from deflection.
- 3.6 All material shall be straight, free from laminations and distortion. If necessary, before being worked it shall be straightened and/or flattened by pressure.
- 4.0 Workmanship and Fabrication**
- 4.1 For all the works, workmanship shall be of first class quality throughout in conformity with IS: 800 (Latest) and true to line, level and dimensions as shown in the drawings or instructed by the engineer.
- 4.2 All sheared and flame-cut edges shall be free from distortion and be filed or ground or otherwise properly finished to the satisfaction of the Engineer, prior to welding. All holes in the steel work shall be drilled and/or punched and not flame-cut.
- 4.3 Holes for bolts shall not be more than 1.5 mm larger than the nominal diameter of the bolts for bolt diameters up to 25 mm and not more than 2.2mm larger than the nominal diameter for bolt diameter over 25 mm. All matching holes for bolts shall register with each other within a tolerance of 2mm. When holes are drilled in one operation through two or more separable parts, these parts when specified by the Engineer shall be separated after drilling and the burrs removed.
- 4.4 All parts assembled for bolting shall be in close contact over the whole surface and all bearing stiffeners shall bear tightly at top and bottom without being drawn or caulked. The component parts shall be so assembled that they are neither twisted nor otherwise damaged and specified cambers if any, shall be provided. No drifting of holes shall be permitted except to draw the parts together. Drifting done during assembling shall not distort the metal or enlarge holes. The butting surfaces at all joints shall be so cut and milled so as to butt in close contact throughout the finished joint.
- 4.5 The erection clearance for cleated ends of members and for beams without web cleats, connecting steel to steel shall be as detailed in the working drawings. Where for practical reason greater clearance is necessary, suitably designed seating shall be provided.
- 4.6 All welding for the works shall be carried out by first class welders and shall be in accordance with IS: 816 (Latest). The tenderer shall satisfy the Engineer that the welders are competent to carry out welding of satisfactory quality. All surfaces prior to welding shall be suitably cut, mitered or leveled according to the instruction of the Engineer. The Engineer may at his

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discretion order periodic tests of the welder and / or of the welds produced by them. All such tests shall be carried out by the tenderer at his own cost. All surfaces prior to welding shall be suitably cut, mitered or leveled according to the instruction of the engineer. The engineer may at his discretion order periodic tests of the welder and/or of the welds produced by them. All such tests shall be carried out by the tenderer at his own cost.

- 4.7 As much work as possible shall be welded in shops. The pieces shall be manipulated to ensure down hand welding for all shop joints as far as possible. All parts to be welded shall be arranged so as to fit properly on assembly. After assembly and before the general welding is to commence the parts are to be tack welded with small fillet or butt welds as the case may be. The tack welding must be strong enough to hold the parts together but small enough to be covered by the general welding. The welding procedure shall be so arranged that the distortion and shrinkage stresses are reduced to a minimum.

The minimum throat depth of a fillet weld as deposited shall not be less than specified size. In no case shall a concave weld be deposited. The butt weld face at all places shall be deposited above the surface of the parent metal. Where a flush surface is required the surplus metal shall be ground off. After making each run of welding all slag shall be thoroughly removed.

- 4.8 All joints required in structure to facilitate transport or erection shall be shown on the drawings or as specified by the engineer. Should the tenderer need to provide joints in locations other than those specified by the engineer he shall submit his proposals and obtain the prior sanction of the Engineer for such joints. The length of structural members shall be the maximum normally available in the market. Joining of shorter length in order to make up lengths required shall not be permitted.
- 4.9 Each piece of steel work shall be marked distinctly before delivery indicating the position and direction in which it is to be fixed. Three copies of a complete working plan are to be supplied to the engineer before erection commences.
- 4.10 All complete work must be exact to the dimensions required. Every piece of fabricated material shall be free from rust, scale and pitting, true to thickness throughout and free from lamination, twist and distortion. All projecting plates and ends of members shall be suitably stiffened and protected to avoid distortion during storage and erection.
- 4.11 In the case of welded fabrication, any distortion remaining in the member after welding operations are completed shall be rectified by and/or at the expense of the tenderer to the approval of the engineer.
- 4.12 All members of trusses and lattice girders shall be straight throughout their length, unless shown otherwise on the drawings, and shall be accurately set to the lines shown on the drawings. Sheared edges of gussets or other members to be straightened and dressed where necessary.
- 4.13 Templates and jigs used throughout the work shall be all steel. In case where actual materials have been used as templates for drilling similar pieces, the engineer shall decide whether they are fit to be used as parts of the finished structure.

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5.0 Protection of Steel Works (IS: 8629)

5.1 The steelwork, prior to delivery, shall be cleaned from scale, rust, dirt and grease etc. by means of chipping, scraping and wire brushing using skilled operators. The cleaning shall be thorough and to the entire satisfaction and approval of the Engineer. The cleaning shall proceed easy day over the extent of surfaces which can be painted on that day.

5.2 Immediately after cleaning as described above, the surfaces which shall be thoroughly dry, shall be given one coat of *zinc* chromate paint of approved make of thickness not less than 25 microns DFT. Site weld locations shall be left free from paint within six inches of the weld position, and contact surfaces in connections using High Strength Friction Grip Bolt shall not be painted, but these surfaces shall be cleaned and adequately covered by a masking tape or other suitable means.

Immediately after completion of erection all damaged paint shall be scraped off and made good to the approval of the Engineer. The steelwork specialist shall also down and apply one coat of primer to all site bolts, site bolt connections and site weld locations and the painting work generally shall be left in sound condition for any subsequent painting of two coats of finishing paint of thickness not less than 80 microns DFT.

5.3 All paints and primers shall be of best quality conforming to the relevant Indian Standards and shall be procured directly from the manufacturers. All paint to be used shall be stored under cover in such conditions as will preserve it from extreme temperatures and the paint shall be used and applied strictly in accordance with the manufacturer's instructions.

5.4 In addition the following specification shall apply to the shop painting of contract and inaccessible surfaces:

- a) Surfaces which are to be brought permanently into close contact or made inaccessible either in the shops or upon erection shall, after cleaning, be given two coats of red lead priming paint. The surfaces shall be brought into contact while the paint is still wet.
- b) Surface to be painted shall be thoroughly cleaned from scale, rust, dirt, grease etc.
- c) Contact surfaces in connections using High Strength Friction Grip Bolts shall not be painted or oiled and shall be free from dirt, loose scale, burrs, pits and any other defects which would prevent the solid seating of the parts and would interfere with the development of friction between them.
- d) All enclosed surfaces of box members shall be completely sealed by oiling or by coating with approved bitumen paint and such members and tubes shall have their ends closed by suitable plates welded in position.

5.5 The tenderer shall take all precautions to prevent dust and dirt coming in contact with freshly painted surfaces or with surface being painted. The second coat of paint shall only be applied when the first coat has dried.

6.0 Erection and Site Work

6.1 The tenderer shall be responsible for checking the alignment and level of foundations and correctness of foundation bolt centers well in advance of starting erection work and shall be responsible for any consequences for non-compliance thereof. Discrepancies if any shall immediately be brought to the notice of the Engineer for his advice.

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- 6.2 During the erection, the rough handling of fabricated materials such as bending, straining or pounding with sledges shall be avoided. Any damage to the structure during transportation or erection shall be immediately rectified by the tenderer at his own cost. The straightening of bent edges of plates, angles and other sections shall be done by methods which will not cause fracture.
- 6.3 Following the completion of the straightening, the surface of the member shall be carefully inspected for damage and got approved by the Engineer before further use.
- 6.4 The tenderer shall be responsible for accurately positioning, leveling and plumbing of all steelwork and placing of every part of the structure in accordance with the approved drawings and to the approval of the Engineer. All stanchion based beam and girder bearings etc. shall be securely supported on suitable steel racks. All reference and Datum points shall be fixed near the work site for facilitating the erection work. Adequate arrangement shall be made to resist wind loads and lateral forces arising at the time of erection.
- 6.5 All equipment by the tenderer shall be sufficient for the purpose and for the erection of the steelwork as specified in the contract. Any lifting or erecting machinery shall be to the approval of the engineer and not dangerous or unsuitable for their functions. The approval of the Engineer shall not relieve the tenderer of his responsibilities regarding the loads to which the erection equipment shall be called upon to carry. Adequate arrangement shall be made to resist wind loads and lateral forces arising at the time of erection.
- 6.6 The tenderer is entirely responsible for the stability of the structure during erection and shall arrange that sufficient tack bolts, braces or guy ropes are used to ensure that work will remain rigid until final bolting, riveting or welding is completed. The tenderer shall supply and fix, without extra charge, any temporary bracing which may be necessary.
- 6.7 All steelwork shall be erected in the exact position as shown on the drawings. An vertical members shall be truly in plumb, fabrication being such that an parts can be accurately assembled and erected. No permanent bolting, welding or grouting shall be done until proper alignment has been obtained.
- 6.8 At stanchion splices and at other positions where concrete cover to the steel is liable to be restricted, bolts will be placed with their heads on the outside of the member.
- 6.9 All field assembly bolting and welding shall be executed in accordance with the requirements for shop fabrication excepting such as manifestly apply to shop conditions only. Where steel has been delivered painted, then paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints. The number of washers on permanent bolts shall not be more than two for the nut and one "for the bolt head.
- 7.0 Rectification of Damaged Materials**
Any error in shop work which prevents the proper assembly and lifting up of the parts by moderate use of drift pins or reaming or cutting shall be immediately reported to the engineer and his approval of the method of rectification obtained in writing. Wrongly fabricated material whose erection in the field necessitates extra work shall be the responsibility of the tenderer. The entire costs of such operations including the replacement of defective members if required shall be borne by the contractor.
- 8.0 Inspection**
- 8.1 The tenderer shall inform the engineer of the progress in fabrication and as to when individual pieces are ready for inspection. Gauge templates necessary to satisfy the engineer shall be supplied by the tenderer. The engineer may at his discretion check the results obtained at the tenderer's works by independent tests and should the material so tested be found unsatisfactory, the cost of such tests shall be borne by the tenderer.

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- 8.2 The weld metal as deposited shall be free from cracks, slag, inclusions, porosity and cavities. The weld metal shall be properly fused with the parent metal.

9.0 Erection Tolerances

- 9.1 All tolerances shall be in accordance with 15:7215 unless otherwise specified.
- 9.2 The maximum deviation for line and level shall be + 3mm for any part of the structure including for location of column centers.
- 9.3 The maximum deviation for plumbing for columns shall be 3 mm in 1.0 m height- subject to a maximum of 6 mm in a total height of 30 m.
- 9.4 The deviation at the center of the upper chord member from vertical plane running through the centre of the bottom chord shall not be more than 1/1500 of span but in no case more than 10 mm. The lateral displacement of top chord at center span from vertical plane running through centre of supports shall not be more than 1/250 of the depth of truss but in no case more than 20 mm.
- 9.5 The crane rails shall not deviate from the true location by more than + 2 mm.

10.0 Mode of Measurement

- 10.1 The particular pricing must include for all rolling margins, extra for length and size, allowance for waste, complete fabrication, delivery and erection, and grouting of pockets for foundation bolts and caulking the gap between base plates and foundation.
- 10.2 Any temporary strutting, tying or anchor bolts, black bolts, fasteners, welding required to withstand the stresses of erection and carrying of plant are to be included in the price.
- 10.3 The payment for the steelwork will be for the weight of the steelwork actually erected, i.e. plates, rolled sections, shear connections, cleats, splice plates. Dimensions of the steelwork will be taken on site or from the actual shop working drawings as preferred by the Engineer. In calculating the weights of gusset plates; payment will be made for the least enclosing parallelogram or triangle. For structural sections the weight will be calculated in lengths actually used with no deduction for splay cut or mitered end, In case of imported sections, the weights chargeable shall be the weight according to the relative standards of the country of origin. Full weight of the bolts and nuts will be paid for as per Indian Standard codes without any deductions for shanks, etc. No erection packing plates bedded in mortar and wedges shall not be measured but shall be included in the rates. No deductions shall be made for openings less than 0.1 smt in area measured in plane for bolt holes. The weight of sheet steel, plate, strip and rolled sections shall be taken from relevant Indian Standards.

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Section V

Approved List of Materials and Suppliers

All materials to be used in the work shall conform to technical specifications, relevant Indian Standard Specifications and wherever available ISI marked materials will be used. All material procured shall be subjected to relevant tests specified in B.I.S. at the frequency specified therein from any Government recognized laboratory. The list given below is only indicative and not restricted to brand mentioned. Other equivalent brand may be approved at the discretion of the Engineer-in-charge after verifying the quality thereof. The tenderers may suggest additional brand names if desired. The same may be approved by CIDCO provided the tenderer convinces CIDCO regarding credential of the supplier. The final selection will have to be done with the approval of Engineer-in-charge.

Make / Manufacturer / Brand of Materials

Item	Approved Make/Manufacturer
Cement	Ultratech, Ambuja
White Cement	Birla, JK
TMT Bars	Tata, Sail
Coarse Aggregates 6 mm to 25 mm sizes	Material should be as per specification & should be Angular blade trap stone aggregate Chikhali. Approved by EIC before use.
Stone Rubbles	Material should be as per specification & should be approved by EIC before use.
Shuttering Plywood	Anchor, Century, Green.(12 mm Film faced)
Adhesives	Fevicol, Kitcol, Araldite, Bal
Construction chemicals/ Admixtures, plasticizers Water proofing Compound	Roff, Fosroc, Pidilite, Sika, Perma
Electrical Conduit	Precision,Jain.
M.S. Boxes	Fabricated out of 16 gauge continuously welded (sample to be approved).
Shuttering Sheets	Mild Steel confirming to IS: 2062 2mm thick ie 14SWG gauge.

Developer with mutually agreed terms with Contractor may opt to procure shuttering plywood as required within tender specifications. In such circumstances, contractor shall give suppliers quotation to Developer.

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List of Approved Make / Manufacturer for Electrification Items

APPLICABLE STANDARDS

Following IS Specifications, Standard and rules will be applicable.

<u>Sr.No. IS No.</u>	<u>Description</u>
1) IS:1646 :	Code of practice for fire safety of Buildings (general) electrical installation.
2) IS:1653 :	Rigid steel conduits for electrical wiring.
3) IS:2667 :	Fittings for rigid steel conduits for electrical wiring.
4) IS:3837 :	Accessories for rigid steel conduits for electrical wiring.
5) IS:2509 :	Rigid non-metallic conduits for electrical wiring.
6) IS:9537-1980 :	Specification for conduit for electrical installation.
7) IS:1913-1969 :	General and safety requirement for lighting fittings.
8) IS:3528 :	Waterproof electric lighting fittings.

The contractor is supposed to provide any of the above mentioned brands as decided by the Engineer in Charge without any extra cost & shall seek the Engineer in Charge's prior approval before placing the order. As far as possible, the successful tenderer will have to place order directly to the Manufacturer.

NOTE: ALL THE MATERIALS / MAKES LISTED ABOVE AND OTHER THAN AS SPECIFIED ABOVE SHALL BE USED AFTER OBTAINING PRIOR APPROVAL FROM THE ARCHITECT / ENGINEER-IN-CHARGE.

TENDERER'S SEAL AND
SIGNATURE

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Section VI

Certificate of Tenderer's inspection of the Drawing

I/Weof

.....

have inspected and studied all the drawings as in the list of drawings on page No.....of the tender.

I / We certify that I / We have obtained sufficient information from the drawings to enable me/us to fill in the tender for the proposed work of Construction of **Compound Wall for Gem & Jewellery Park, Ichchhapore, Surat.**

Signed byfor and on behalf of Tenderer.

Place :

Date :

Signature of the Tenderer.

Note:

The failure of a tenderer to inspect and study the drawings and collect adequate information will not relieve him / them from the responsibility for properly estimating the cost of the work / quoting rates and no claims from the tenderer / tenderer for additional cost on the ground that he / they is / are unfamiliar with the drawings will be entertained.

Signed byfor and on behalf of Tenderer.

Place :

Date :

Signature of Tenderer.

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Section VII

Certificate of Tenderer's Visit to the Site

I, ofhave
visited the site and are well acquainted with the conditions of site related to access / approach at
site, topography , climatic conditions, availability of water and electricity and other basic necessities.

Signed

For and on Behalf of Tenderer,

Note:

The failure of the tenderer to visit the site and collect adequate information will not relieve him for
the responsibility for properly estimating the cost of work and no claims from the tenderer / tenderer
for additional cost on the ground that he is unfamiliar with the location and/ or nature of the site will
be entertained.

Signed

For and on Behalf of Tenderer,

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Section VIII

List of Working Drawings for Compound Wall

List of Drawings Attached		
Sr.No.	Description	Drawing No.
01	Master Plan – Typical Detail Demarcation Plan	U010/WD/IP/08
02	Typical Compound Wall Detail - 01	U010/WD/PP/TYP/01-1
03	Typical Compound Wall Detail - 02	U010/WD/PP/TYP/01-2
04	Typical Compound Wall Corner Detail	U010/WD/PP/TYP/02
05	Typical Gate Demarcation at PAS	U010/WD/PP/TYP/06
06	Electrical Conduits Detail at PAS Entry Gate	U010/WD/PP/TYP/07
07	Detail of Plot Approach Street - 'O'	U010/WD/PP/PAS/05

Construction of Compound Wall for M/s. Gujarat Hira Bourse