

भूमिगत पाइपिंग हेतु भूमि कार्य
के लिए
मानक विनिर्देशन

STANDARD SPECIFICATION
FOR EARTHWORK
FOR
UNDERGROUND PIPING

2	16.02.06	REVISED AND ISSUED AS STD. SPEC	SKC	NK	VDS	VJN
1	30.09.96	REAFFIRMED & ISSUED AS STD. SPEC	SM	PCS	MMK	A SONI
0	13.6.83	ISSUED AS STD. SPEC.	UCJ	RPB	RCPC	AK
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

cm	CENTIMETRE
m	METRE
mm	MILLIMETRE
K.M.	KILOMETRE
U/G	UNDER GROUND

General Civil Standards Committee

Convenor : Mr.V.D. Soni

Members : Mr.N. Kaul
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Mr.R. Chutani
Mr.M.B. Lal (Strl.)
Mr.V.S. Chhaya (Env.Engg.)
Mr.R. Jain (Constn.)
Vacant (Piping)

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1.0 SCOPE

This specification deals with earthwork in trenches and pits (for valves, manholes, catch pits etc.) for underground piping.

2.0 CODES & STANDARDS

- IS: 783 Code of practice for laying of RCC pipes.
- IS: 1200 (Part-I) Method of measurement of building and civil engineering works.
- IS: 3764 Excavation work – code of safety.
- NOTE:- Latest Edition of all Codes and Standards shall be followed.

3.0 MATERIAL

All workmanship and materials shall conform to the provisions of IS: 1200 (Part-1) and IS: 3764.

4.0 EARTHWORK IN EXCAVATION FOR TRENCHES / PITS FOR PIPELINES

4.1 Excavation

Plant, machinery and equipments for excavation shall be selected and deployed to provide optimum mechanisation in excavation of trenches and pits. The selection for excavation and earth movement machinery etc. shall take into account type of materials to be excavated, method of excavation, prevailing weather conditions and type of transport to be used.

The excavation of area of cut shall be so timed that the bottom level is not exposed to the deteriorating influence of the weather for longer duration.

Excavation and earth moving equipment shall be deployed such that minimum damage is caused to the natural sub-soil structure of exposed formations.

The monitoring of soil deformations, ground water levels during and possibly after construction work shall be taken into consideration.

In the event, when excavation works are carried out in the vicinity of structures of any importance, the above monitoring shall be carried out within a distance, from the edge of the excavation of 5 to 15 times the excavation depth, depending upon the subsoil conditions and the stability of the neighboring structures.

- 4.2 Trenching work shall be carried out in all classes of soil including soft rock and excluding hard rock and shall be for all depths.
- 4.3 The trench shall be cut true to the line and level as per drawings.
- 4.4 If the trench is excavated below the required level than that indicated in the drawing, the extra depth shall be filled with concrete 1:5:10 or approved equivalent materials, as directed by the Engineer-in-Charge, at no extra cost to the owner.

- 4.5 In case of pressure piping, the trench shall be excavated generally as to provide a cover of 1000 mm or dia of pipe whichever is more. In case of gravity sewers/ pipes, the trench shall be excavated to conform to invert levels as per drawings. However in certain cases, the pipes may run at shallower levels or at deeper levels depending upon drawing, site condition etc. No rebate for lesser excavations, nor extra payment due to deeper excavations, shall be admissible in those cases where pipeline laying rates are inclusive of earthwork items. The rates quoted shall be deemed to cover all works connected with trenching, whether trenches are with single pipeline or have multiple pipelines in common trenches including road cutting and making good the same.
- 4.6 The width of the trench shall be sufficient to give free working space of personnel, equipment, supports and ancillaries on each side of the pipe. The free working space shall conform to IS: 783. Generally it shall not be less than 150 mm on either side or 1/3 dia of outer diameter of the pipe, whichever is greater.
- 4.7 When pipelines are running parallel, whether the trenching shall be individual or common, shall be decided by the Engineer-in-Charge and such decision shall be final and binding on the contractor. No extra shall be payable for common excavations.
- 4.8 All earthwork involved in excavations of all types of manholes, catch pits, valve chambers, inspection chambers, chambers for instrumentation tapping etc., which are coming on the alignment of U/G piping or as defined by drawing as a part of U/G piping work, shall be paid extra under Earth work in excavation, back filling and removal of surplus earth etc. under relevant clauses of the SOR.
- 4.9 Aspects such as variations in the soil conditions and the geological structure, depth of excavation, the existence of ground water and surface water, the type and extent of excavation, the topography of site, the proximity of items such as roads, buildings and buried services, construction traffic and activities near the excavation eg. stock piling shall be taken into account when determining whether the sides of excavation should be free standing, sloping or temporary supported.
- Suitable drainage and / or dewatering system like Well Point method / Bore well method etc. shall be provided to prevent or limit ingress of surface or sub surface water into excavation.
- Serviceable materials intended for reuse should be used as soon as possible after excavation otherwise they should be stock piled at a location beyond 1.5m from the top edge of the excavation or beyond a distance equal to the depth of the excavation whichever is higher at a location approved by the Engineer-in-charge. If excavated serviceable material is not possible to be stacked within the limits specified above, due to some constraint, it shall be stacked away at a location approved by Engineer-in-Charge and paid separately under relevant item.
- Areas used for temporary stockpiling of excavated material shall be kept clean and orderly, with excavated material kept by the side of road to avoid traffic movement. Excavated areas shall be restored to their original condition before completion of works.
- All types of shoring and strutting, wherever necessary, shall be adopted to with hold the face of earth or cutting in slope, as per site requirements and direction of Engineer-in-Charge. Supports shall be maintained such that the integrity of the sides of the excavation is not impaired.
- 4.10 Any obstacle encountered during excavation shall be reported immediately to the Engineer-in-Charge and shall be dealt with as instructed.
- 4.11 The contractor shall maintain all excavated trenches and pits, in a dry and trim condition.

- 4.12 Necessary barricading and protection of slopes against slips due to traffic movement shall be provided to the satisfaction of Engineer-in-Charge. Necessary warning flags and lights shall be provided to caution traffic in the areas where trenches and/ or pits are provided.
- 4.13 In case of road cutting, all road material i.e. metal etc., shall be taken out carefully and kept separately for reuse and road work shall be redone up to the original level, as it was prior to cutting the road, with the excavated road materials after laying and testing of the pipeline, within 10 days from the date of starting this work, at the cost of the contractor. The contractor shall provide suitable warning signs and barricades to prevent accidents.

Contractor shall also provide reasonable bye pass at his own cost when a road is cut for laying pipeline. Tankage dykes cut due to laying of the pipes, shall be redone conforming to the original specifications, by the Contractor at his own cost. Secondary dykes, to take care of any eventuality during construction, shall be provided by the Contractor at his own cost.

- 4.14 Dewatering shall be done in advance of the installation of the pipe to allow adequate inspection of padding of the bottom, if required. Dewatering shall be continued throughout during installation and backfilling.

The trench shall follow the gradient of pipeline as specified in the drawing. The contractor shall keep the trench in good condition, until the pipe is laid and tested. No extra claim shall be entertained due to its caving or setting down, either before or after the pipe is laid.

In case, pipe is lowered in caved trench and backfilled before being inspected by the Engineer-in-Charge, the Contractor shall re-excavate the trench for inspection and backfill it at his own cost.

5.0 BACKFILLING AND COMPACTION IN TRENCHES AND AROUND VALVE PITS, MANHOLES ETC.

Backfilling

Trenches shall be back filled with suitable materials which should be compacted to the same degree or better as the surrounding soils.

- 5.1 The soil used should be selected and approved by Engineer-in-Charge. Suitable material can be extracted from available excavated material. The soil should be free from rubbish, grass, organic matter, stones, building waste and Black Cotton Soil etc. It should be free from clods and hard lumps. In case good soil is not available from excavated material for back filling, trench shall be filled back with locally available coarse sand upto 30 cm. thick above the pipe and rest of trench shall be filled back with excavated soil upto required level.
- 5.2 The filling should commence only after approval of Engineer-in-Charge is obtained and after the structures or pipes to be buried are tested and approved. Otherwise, if required, contractor shall uncover buried portion and refill at his own cost.

Temporary excavation supports should be removed as back filling and compaction proceeds, such that unacceptable movement of the supported ground does not occur.

Voids caused by extracted supports should be filled and compacted.

- 5.3 Filling should be done in layers. Each layer should be not more than 15 cm thick when loose and should be well rammed, with necessary watering, to obtain at least 90% of maximum laboratory dry density.

Compaction trials should be carried out on each soil type to be placed in backfill, in order to confirm the type of machine and number of passes required to obtain optimum compaction for given soil moisture contents. These trials should also be used to determine the variability of the proposed fill material for different weather conditions.

- 5.4 Care must be exercised to protect cables, pipes, joints, and other features from damage due to backfilling and consolidation.
- 5.5 Filling should extend up to the level of original ground surface or as per drawing or as directed by Engineer-in-Charge. The finished surface should be properly trimmed and dressed. The adjoining area should be cleaned and no heaps of surplus earth should be left out.

6.0 TRANSPORTATION OF SURPLUS EARTH

Unserviceable materials and serviceable materials not intended for re-use shall be removed from the work site and disposed off at a location as approved by Engineer-in-charge.

The surplus earth is generated due to pipe laying, valve chambers, and manhole construction etc. Surplus earth is also generated due to voids in the back filled volume of earth. The removal of surplus earth shall include excavation, loading, transportation, dumping, stacking or spreading, as per the directions of Engineer-in-charge.

7.0 PAYMENT

- 7.1 Unless specifically stated in the schedule of rates, no separate payment for earthwork in excavation, backfilling, transportation, dewatering etc. shall be admissible and the payment for the same is deemed to have been included in the relevant items of the contract.
- 7.2 In case payment for earthwork is specified separately in the Schedule of Rates, the payment shall be based on the actual quantity of excavation, backfilling and transportation done, taking into consideration the slopes authorised by the Engineer-in-Charge for excavation, volume of backfilling calculated on the basis of excavation reduced by the volume of pipes.
- 7.3 In cases where hard rock excavation is involved, the matter shall be referred to Engineer-in-Charge, before proceeding with the work.

सड़को एवं लचीले पेवमेंटो हेतु मानक विनिर्देशन (डब्लू. बी. एम. सतह तक)

STANDARD SPECIFICATION FOR ROADS AND FLEXIBLE PAVEMENTS (UPTO WBM LAYER)

6	12.03.08	REVISED AND ISSUED AS STD. SPEC.	GAURAV	RKS	NK	VC
5	11.04.01	REVISED AND ISSUED AS STD. SPEC.	RC	PCS	MMK	MI
4	15.11.99	REVISED AND ISSUED AS STD. SPEC.	RB	PCS	MMK	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

IS	INDIAN STANDARD
mm	MILLIMETER
WBM	WATER BOUND MACADAM
IRC	INDIAN ROAD CONGRESS
cm	CENTIMETER
P I	PLASTICITY INDEX

General Civil Standards Committee

Convener: Mr. N.Kaul

Members: Mr. Ravi Bhargava
Mr. Vipin Goel
Mr. R.K Sharma
Mr. P.K Mittal (Strl.)
Mr. V.S. Chhaya (Env.Engg.)
Mr. Anil Bhatia (Constn.)
Mr. P.V.R Murthi (Piping)
Mr. S. Kaul (Projects)

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1.0 SCOPE

This specification covers the material and construction details for earthwork in filling for embankments, filling with sand/murum, WBM sub-base, WBM base course and shoulders for roads and flexible pavements.

2.0 REFERENCES

2.1 Codes & Standards

IS: 460	Specifications for Test Sieves
IS: 2720	Methods of Test of Soil
IRC: 19	Standard Specification and Code of Practice for Water Bound Macadam
IRC: 36	Recommended Practice for the Construction of Earth Embankments for Road Works

2.2 Specifications

Specifications for Road and Bridge Works – Ministry of Surface Transport (Road Wing)

NOTE: -Latest Edition of all Codes, Standards and Specifications shall be followed.

3.0 CONSTRUCTION OF EMBANKMENTS SUBGRADE AND SHOULDERS

3.1 Materials

Only those materials, considered suitable by the Engineer-in-Charge shall be employed for the construction and that considered unsuitable shall be disposed off as directed by Engineer-in-Charge at contractor's cost and no claim for compensation will be entertained. The Contractor shall give the samples of earth, he proposes to use for filling along with the following characteristics of the sample to Engineer-in-Charge prior to collection and use, for approval.

- i) Mechanical analysis or grain size analysis as per IS: 2720 Part IV.
- ii) Liquid limit as per IS: 2720 Part V.
- iii) Plastic limit as per IS: 2720 Part V.
- iv) Moisture density relationship as per IS: 2720 Part VIII.

The material (soil) used for filling shall be free from boulders, lumps, tree roots, rubbish or any organic deleterious matter.

Material (soil) having plasticity index less than 20 shall be used for filling purposes. Soil having laboratory maximum dry density of less than 1.5gm/cc shall not be used. Care shall be taken to see that unsuitable waste material is disposed off in such a manner that there is no likelihood of its getting mixed with the materials proposed to be used for filling.

The work shall be so planned and executed such that the best available material (soil) is reserved for the top portion of embankment.

3.2 Filling and Compaction

- 3.2.1 The area where filling is to be placed must be cleared of all loose material and virgin soil must be exposed. Such exposed surface must be consolidated properly to obtain 95% of maximum laboratory dry density of the soil as per IS: 2720 Part VIII. All soft patches must be worked out to remove the soft soil and selected approved earth must be filled back and compacted.
- 3.2.2 Payment for the removal of loose top soil as described in clause 3.2.1 above shall be included in the item for earthwork in filling. No separate payment for consolidation of exposed ground surface will be made. The rate quoted for the earth fill shall be inclusive of the cost of clearing and stripping, consolidation, including watering, testing etc. of the exposed ground.
- 3.2.3 Approved fill material shall be spread in uniform layers not exceeding 20 cm in loose depth for embankment filling. Shoulder construction shall be so organised as to keep pace with the construction of different layers of the pavement, which may require earth fill thickness less than 20 cm. All clods, lumps etc. shall be broken before compaction.
- 3.2.4 In general the soil shall be spread uniformly over the entire width of embankment or shoulder as the case may be. For large embankments, the spreading of soil shall be as directed by Engineer-in-Charge.
- 3.2.5 Successive layers of filling shall not be placed until the layer under construction has been thoroughly compacted to satisfy the requirements laid down in this specification.
- 3.2.6 Prior to rolling, the moisture content of material shall be brought to within plus or minus 2% of the optimum moisture content as described in IS: 2720 - Part-VIII. The moisture content shall preferably be on the wet side for potentially expansive soils.
- 3.2.7 After adjusting the moisture content as described in Clause 3.2.6, the layers shall be thoroughly compacted by means of 8-10T rollers or equivalent vibratory rollers till 95% of maximum laboratory dry density for embankment and 97% of maximum laboratory dry density for sub-grade as per IS:2720 Part VIII is obtained.
- 3.2.8 Each layer shall be tested in field for density and accepted by Engineer-in-Charge subjected to achieving the required density before laying the next layer. A minimum of one test per 500m² area for each layer shall be conducted.
- 3.2.9 All type of rollers that should be employed for compaction shall be as per direction of Engineer-in-Charge.
- 3.2.10 If the layer fails to meet the required density, it shall be reworked or the material shall be replaced and method of construction altered as directed by Engineer-in-Charge to obtain the required density.
- 3.2.11 The filling shall be finished in conformity with alignment, levels, cross-sections and dimensions as shown in the drawings.
- 3.2.12 Extra material shall be removed and disposed off as directed by Engineer-in-Charge.

3.3 Tolerance

Embankment and shoulders for roads, units etc. shall be carried to within a tolerance of plus minus 2.5 cm. from final lines but shall be to required grades and slopes.

4.0 FILLING WITH SAND/MURRUM

4.1 Sand for filling shall preferably be locally available sand, clean and free from any chemical or other impurities. Murrum for filling shall be clean and well graded. Sand/Murrum shall not contain any vegetation, organic, clayey or other material and shall be obtained from a source approved by Engineer-in-Charge.

4.2 Murrum/Sand shall be spread in layers not exceeding 15 cm in loose thickness over the areas. Each layer shall be uniform in density, quality of material and moisture content before compaction. The moisture content shall be within two percent of the optimum moisture content as per IS: 2720 Part VIII.

4.2.1 In case of pure sand, flooding with water is permissible.

4.3 Compaction of each layer shall be by mechanical means as per directions of Engineer-in-Charge. Only in accessible reaches shall be worked manually. Each layer shall be uniformly compacted to obtain 85% relative density in case of sand and 95% of maximum laboratory dry density in case of murrum. If the material fails to achieve the required density, the layer shall be reworked with necessary alteration in compaction, so that the required compaction is obtained. A minimum of one test per 500 m² area for each layer shall be conducted.

4.4 Subsequent layers shall be placed only after the layer already laid has been compacted to the required density-and approved by Engineer-in-Charge.

4.5 The finished surface must be dressed to required grade and slope. Excess material must be removed from compaction site, as directed by Engineer-in-Charge.

5.0 WATER BOUND MACADAM SUB BASE/BASE COURSE

The sub-base course shall consist of one or more layers, each of 100 mm compacted thickness.

The base course shall consist of one or more layers, each of 75 mm compacted thickness.

5.1 Materials

5.1.1 Stone Aggregate for WBM

5.1.1.1 The coarse aggregates shall be hard, crushed or broken stone metal from quarries approved by Engineer-in-Charge, it shall be hard durable and free from flat elongated, soft and disintegrated particles. It shall not have excess of dirt and other objectionable matter. The quality, size and grading of the coarse aggregate shall be conforming to IRC: 19.

- a) The grading of the coarse aggregates for the sub-base course shall be as below:

Size Range	Sieve Designation (IS: 460)	% by weight passing the sieve
90mm to 45mm	125mm	100
Grade-I	90mm	90-100
	63mm	25-60
	45mm	0-15
	22.4mm	0-5

- b) The grading of the coarse aggregate for the base course shall be as below:

Size Range	Sieve Designation (IS: 460)	% by weight passing the sieve
63mm to 45mm	90mm	100
Grade-2	63mm	90-100
	53mm	25-75
	45mm	0-15
	22.4mm	0-5

- c) Physical requirement of coarse aggregates for sub-base course shall be as below:

- | | | |
|-----|---------------------------|---------------|
| i) | Los Angles Abrasion Value | 50% (Maximum) |
| | or | |
| ii) | Aggregate Impact Value | 40% (Maximum) |

- d) Physical requirement of coarse aggregates for base course shall be as below:

- | | | |
|-----|---------------------------|---------------|
| i) | Los Angles Abrasion Value | 40% (Maximum) |
| | or | |
| | Aggregate Impact value | 30% (Maximum) |
| ii) | Flakiness index value | 20% (Maximum) |

Samples of test shall be representative of the material to be used and collected as per IS: 2430.

5.1.1.2 The aggregates shall be unloaded at the road side on firm, well drained ground, as directed by Engineer-in-Charge. The various grades shall be placed separately and contamination by earth and other extraneous matter shall be prevented effectively.

5.1.2 Screenings

5.1.2.1 Screening to fill voids in the course aggregates shall, as far as possible be the same material as the course aggregates where it is decided by the Engineer-in-Charge to use other materials, the same shall be predominantly non plastic materials such as kankar nodules gravel (other than river-borne rounded aggregate) or murrum provided that the liquid limit and plasticity index of such material is below 20 and 6 respectively and the fraction passing 75 micron sieve does not exceed 10 percent.

Grading Requirement of Screening

Size of Screening	Sieve Designation (IS: 460)	Percentage by Weight Passing the Sieve
13.2mm	13.2mm	100
	11.2mm	95-100
	5.6mm	15-35
	180micron	0-10

This grading, however, shall not be mandatory, in case either murrum or gravel is used as screening.

For procurement of quantities for course aggregates and screenings required for 100mm and 75mm compacted thickness of WBM sub base course and base course shall be as per the IRC- 19.

5.1.3 Binding Material

Binding material, to prevent revelling of WBM, shall consist of fine grained material possessing P.I value up to 6.

Application of binding material shall not be necessary where murrum or gravel is used as screenings.

Binding material shall be obtained from quarries/ sources approved by the Engineer-in-charge.

5.2 Laying of WBM

5.2.1 Spreading Course Aggregates

5.2.1.1 The sub grade or sub-base to receive WBM course shall be prepared to the required grade and camber. Before starting with WBM construction, side shoulders shall be constructed in advance to a thickness corresponding to the compacted layer of the WBM course for lateral confinement of aggregate. After shoulders are ready, their inside edge shall be trimmed vertical to receive the aggregate. The practice of constructing WBM in a trench section excavated on the embankment/formation must be avoided.

5.2.1.2 The coarse aggregate shall be spread uniformly and evenly on the prepared base in required quantities from the stacks. The aggregate shall be spread to proper profiles by using templates across the road about 6 m apart.

5.2.1.3 The surface of the aggregate spread shall be carefully, trued up and all high or low spots remedied by removing or adding aggregate as may be required. The surface shall be checked from time to time, during the spreading and rolling of the coarse aggregate to ensure a finished surface without variation greater than 12 mm, when a 3 meter long straight edge is laid parallel to centre line of the road.

5.2.1.4 The WBM layer shall be tested by depth blocks. No segregation on large or fine particle shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pocket of fine materials.

5.2.1.5 The coarse aggregate shall not be spread in lengths more than 3 days average work in advance of the rolling, spreading murrum and bonding of the preceding section.

5.2.2 Rolling Road Metal

- 5.2.2.1 Immediately following the spreading of the coarse aggregates, it shall be compacted to full width by rolling with either three wheeled power roller of 8 to 10 tonne weight or equivalent vibratory roller true to the line and camber as shown in the drawing. The course shall not be rolled when the sub-grade is soft or yielding or the rolling causes a wave like motion in the base course or sub-grade. When rolling develops irregularities that exceed 12mm when tested with a 3 meter straight edge, the irregular surface shall be loosened and then aggregate added to or removed from it as required and the area rolled until it gives uniform surface conforming to the desired cross-section and grade. The surface shall also be checked transversely by template and any irregularities corrected as above. The use of murrum to make up depression shall not be permitted.
- 5.2.2.2 The rolling shall begin from edges with roller running forward and backward until the edges have been firmly compacted. The rolling shall then progress gradually from edges to the centre parallel to the centre line of the road lapping uniformly each preceding rear wheel track by one half width and shall continue until the entire area of the course has been rolled by the rear wheel. On the super elevated portions of road, the rolling shall commence from the lower edge and progress gradually towards the upper edge of the road.
- 5.2.2.3 Rolling shall be discontinued when aggregate are thoroughly keyed and creating of stone wheel of roller is no longer visible partially compacted with sufficient void space in them to permit application of screenings. Slight sprinkling of water may be done if required.

5.2.3 Application of Screening

- 5.2.3.1 After the coarse aggregate has been rolled as described in Clause 5.2.2, screenings shall be applied uniformly and gradually over the surface to completely fill the interstices. Dry rolling shall be continued while the screenings are being spread so that the jarring effect of the roll will cause them to settle into the voids of the coarse aggregates.
- 5.2.3.2 The screenings shall not be dumped in piles on coarse aggregate but shall be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanic spreaders.
- 5.2.3.3 The screenings shall be applied at a uniform and slow rate (in three or more applications so as to ensure filling of all voids. Rolling and brooming shall continue with the spreading of the screenings. Either mechanical brooms or hand brooms or both may be used. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface making the filling of voids difficult or preventing the direct bearings of the roller on the coarse aggregates. The spreading, rolling and brooming of screenings shall be performed on sections which can be completed within one day's operation and shall continue until no more screenings can be forced into the voids of the coarse aggregates. Damp and wet screening shall not be used under any circumstances.
- 5.2.3.4 The quantity of screenings used shall be such as to fill all voids in the water bound macadam courses.

5.2.4 Sprinkling and Grouting

- 5.2.4.1 After spreading the screening, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling shall be continued and additional screenings applied where necessary until the coarse aggregates are well compacted and grout of screenings and water form a wave ahead of wheels of the roller. Care shall be taken to see

that the base of the sub-grade does not get damaged due to the addition of the excessive quantity of water during the construction.

5.2.5 Application of Binding Material

- 5.2.5.1 After the application of screenings as described above, the binding material shall be applied at a uniform and slow rate (in two or more successive thin layers) so as to ensure filling of all voids.

After each application of binding material, the surface shall be copiously sprinkled with water and the resulting slurry swept in with hand brooms/ mechanical brooms or both so as to fill the voids properly. This shall be followed by rolling with a 8-10 tone roller during which water shall be applied to the wheels to wash down the binding material that may get stuck to them. The spreading, rolling and brooming of binding material shall be performed on sections which can be completed within one day's operation and shall continue until no more binding material can be forced into the voids of the coarse aggregates and until the slurry of the binding material and water forms a wave ahead of the wheels of moving roller. Damp and wet binding material shall not be used under any circumstances.

- 5.2.5.2 The quantity of binding material used shall be such as to fill all voids in the water bound macadam.

5.2.6 Setting and Drying

After final compaction of the course, the layer shall be allowed to dry overnight. Next morning, hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set.

5.2.7 Subsequent Layers of WBM

Before laying the subsequent layers of WBM, the surface shall be scarified and reshaped to the required camber and profile, and all ruts, depressions, pot holes etc. made good. The second layer shall be laid after the surface preparation is approved by Engineer-in-Charge. The specification and mode of measurement for subsequent layers of WBM will be similar to that described before.

6.0 CONSTRUCTION OF SHOULDERS OR BERMS

After the WBM course is laid and compacted, the existing surface at side berms or shoulders of the roadway must be scarified. Fresh quantity of approved earth must be spread in layers for building up of berms upto the required level and scope.

The earth must be consolidated by at least three passes of an 8-10 tonne road roller. The edges must be well compacted by suitable means to prevent edge slips and the work properly trimmed and dressed.

7.0 PAYMENT

7.1 Filling in Embankment, Sub Grade and Shoulders

- 7.1.1 Payment for filling shall be made on cubic meter of volume calculated on the basis of cross section plotted from the level of the ground surface prepared as described in clause 3.2 above and from where filling is to be carried out and the levels reached after filling and due consolidation.

- 7.1.2 Rates for embankment, shoulder or fill formation shall include cost of breaking clods, watering, consolidation, providing testing apparatus and testing the degree of consolidation, providing and operating, including POL and operator charges of necessary road rollers and other equipment, dressing and levelling of sides and top surfaces etc.

7.2 Filling with sand / murrum

Payment for sand/murrum filling shall be made on the basis of volume of fill, after placement and compaction. The rate quoted shall include cost of sand/murrum, royalties, transportation, handling, compacting, watering, testing at various stages, dressing, removal of surplus material and any other work incidental to this.

7.3 Water Bound Macadam Sub Base/ Base Course

Paying for laying WBM shall be made on square meter basis of each layer of WBM laid, measured after consolidation and finishing. Rate shall include supply of all materials, royalty, taxes, handling, transportation, spreading metal in layers, including screenings, consolidation by power roller, binding with murrum or other approved binding material, cost of carrying the material to work for all leads and lifts, providing and running roller etc. complete as per specifications and satisfaction of Engineer-in-Charge.

7.4 Subsequent layers of WBM

Payment for surface preparation, rectification of damaged portions of Proceeding layers of water bound macadam and filling in ruts and depressions shall be made in M2 or M3 as % per schedule of items. Payment for subsequent layer of WBM shall be made on M2 basis as per Cl. No.5.2.6.

- 7.5 The payment clause(s) as described in the above clauses shall not be referred / applicable for LSTK Jobs

कंक्रीट पेवमेंट हेतु मानक विनिर्देशन

STANDARD SPECIFICATION FOR CONCRETE PAVEMENT

2	20.01.05	REVISED AND ISSUED AS STD. SPEC.	GG	SKC	VDS	SKG
1	15.7.98	REVISED AND ISSUED AS STD. SPEC.	PCS	RJAIN	MMK	ASONI
0	31.3.82	ISSUED AS STANDARD SPECIFICATION	RP	RPB	HVR	RCPC
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

IS	INDIAN STANDARD
WBM	WATER BOUND MACADAM
RCC	REINFORCED CEMENT CONCRETE
PCC	PLAIN CEMENT CONCRETE
mm	MILLI METER
Kg/cm ² /cm	KILOGRAM/SQUARE CENTIMETER/CENTIMETER
M.S.	MILD STEEL
°C	DEGREE CELCIUS
BS	BRITISH STANDARD
Cl.	CLAUSE

General Civil Standards Committee

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Mr. VS. Chhaya (Env.Engg.)

Mr. R. Jain (Constn.)

Mr. B. Halder (Piping)

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1.0 SCOPE

This specification establishes the requirements of material, laying and finishing of concrete pavements.

2.0 REFERENCE CODES AND SPECIFICATIONS

IS: 456-	Plain and Reinforced Concrete-Code of Practice.
IS: 1834-	Specification for Hot Applied Sealing Compounds for Joints in Concrete.
IS: 1838, Part-1-	Specification for Preformed Fillers for Expansion Joints in Pavements and Structures (Non Extruding and Resilient Type): Part 1 Bitumen Impregnated Fibre.
IS: 2720, Part-8-	Method of Test for Soils-Part 8: Determination of Water Content-Dry Density Relation Using Heavy Compaction.
IS: 9214-	Method of Determination of Modulus of Sub-grade Reaction (k value) of Soils in the Field.
7-65-0404	RCC pavement Details.
6-65-0018	Standard Specification for Roads and Flexible Pavement (Upto WBM Layer)
6-68-0002	Technical Specification - Civil & Structural Works - Materials.
6-68-0004	Technical Specification - Civil & Structural Works – Plain and Reinforced Cement Concrete.

In case of conflict between the Clauses mentioned in this Specification and those in above Codes And Specifications, this Specification shall govern.

3.0 MATERIALS

- 3.1 Material for Cement Concrete viz. Cement, Sand, Coarse and Fine aggregate and water, Reinforcements Bars, Embedment, Inserts and Admixture etc. shall be as described in EIL Specification no. 6-68-0002.
- 3.2 Material for WBM shall be as described in EIL Specification no. 6-65-0018.

4.0 GRADES, TYPE OF CONCRETE MIX, PROPORTIONING AND BATCHING

- 4.1 The grades of concrete shall be as follows:
 - Type-I Pavement - M30
 - Type-II Pavement - M25
 - Type-III Pavement - M25
- 4.2 Specification for Concrete mix, Mix Proportioning and Batching shall be as described in EIL Specification no. 6-68-0004 and IS: 456.

5.0 EQUIPMENTS

All equipments like sub grade templates, hand tempers, vibrating screens, internal vibrators, longitudinal floats, bridges, push brooms, straight edges, edging tools etc. shall be on the worksite in first class working condition and shall have been inspected by the Engineer-in-Charge before paving operations are permitted to start. Throughout the construction period, the contractor shall maintain adequate equipment in first class working conditions to ensure the proper execution of the work.

6.0 PREPARATION OF SUB GRADE

- 6.1 The area where concrete is to be placed must be cleared of all loose material and virgin soil must be exposed. Such exposed surface must be consolidated properly to obtain 95% of Maximum Laboratory Dry Density of the soil. All soft patches must be worked out to remove the soft soil and selected approved earth must be filled back and compacted.
- 6.2 For areas, where pavement is to be laid on cutting / natural grade level, Sub grade shall be thoroughly compacted to 95% of laboratory dry density as per IS: 2720 Part VIII. For filled up areas, top 450 mm of the soil shall be compacted to 95% of laboratory dry density below pavement in layers of 150 mm.
- 6.3 The difference between the sub grade levels of Type-I, Type-II and Type-III Concrete pavements (due to difference in thickness of Type-I, Type-II and Type-III pavements) shall be achieved by stripping the grade level and not by filling. Hence, site-grading level below pavement shall be kept up to sub grade level of Type-II or Type-III as the case may be, to avoid filling of smaller thickness at later stage.
- 6.4 The sub grade or sub base for laying of the concrete pavement shall comply with the following requirements:
- 6.4.1 No soft spots shall be present in the sub grade.
- 6.4.2 The uniformly compacted sub grade or base course shall extend at least 300mm on either side of the area to be concreted.
- 6.4.3 The sub grade shall be properly drained.
- 6.4.4 The minimum modulus of sub grade in wet condition, reaction obtained with a Plate Bearing Test as per IS: 9214, shall be $6.0 \text{ Kg/cm}^2/\text{cm}$.
- 6.4.5 Sub grade shall be prepared to the lines and grades to match with the slope of pavement as shown on the drawings.

7.0 PREPARATION OF SUB BASE

- 7.1 WBM under Type-1 Pavement (Ref. EIL Standard Drawing No. 7-65-0404)
- WBM Base Coarse shall consist of 2 layers of WBM Gr.-II, each of 75mm compacted thickness, as per IRC-19 and described in EIL Specification no. 6-65-0018.
- 7.2 PCC 1:5:10 under Type-II and Type-III Pavement (Ref. EIL Standard Drawing No. (7-65-0404))
- 7.3 PCC 1:5:10 in sub base layer shall be as described in EIL Specification no. 6-68-0004.
- 7.4 Sub Base layer shall be prepared to the lines and grades to match with the slope of pavement as shown on the drawings.
- 7.5 No concrete shall be placed around manholes or other structures until they have been brought to required grade and alignment. All sides of manholes / pits etc. shall have same elevation.
- 7.6 The sub base layer shall be in moist condition at the time of concrete placement.

8.0 FORMS

8.1 All side Forms shall be of mild steel unless use of wooden sections is specially permitted. The steel forms shall be of MS channel sections and their depth shall be equal to thickness of the pavement. The sections shall have a length of at least 3.0m except on curves, where shorter sections may be used. These forms should be provided with ample bracing and supports to prevent the springing of the forms under the concrete pressure or thrust of machinery operating nearby.

8.2 The forms should be in a sufficient number and they should not be removed until concrete has hardened sufficiently.

8.3 In case wooden forms are permitted, these shall have minimum base width of 100 mm for 150mm or lesser thick slabs and 150mm for 200mm thick slabs.

9.0 LAYING OF REINFORCEMENT, MIXING, PLACING, COMPACTION & FINISHING AND CURING

9.1 Laying Of Reinforcement

All reinforcement work shall confirm to IS: 456 and as described in EIL Specification no. 6-68-0004.

9.2 Mixing

Mixing shall be as described in EIL Specification no. 6-68-0004.

9.3 Placing

9.3.1 The place where concrete is to be poured should be clean and free from all loose dirt, wooden pieces, dust, standing water etc.

9.3.2 Walking on reinforcement layers is not permissible. Walkways of wooden planks or similar material can be placed with removable supports and should be independent of the reinforcement. The reinforcement position should not be disturbed nor should it sag during carriage and placement of concrete.

9.3.3 Placing and vibration should not take totally more than 20 minutes from time of mixing. Method of placing should be got approved by Engineer-in-Charge. Segregation during carriage and placement should be avoided. If during carriage concrete segregates, it should be remixed before placement.

9.3.4 Concrete should not be dropped from a height of over 1.5m.

9.3.5 To ensure bond and water tightness between old concrete surface and fresh concrete to be placed, the surface should be cleaned and roughened by "initial green cut" by wire brushing or chipping. The initial green may be done by wire brush after 6 hours of placing concrete in order to facilitate the work. Chipping can be done only after 48 hours. A layer of cement slurry with 1:1 mix (1 cement: 1 sand) should be poured to obtain a uniform coating on old concrete. Immediately thereafter, the fresh concrete should be poured.

9.3.6 Concrete shall be mixed in quantities required for immediate use and shall be deposited on the sub-grade in a single operation to the required depth and width of the pavement. Spreading shall be as uniform as possible to avoid re-handling of concrete. Where however, a certain amount of redistribution is necessary, it shall be done with shovels and not with rakes. Concrete shall be vibrated with internal vibrators. Concrete shall be placed continuously until

completion of the part of the work between construction joints or as directed by Engineer-in-Charge continuously until completion of the part of the work between construction joints or as directed by Engineer-in-Charge.

9.3.7 Placing in inclement weather

All precautions shall be taken for concreting in extreme weather in accordance with the relevant clauses of IS: 456. Due protection shall be provided to prevent cement being blown away while proportioning and mixing during windy weather. No concreting shall be carried out in continuous heavy rains. Necessary arrangements to cover the freshly poured concrete shall be provided, to protect it from the direct rays of the sun and from drying winds.

9.3.8 All concreting placement should be co-ordinated with placement of conduits, inserts, embedded parts etc. executed either by same agency or separately.

9.3.9 Concrete shall be laid in panels as shown in the standard drawing or as directed by Engineer-in-Charge.

9.4 Compaction & Finishing

9.4.1 Compaction

The surface of the pavement shall be compacted either by means of power driven finish machine or a vibrating hand screed. For areas where width of the pavement is very small, hand consolidation and finishing shall be done as follows:

9.4.1.1 Concrete as soon as placed, shall be struck off uniformly and screeded to the crown and cross-section shown on the plans and to such level above the base that when compacted and finished, the pavement shall conform to the grade and cross-section indicated by the plans. The entire surface shall then be tamped until a close-knit dense surface is obtained.

9.4.1.2 The Tamper shall rest on the side forms and shall be drawn ahead with a swing motion in combination with a series of lifts and drops alternating with lateral shifts. The aim of this operation is compaction and screeding to the approximate level required. Subsequent tamping should advance 75 mm at a time in the direction in which the work is proceeding and in final stages, the tamping should be closer, about 12 mm at a time, until a level and dense surface is obtained.

9.4.1.3 If so directed by Engineer-in-charge, hand operated vibrating tamper consisting of normal type of hand tamper attached to a pneumatic or electric vibrating unit shall be used for compaction.

9.4.1.4 Segregated particles of coarse aggregate, which collect in front of the tamper, shall be thrown outside the forms or thoroughly mixed by hand with a mass of concrete already on the base.

9.4.1.5 Compaction by tamping shall be carried on till the mortar in the mix just works up to the surface. The surface shall be examined after compaction correction. If needed correction shall be made by adding or removing concrete, followed by further compaction and finishing.

9.4.2 Floating

As soon as practicable, after concrete has been struck off and compacted, it shall be further smoothened and compacted by means of a longitudinal float, 1200 mm long and 75 mm wide, operated from a foot bridge.

9.4.3 Straight Edging

After floating is completed and excess water removed but while concrete is still plastic, the slab surface shall be tested for trueness with a straight edge and rectified, if necessary.

9.4.4 Brooming

After belting and as soon as surplus water has risen to the surface, the pavement shall be given a broom finish to produce corrugations of uniform appearance of not more than 1/16 inch in depth.

9.4.5 Edging

Before the concrete has its initial set, the edges shall be carefully finished with an edger of the radius required and pavement edge shall be left smooth and true to line.

9.5 Curing

Curing of concrete shall be as described in EIL Specification no. 6-68-0004.

10.0 JOINTS

10.1 Wherever called for on the drawings, expansion joints, construction joints and sealing joints shall be provided as per details indicated in the drawing and as directed by Engineer-in-Charge.

10.2 Sealing of Joints

10.2.1 After the curing, the temporary seal or other intruded materials of all expansion and contraction joints shall be removed completely and the slots filled with approved joint sealing compound as conforming to IS: 1834, Type B. The filler material for Expansion and Sealing joints shall be preformed fillers of Bitumen Impregnated Fiber, conforming to IS: 1838, Part-I.

10.2.2 The edges of the joints shall be thoroughly cleaned and primed with a thin bituminous paint, which shall be allowed to dry before the sealing compound is applied.

10.2.3 The primer shall be applied with a brush. The composition of primer shall be as follows:

	Name of Material	Percent by weight
1.	200-Penetration Bitumen Blended	66
2.	Light creosote oil Hot/ Cold	14
3.	Solvent Naphtha	20

The bitumen shall be melted and fluxed with oil. When cold, solvent Naphtha shall be added. BITUMINOUS emulsion shall not be used as primers. Care shall be taken to ensure that the sealing compound is not heated above 200°C and the temperature does not exceed 180°C for long periods.

10.2.4 Sealing compound shall be poured into the joint opening in such a manner that the material will not be spilled on the exposed surface of the concrete. When required to prevent pick up under traffic, the exposed surface of the sealing compound shall be dusted with hydrated lime.

11.0 OPENING TO TRAFFIC

- 11.1 Traffic shall not be allowed for a period of 28 days after laying of concrete in pavement.
- 11.2 Before opening the pavement to traffic, all joints shall be filled and trimmed or topped out as required.
- 11.3 Sampling, testing and acceptance of concrete work shall be according to IS: 456-2000

12.0 METHOD AND BASIS FOR PAYMENT

12.1 Plain and Reinforced Concrete

- 12.1.1 Payment for plane and reinforced concrete in pavements shall be made on cubic metre basis of the volume of the actual finished work done and shall be inclusive of cost of providing Forms, Pockets, Chamfers, Fillets, Grooves, Cement wash, Curing by normal moist curing or using curing compound etc. as directed by Engineer-in-Charge. The rates shall be deemed to include complete cost of getting the respective mix designs approved, making and testing concrete cubes and carrying out other tests including tests of various ingredients, as per specifications and as directed by Engineer-in-Charge.
- 12.1.2 No separate payment shall be made for any admixture used by the contractor for accelerating or retarding the strength of concrete or for achieving specified workability / water tightness. The rate quoted shall be deemed to be inclusive of all costs related to any such additive / admixture.
- 12.1.3 The rate shall however be exclusive of reinforcement, metal inserts, pipe sleeves and any filler material in expansion / sealing joints.
- 12.1.4 Where the strength of concrete mix (nominal or design mix) as indicated by tests, lies in between the strengths of two grades given in Table-1 of EIL Specification No. 6-68-0004 and it is accepted by owner/Engineer-in-charge, such concrete shall be classified as a grade belonging to the lower of the two grades between which it lies. In case the cube strength shows higher results than those specified for the particular grade of the concrete, it shall not be placed in the higher grade nor shall the Contractor be entitled for any extra payment on such account. The concrete giving lower strength than specified may be accepted at reduced rates after satisfying the safety of the structure by checking it with tests as specified or rejected entirely at the discretion of the Engineer-in Charge. The rejected concrete shall be dismantled at no extra cost to the owner and no payment or extension of time shall be granted for the concrete so rejected and the formwork and reinforcement used for the same. Cost of any material supplied by the Owner free of cost shall be recovered from the contractor at double the prevailing market rate. In case the concrete of lower strength can be improved by carrying out some strengthening measures entirely at the discretion of the Engineer-in-Charge, then Contractor shall carry out the said measures including all related tests at his own cost. If the Contractor is able to make up the strength to the required grade by such improvement measures to the entire satisfaction of Engineer-in-Charge, payment shall be made for the grade achieved. However, if the strength of concrete is not made up to the strength of required grade, payment shall be made only for the lower strength if such concrete is accepted by the Engineer-in-Charge.
- 12.1.5 Deductions for openings, pockets etc. shall be as specified in relevant Indian Standard Codes.

12.2 Reinforcement

12.2.1 Payment for plain round mild steel reinforcement bars and high strength deformed steel bars shall be on the basis of weight of bare steel, irrespective of any coating applied, in metric tons. The weight of the bar shall be derived from the sizes and corresponding unit weights given in hand book of Bureau of Indian Standards. Standard hook length, chairs, spacer bars and authorised laps only shall be included in the weight calculated. Binding wire shall not be weighed nor otherwise measured. Measurement for weight shall not include cutting allowance etc.

12.2.2 Rate quoted for reinforcement shall include cost of supplying, decoiling, straightening, cleaning, cutting, bending, placing, binding, welding if required, and providing necessary cover blocks of concrete.

12.3 Joints

Payment for expansion joints, construction joints and sealing joints shall be made on running metre basis. The rate shall include cleaning of joints, filler material and sealing with approved compound, all material, labour etc. complete, as per drawing.

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STANDARD SPECIFICATION FOR UNDERGROUND & ABOVE GROUND G.I. PIPELINE SYSTEM (WATER SERVICES)

3	12.03.08	REAFFIRMED & ISSUED AS STD. SPEC.	GAURAV	RNS	NK	VC
2	15.07.98	REVISED & ISSUED AS STD. SPEC	RC	PCS	MMK	ASoni
1	08.02.91	UPDATED & ISSUED AS STD. SPEC	PCS	RB	RPB	RNS
0	31.03.82	ISSUED AS STD. SPEC.	HQ	RPB	HVR	RCPC
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

IS	INDIAN STANDARD
GI	GALVANISED IRON
Kg/cm ² g	KILOGRAM PER SQUARE CENTIMETER GUAGE

General Civil Standards Committee

Convener: Mr. N.Kaul

Members: Mr. Ravi Bhargava
Mr. Vipin Goel
Mr. R.K Sharma
Mr. P.K Mittal (Strl.)
Mr. V.S. Chhaya (Env.Engg.)
Mr. Anil Bhatia (Constn.)
Mr. P.V.R Murthi (Piping)
Mr. S. Kaul (Projects)

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1.0 SCOPE

This specification covers the fabrication and erection of G.I. pipeline system, both underground and above ground, including excavation, backfilling for the pipeline and testing of completed system.

2.0 CODES AND STANDARDS

IS: 554	Dimensions for pipe threads where pressure tight joints are made on threads.
IS: 778	Copper alloy gate, globe and check valves for water works purposes.
IS: 1239 Part I	Mild steel Tubes, Tubular and other wrought steel fittings.
IS: 1239 Part II	Mild steel Tubes, Tubular and other Wrought Steel fittings. Mild steel Sockets, Tubular and other Wrought steel pipe fittings.

NOTE: -Latest Edition of all Codes and Standards shall be followed.

3.0 MATERIALS

- a) All G.I. piping shall conform to IS: 1239 part I.
- b) All gun metal valves shall conform to IS: 778 Class II.
- c) All G.I. fittings shall conform to IS: 1239 Part II.

The schedule of pipes & fittings shall be as per schedule of items under respective works.

4.0 EARTHWORK IN EXCAVATION AND BACKFILLING ETC.

All earthwork for G.I. lines shall be governed by the provisions of EIL specification 6-65-0006, "Earthwork for underground piping", to the extent applicable. All earthwork in excavation, backfilling and transportation are included in the quoted rates.

5.0 JOINTING AND ERECTION OF G.I. PIPING SYSTEM

5.1 Screw socket Joints.

The screwed end of all GI pipes shall be thoroughly cleaned and painted with a mixture of Red and White Lead or Teflon before jointing. The joint shall be made by winding a few threads of hemp round the ends of tubes and then screwing them into sockets to the full depth of threads. Exposed threads shall be coated with approved anticorrosive paint. No pipe shall be bent / offset to save fittings. The offset in GI pipes shall be made only after the permission of the Engineer-in-Charge. If threaded end of pipe is damaged, the contractor shall cut the end with hacksaw and shall prepare new threads conforming to IS: 554, to required length.

All fittings shall be malleable Galvanised Iron approved by the Engineer-in-charge. Fitting in GI line shall include all couplings, elbows, tees, bends, unions, nipples, reducers, flanges with nuts and rubber insertion and all other fittings to make a complete job.

5.2 Flanged Joints

Flanged joints shall be made by painting the faces of the flanges with red lead and bolting up evenly on all sides with compressed asbestos gasket as per piping material specification.

5.3 Valves

Flanged or screwed valves shall be installed in locations shown on the drawings as per specification for screwed or flanged joints.

6.0 TESTING

All completed G.I. lines shall be hydrostatically tested to a test pressure of 5Kg/cm²g.

7.0 PAYMENT

- 7.1** Payment shall be made on running meter basis of finished pipeline with fitting after testing etc. complete. No separate payment shall be made for earthwork in trenching and backfill, road cutting etc. Payment for valves and flanges etc. shall be made as per schedule of items on unit rate basis. The unions shall be provided at every 50 meter, unless otherwise stated in schedule of items / construction drawing. Rates shall include all incidental work such as transportation of all materials from Owners stores, custody, and fabrication and laying of G.I. piping system.
- 7.2** The payment clause(s) as described in the clause no. 7.1 shall not be referred / applicable for LSTK Jobs

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STANDARD SPECIFICATION FOR FABRICATION AND LAYING OF UNDERGROUND PIPING

3	29.04.08	REVISED & ISSUED AS STD. SPEC	GAURAV	RKS	NK	VC
2	25.06.99	REVISED & ISSUED AS STD. SPEC	RC	PCS	MMK	A SONI
1	01.04.91	UPDATED & ISSUED AS STD.	PCS	PCS	MMK	RPB/RNS
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

ASME : American Society of Mechanical Engineers

CS : Carbon Steel

IS : Indian Standard

LSTK : Lump Sum Turn Key

U/G : Underground

General Civil Standards Committee

Convener: Mr. N.Kaul

Members: Mr. Ravi Bhargava
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Mr. V.S. Chhaya (Env.Engg.)
Mr. Anil Bhatia (Constn.)
Mr. P.V.R Murthy (Piping)
Mr. S. Kaul (Projects)

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1.0 SCOPE

This specification covers the technical requirements for the execution of Piping Fabrication, Assembly and Laying of the underground pipe work defined here under, for water pipe lines.

- i) Fabrication and erection of underground piping systems from piping materials supplied by Owner in accordance with this specification and applicable drawings and standards.
- ii) Testing and flushing.
- iii) Coating of under ground piping.
- iv) Fabrication and erection of drain assemblies.

Underground piping systems shall be fabricated, installed, flushed, and tested in accordance with this specification and applicable codes, drawings and standards. Any deviation from the specification and drawings shall be permitted only after obtaining the written approval of the Engineer-in-Charge.

2.0 CODES & STANDARDS

ASME B31.3 Process Piping.

- | | |
|-----------|---|
| 6-65-0006 | Standard specification for earth work for U/G piping. |
| 6-44-0012 | Standard specification for fabrication and erection of piping. |
| 6-77-0001 | Welding specification for the fabrication of piping |
| 6-77-0005 | Welding specification charts for piping classes |
| 6-79-0011 | Standard specification for corrosion protection tape coating for underground steel piping |

NOTE: - Latest Edition of all Codes and Standards shall be followed.

3.0 FABRICATION

- 3.1 The contractor shall fabricate all the pipe work in conformity with the Standard Specification for Erection of Piping, Specification no. 6-44-0012 and requirements of relevant general arrangement drawings. Where specific details of fabrication are not indicated on the drawings or not specified in the specification, fabrication and erection shall be done in accordance with ASME B 31.3.
- 3.2 The contractor shall be responsible for working to the exact dimensions as shown on the drawings, irrespective of individual tolerances permissible. Where errors and / or omissions occur on the drawings, it shall be the contractor's responsibility to notify the Engineer-in-Charge, prior to fabrication or erection. Dimensional tolerance for fabrication shall be as per EIL standard.

4.0 LAYING OF UNDERGROUND PIPING

4.1 Laying

- 4.1.1 The Contractor shall lay the underground piping in accordance with the following clauses and as per the piping arrangement drawings issued during the course of construction. Corrosion protection tape coating of the underground lines shall be in accordance with Standard Specification no. 6-79-0011.
- 4.1.2 The Contractor shall be responsible for correct layout and gradient of the line. Errors, if any, shall be rectified by the Contractor at his own cost.

4.2 Trenching

- 4.2.1 The trench shall be cut according to the drawing, true to the line, levelled with the help of sight rails provided at every 30 m, at change of direction / gradient and at any suitable distance, as directed by Engineer-in-Charge.
- 4.2.2 If the trench is excavated below the required level as indicated in the drawing, the extra depth shall be filled with concrete 1:5:10 or approved equivalent material, as directed by the Engineer-in-Charge, at no extra cost to owner.
- 4.2.3 The trench shall be excavated so as to provide an average cover of 1000 mm or equal to the diameter of the largest pipe to be laid in the trench, whichever is greater or as shown in drawings. The average cover will be reckoned from top of the pipe of the largest diameter to be laid in the trench, to the finished grade level. The width of the trench shall be sufficient to give free working space on each side of the pipe. The free working space shall conform to specifications. Generally it shall not be less than 150 mm on either side or 1/3 of dia of pipe, whichever is greater.
- 4.2.4 No excavated material shall be deposited within 1.5 meters from the excavated trench.
- 4.2.5 In case of road cutting, all materials i.e. metal, bricks etc., shall be taken out carefully and kept separately for reuse. Road work shall be redone up to the original level and profile with the excavated road materials, after laying and testing of the pipe line, within 10 days from the date of starting the work, at the cost of the contractor. The contractor shall provide suitable slings and barricades to prevent accidents. He shall also provide reasonable by-pass at his own cost when a road is cut for laying pipeline.
- 4.2.6 During excavation, if some obstacle is met with, the same shall be reported to the Engineer-in-Charge and dealt with as instructed by him.
- 4.2.7 The contractor shall do dewatering, shoring, strutting / timbering if required or do whatever might be required to excavate the trench, install the pipe in it and backfill the trench, in accordance with the specifications, at no extra cost to the Owner. Dewatering shall be done in advance of the laying of the pipe, to allow adequate inspection of padding of the bottom, if required. Dewatering shall be continued throughout during laying of the pipe and backfilling of the trench.
- 4.2.8 In muddy / slushy ground, the bed shall be provided with a layer of sand or lean concrete as directed by the Engineer-in-Charge.
- 4.2.9 The trench shall follow the gradient of pipeline as specified in the drawing. The contractor shall keep the trench in good condition, until the pipe is laid and tested. No extra claim shall be entertained due to its caving or settling down, either before or after the pipe is laid. All

materials to shore the trench, in order to prevent caving, shall be furnished and removed by the Contractor, at no extra cost to the Owner.

- 4.2.10 In case pipe is lowered in caved trench and back filled before being inspected by the Engineer-in-Charge, the Contractor shall re-excavate the trench for inspection and backfill it at his own cost.

4.3 Lowering & Laying

- 4.3.1 The pipe shall be lowered by mechanical method when the trench is ready and bottom of the trench is graded as per required pipe laying conditions and specifications.

4.3.2 By Machine

The shop coated pipe already transported to the pipe laying site in convenient length of pipe assembly, near the trench after hydrostatic testing, shall be placed on clean square cut skids suitably spaced, so as to keep the pipe away from touching the ground. The pipe may be lowered down in the trench by the launcher cranes with sufficient care, to protect the coating of the pipeline.

At tie in welds and other site fabrications, the contractor shall clean, prime, coat and wrap manually.

Also short sections of pipelines, which are impracticable to shop-treat, may be hand treated, but only after obtaining prior written approval of the Engineer-in-Charge.

4.3.3 By Hand

Only in unavoidable circumstances and after obtaining approval of Engineer-in-Charge, the pipe may be lowered with the help of tripods and chain pulley blocks into the trench. However, if in the opinion of the Engineer-in-Charge, the temperature condition does not allow direct lowering, then the pipes shall be set down on clean square cut skids. The skids shall be so spaced as to keep the pipe away from touching the ground.

4.4 Method & Time of Lowering Pipe

- 4.4.1 Under favorable temperature conditions and using methods, which will not damage the coating, the pipe may be lowered into the trench.
- 4.4.2 Pipes previously set on skids, because of unfavorable temperature conditions, shall be lowered into the trench normally in the cool of the morning and only when the temperature of the pipes is below the softening point of the coating materials.
- 4.4.3 All skid marks and other places of damage shall be thoroughly examined to ensure proper patching where necessary, before the pipe is finally lowered into the trench.

4.5 Handling Coated Pipe

- 4.5.1 Coated pipe shall not be placed in trench, until cave-in plugs, hard clods, stones, skids and welding rods etc. have been removed from there. Where the trench has a hard or jagged bottom, sufficient fine dirt or sand shall be placed therein, before the pipe is lowered.
- 4.5.2 Coated pipe shall not be handled or moved by means of cable or chains or by prying with skids or bars. It shall be tied and lowered by using belts of a standard width and design, for the size of pipe being handled.

4.5.3 Coated pipe shall not be dragged along the ground or otherwise handled in a manner that will be detrimental to the coating.

4.5.4 Despite all precautions taken during handling of coated pipes, if the coating gets damaged, same shall be recoated by Contractor at site, at his own cost, as per directions of Engineer-in-Charge.

4.6 Lining up & Welding

4.6.1 The ends of the pipeline shall be kept securely closed, to prevent entry of any foreign material/ moisture, after lowering into the trench.

4.6.2 Before making joints the pipe shall be laid carefully, so as to be perfectly aligned, in both plan and profile and the end closures provided shall be removed.

4.6.3 Tie-in shall be made in the coolness of the morning or when the ambient temperature is not exceeding 29°C or softening temperature of the coating material, whichever is less. All bevelling, aligning and welding shall be in accordance with the welding specification given in the tender.

4.6.4 Free access shall be provided for the welding of the circumferential joints by increasing the width and depth of the trench at these points. There should be no obstruction to the welder from any side, so that good welded joint is obtained.

4.7 Testing & Coating

The completed system shall then be tested as per clause 6.0 and the field welded joints coated as per specification 6-79-0011.

4.8 Back Filling

4.8.1 After testing and inspection of the pipeline to the entire satisfaction of the Engineer-in-Charge, the trench shall be back filled with the excavated material. No trench shall be back filled without the approval of the Engineer-in-Charge.

4.8.2 Backfilling with the excavated material shall be done in layers of 200 mm, well watered and rammed to avoid any settling afterwards.

4.8.3 The Contractor shall place soil over the trench to such a height as well as in opinion of the Engineer-in-Charge, to provide adequately for future settlement of the trench backfill.

If due to exigencies of the work, some portion of the pipeline is backfilled without approval of the Engineer-in-Charge, the Engineer-in-Charge shall have the right to order uncovering of the pipe for examination and the cost of such uncovering shall be borne by the Contractor.

4.8.4 The backfill material shall be free from stone pieces.

4.8.5 When the trench has been dug through roads, all backfill shall be thoroughly compacted. In certain cases, special compaction methods may be required by the Engineer-in-Charge. This shall be done by the contractor at no extra cost to the Owner.

4.8.6 When the trench has been dug through unlined ditches, the backfill shall be thoroughly compacted in 150 mm layers for a distance of 1.5m beyond the outside banks of the ditch on either side. The banks of the ditch shall also be compacted in 150mm layers, at no extra cost to the Owner.

- 4.8.7 After the roads have been already graded, and if they are trenched or otherwise disturbed by the Contractor during laying of the pipe lines, the contractor shall restore the road to its original level and condition. In the event the Contractor is required to place extra fill, gravel, or other special materials, it shall be done by him without any extra cost to the Owner.

4.9 Clean up of Surroundings

- 4.9.1 As soon as the backfill is completed, the contractor shall immediately clean up the adjoining area by removing all surplus and defective material and dispose off all refuse such as spurs, sheet-iron and broken skids and surplus excavated earth etc., at his own cost, to the entire satisfaction of the Engineer-in-Charge.
- 4.9.2 The earth on both sides of the pipeline trench, which has been disturbed during the construction of the pipe line, shall be smoothened and left in a condition to the entire satisfaction of Engineer-in-Charge.

5.0 INSPECTION

5.1 General

- 5.1.1 Owner's inspector shall have free access to all places where the work is being done or any other thing and place concerned with the work.
- 5.1.2 Owner is entitled to send his own inspector to field or shops, where prefabrication and erection of pipe lines are being done, with the following functions but not limited to:
- i) To check that the welding performance and welding equipment used on the job are suitable and conform to relevant standards.
 - ii) To supervise welding procedure qualification.
 - iii) To supervise welder performance qualification.
 - iv) To check whether welding is conforming to relevant specification and the practice followed is in accordance with good pipeline construction practice.
 - v) To check any other performance to ensure quality of work.
- 5.1.3 Contractor shall notify sufficiently in advance the commencement of qualification tests, welding work and acceptance tests, to enable the Owner's Inspector to supervise the same.
- 5.1.4 Contractor shall provide all the facilities to Owner's Inspector, necessary for carrying out his work, at no extra cost to the Owner.
- 5.1.5 Approval from the Owner's Inspector shall not relieve the contractor partially or fully of his responsibilities and guarantees under this contract.

6.0 TESTING

6.1 General

- 6.1.1 The field test pressure shall not be less than the greatest of the following:
- a) 1.5 times the maximum sustained operating pressure.
 - b) 1.5 times the maximum pipeline static pressure, and

- c) Sum of the maximum sustained operating pressure or the maximum pipeline static pressure and the maximum calculated surge pressure.

The field test pressure shall, wherever possible be not less than two thirds of the work test pressure, and shall be applied and maintained for at least four hours.

Where the field test pressure is less than two-thirds the works test pressure, the period of test shall be increased to at least 24 hours. The test pressure shall be gradually raised at the rate of nearly 1.0 kg/cm²/minute.

- 6.1.2 The testing shall be carried out in convenient section as approved by the Engineer-in-charge. The joints of the pipe, connecting the testing sections, shall be 100% radiographed.

If some defect is noticed during the hydrostatic testing, the same shall be brought to the notice of Engineer-in-Charge. Joints, if leaking, shall be rectified as per the welding specifications and instructions of Engineer-in-Charge and tested to his satisfaction, at no extra cost to the Owner.

- 6.1.3 The Engineer-in-Charge shall be notified in advance by contractor of all testing. The hydrostatic testing / flushing of all the piping shall be carried out by the Contractor, at his own cost.

- 6.1.4 Contractor shall make his own arrangements for flushing, at suitable points, as per the instructions of the Engineer-in-Charge. Any extra work / modification on this account shall be done by the Contractor at his own cost.

6.2 Test Medium

Construction water shall generally be used as the testing medium, for the hydrostatic testing of piping system.

6.3 Cleaning

All systems shall be cleaned and flushed free of all dirt, debris or loose foreign material, after testing.

6.4 Temporary Blinds

Open ends of piping systems, such as at pumps or wherever equipment has been removed or disconnected prior to hydrostatic testing, or at termination point of piping branch connections, shall be blinded off by temporary blind flange, made out of 10 mm thick CS plate.

6.5 Venting

All piping systems and equipment shall be properly vented, to remove air from system, during filling.

6.6 Pressurizing

- 6.6.1 Pressure shall be applied by means of a suitable test pump, which shall not be connected to the system until ready to test. A pressure gauge shall be provided at the pump discharge for guidance in bringing the system to required pressure. The pump shall be attended to constantly during the test, by an authorised operator. The pump shall be disconnected, after the pressure test is completed.

- 6.6.2 The test pressure is to be maintained for sufficient time, to permit complete inspection of the system under test, but in no case shall the time be less than ten minutes. Test shall be considered complete only when approval is given by the Engineer-in-Charge.

6.7 Test Gauges

Contractor's own test gauge shall be installed as close as possible to the lowest point in the system being tested. Prior to installation, the test gauge shall be checked against a standard gauge or calibrated with the aid of a dead weight tester. Calibration of test gauges shall be the responsibility of the contractor.

6.8 Draining

- 6.8.1 All lines and equipments shall be completely drained after the hydrostatic test of the system has been completed. High point vents shall be open to prevent excessive vacuum and permit complete draining.
- 6.8.2 If it becomes necessary to leave a system filled with the testing medium for any abnormal length of time, suitable arrangement such as venting shall be made to provide for possible liquid expansion with change in ambient temperatures.

7.0 RECORDS

Records in triplicate shall be made for each piping system as follows:

- 7.1 In case of underground piping, layouts giving actual elevations of pipeline as laid.
- 7.2 Test certificates containing date of test, identification of the piping system, test fluid used, test pressure and approval of Owner's Inspector.
- 7.3 Certificates for flushing containing flushing medium used, identification of the piping system, date of flushing & approval by Owner's Inspector.

8.0 PAYMENT

- 8.1 Payment for piping shall be based on linear measurements, calculated on the basis of the execution drawings. The length shall be measured along the center lines of pipes, center lines of bends and elbows, tees, reducers and flanged joints. All types of valves shall be excluded from this measurement. Branch connections shall be measured from the outer surface of the header.

The payment shall be made on per metre basis of piping work laid, measured to the nearest centimeter. The unit rates for the underground piping shall be inclusive of earthwork in excavation, backfilling, compaction, disposal of surplus earth and coating and wrapping including supply of materials.

All piping attachments, such as couplings, nipples, thermowells etc., shall be installed by the Contractor as part of piping work and no separate payment shall be made for such work. However, extension on such attachments such as vents and drains will be measured and paid as applicable for the respective size and category of piping / valves.

Fabrication of mitre bends, concentric and eccentric reducers fabricated from pipes supplied by owner & fabrication of flanges from plates supplied by owner, will be paid at respective unit rates. However, erection of these items will be along with piping of the respective size and no separate payment will be made for erection.

The reducers will be measured and paid along with the piping of large diameter.

No separate payment will be made for making pipe to pipe branch connection and crosses, with or without reinforcing pads. The unit rates for piping are deemed to include all such work.

Fabrication, installation and removal of temporary spool pieces etc. to aid contractor's work such as fabrication, erection, flushing and testing etc. will neither be measured nor paid separately. The same is deemed to be included in the unit rates for piping. Payment for carrying out radiographic examination shall be based on linear length of the welded joint radiographed. Repeat radiography / additional radiography required due to contractor's faults / poor performance of his welders and defective films etc., shall be done at contractor's own cost.

- 8.2** The payment clause(s) as described in the clause no. 8.1 shall not be referred / applicable for LSTK Jobs

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विविध सिविल एवं संरचना कार्य
एवं अन्य सिविल कार्यों हेतु
मानक विनिर्देश

STANDARD SPECIFICATION
FOR
MISC. CIVIL & STRUCTURAL WORKS
FOR
U/G PIPING & OTHER CIVIL WORKS

2	16.04.09	REVISED & ISSUED AS STD. SPEC.	GS	RKS	NK	ND
1	30.10.97	REVISED & ISSUED AS STD. SPEC.	SKC	PCS	MMK	A SONI
0	31.3.82	ISSUED AS STD. SPEC.	RB	-	-	RSG
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

CI	:	Cast Iron
ERC	:	Electrical Road Crossings
IRC	:	Instrumentation Road Crossings
IS	:	Indian Standards
LSTK	:	Lump Sum Turn Key
MS	:	Mild Steel
PVC	:	Poly Vinyl Chloride
SCRC	:	Street Communication Road Crossing
U/G	:	Under Ground

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1.0 SCOPE

This specification covers the material and construction details for various civil works as given below:

- (a) All Earthwork except for site Grading and U/G Piping.
- (b) Plain and reinforced cement concrete work in Culverts, ERC/IRC/SCRC, Pipe-way Bridges, Catch pits, Clean outs, Manholes, Pipe supports, Water monitors/Hydrant pedestals, Thrust block, valve pits etc.
- (c) Brick work for various structures such as Drains, Septic Tank, Soak Pit, Manholes, Catch basins, Valve chambers, Instrument tapping chambers, Flushing chambers, etc.
- (d) Plastering for the above structures as applicable.
- (e) Manhole frames, Manhole covers, Ladders, Rungs etc. for the above structures as applicable.
- (f) Miscellaneous steel structure work such as Ladders, Platforms, Chequered plate covers, Gratings etc.

The work shall include supply of various materials as per relevant standards required for the execution of work except for those items designated as Owner's scope of supply in the special conditions of contract or elsewhere in the contract documents. Contractor shall transport material from Owner's stores, which are a part of owner's scope of supply.

All materials not fully specified herein and which may be used for the completion of WORK shall be of quality, as approved by the Engineer-in-charge. Engineer-in-charge shall have the right to determine whether all or any of the materials offered or delivered for the execution of WORK are suitable for the purpose. CONTRACTOR shall give the samples of material to the Engineer-in-Charge and get it approved before procurement and use.

2.0 CODES & STANDARDS

- | | |
|----------|---|
| IS: 458 | Pre cast concrete pipes (with and without reinforcement) |
| IS: 4985 | Unplasticized PVC Pipes for Potable Water Supplies |
| IS: 1239 | Mild steel tubes, tubulars and other wrought steel fittings |
| IS: 1726 | Cast Iron Manhole covers and frames |
| IS: 2062 | Steel for general structural purposes |
| IS: 3502 | Steel chequered plates |
| IS: 5455 | Specification for Cast Iron steps and manholes. |

3.0 EARTHWORK & BACKFILLING

Refer EIL Standard Specification No. 6-68-0003.

4.0 PLAIN AND REINFORCED CEMENT CONCRETE

Refer EIL Standard Specification No.6-68-0004.

5.0 BRICK WORK

Refer EIL Standard Specification No. 6-68-0009.

6.0 CEMENT PLASTERING

6.1 Materials

The specifications for cement, sand and water shall be as given in EIL Standard Specification No. 6-68-0002.

6.2 Cement mortar shall be of grade and thickness as specified in drawing or as directed by the Engineer-in-Charge, if not specified. The surface on which plastering is to be done shall be thoroughly cleaned from dust, dirt, oil, etc. It should be washed properly and watered for 4 hours before plastering. The joints of brickwork shall be raked out to a depth of at least 12mm when plastering has to be done. On cement concrete surface, the surface shall be scarified by lines with trowel when it is still green or hacked, if concrete is hard as directed by Engineer-in-Charge.

6.3 Plaster shall not in any case, be thinner than specified. It shall have uniform specified thickness. Any extra thickness of plaster done by contractor will not be paid for. When smooth finishing is required, the cement plaster shall be floated over with neat cement within 15 minutes of the application of the final coat.

During the process of plastering, all corners shall be rounded to a radius of 25mm unless otherwise specified.

6.4 The plaster shall be protected from sun and rain by such means as per the approval of Engineer-in-Charge. The plaster shall be cured for 7 days.

6.5 Construction joint shall be kept in plastering work at places approved by Engineer-in-Charge.

7.0 MS RUNGS

7.1 Materials

The rungs for valve pits / manholes shall be of MS conforming to Indian Standard and to the shape and size as shown in drawings. MS Rungs shall be coated with 2 coats of approved bituminous paint.

8.0 CHEQUERED PLATES & STRUCTURAL STEEL WORKS

8.1 Materials

8.1.1 Chequered plates shall be 6mm thick (7mm or more chequered plates shall conform to IS: 3502). Steel for chequered plate shall conform to IS: 2062 and shall be clearly rolled and free from harmful surface defects such as crack, surface flaws etc. The plate shall be cut to shape and fixed to the bearing members as shown in relevant drawings and as directed by Engineer-in-Charge. The edges shall be made smooth, no burrs or gagged ends shall be left. The plates may be spliced with prior consent of the Engineer-in-Charge. But in that case, care should be taken so that there is continuity in the pattern of the plates between the portions. Lifting arrangements shall be provided including lifting rods.

- 8.1.2 Grating shall be fabricated out of MS flats, angles and rounds etc., as per drawings and as approved by Engineer-in-Charge. Steel for grating plates shall conform to IS: 2062 of general weldable quality and shall be clearly rolled and shall be free from harmful surface defects.

9.0 CI MANHOLE FRAME AND COVER

9.1 Materials

CI manhole frame and covers shall conform to IS: 1726 with size and grade as shown in drawings.

10.0 VENT PIPES

10.1 Materials

These shall be MS black steel tube conforming to IS: 1239 medium grade or as specified in drawings. The pipe bends shall be embedded in 1:3:6 grade cement concrete or as shown in drawing.

- 10.2 All pipes shall be 25mm clear of wall or column with MS holder bat clamp, as per instructions of the Engineer-in-Charge. All holes in walls and column shall be made good by 1:2:4 grade cement concrete. All pipes and clamps shall be painted with two coats of paints of approved make.

11.0 FUNNELS, CLEAN OUTS, PLUGS

11.1 Materials

These shall be fabricated from MS Plates, pipes, chequered plates, rounds, angles etc., to be supplied by the contractor and painted with 2 coats of anticorrosive paint of approved make. The fabrication shall be in accordance with the approved drawings.

12.0 BRICK BAT FILL

12.1 Materials

The brickbats used as filling in valve pits shall be from common burnt clay building bricks of size ranging from 27mm to 37mm. Sample of brickbats used shall be got approved from Engineer-in-charge.

- 12.2 The compaction of the layer of brickbat shall be proper so that brickbat are not disturbed and do not sink in the soil.

13.0 PAYMENT

13.1 Cement Plastering

- 13.1.1 Payment for plastering shall be made on basis of the area of surface plastered, measured before plastering. All measurements shall be separately made for each face of walls.

- 13.1.2 The rate of plastering shall include cost of scaffolding, swings, cleaning the surface, raking out joints, hacking concrete surfaces, etc. needed for carrying the work and shall cover the extra labour for plastering the jambs, sills, and soffits or opening except for plastering bands, cornices and skirting upto 30 cm width.

13.2 MS Rungs

Payment for rungs shall be made per number and the rate shall include supply and fixing, finishing the wall etc. complete.

13.3 Chequered Plates & Structural Steel Works

Payment shall be made on the basis of weight of MS gratings / chequered plate and supporting frame including hold fast. The rate shall include supply of all necessary steel materials including cutting to size, fabricating, smoothening edge, if necessary, transporting and fixing at all positions and providing lifting arrangements. Full deductions shall be made for all openings above 30mm square and the rate shall include making of opening of all sizes and supplying and painting 2 coats of anticorrosive paint over a coat of red oxide zinc chromate primer. The exposed surface of grating and frame shall be painted with two thick coats of coal tar. The rate shall include providing and laying MS grating and frame, breaking and making good existing concrete/ brick masonry surface if necessary, finishing, painting etc. complete with all labour and materials. Payment shall be made on number basis.

13.4 CI Manhole Frame and Cover

Payment for Manhole Frame and cover shall be made per number and rate shall include supply and fixing etc. complete.

13.5 Vent Pipes

Payment shall be made on running meter basis and the rate shall include supply of all materials, cutting, edge preparation, jointing by welding, fixing in concrete block, cutting of walls or concrete and making good the same, painting with 2 coats of anticorrosive paint of approved make, necessary scaffolding etc. complete.

The rate shall also include excavation and backfilling if any.

13.6 Funnels, Clean Outs, Plugs

Payment for these items shall be made on weight basis and rate shall include fabrication, erection, welding, jointing and painting etc. all complete.

13.7 Brick Bat Fill

The payment for brickbats fill shall be made on m² basis, as shown in drawing and the rate shall include supply, laying, compacting etc. complete, with all materials & labour.

13.8 The payment clause(s) as described in the clause no. 13.1, 13.2, 13.3, 13.4, 13.5, 13.6 & 13.7 shall not be referred / applicable for LSTK Jobs.

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STANDARD SPECIFICATION
FOR
UNDERGROUND C. I. PIPING
SYSTEM

2	05.04.06	REVISED & ISSUED AS STD. SPEC.	SKC	NK	VDS	VJN
1	15.02.98	REVISED & ISSUED AS STD. SPEC.	RBB	NKT	MMK	A SONI
0	31.03.82	ISSUED AS STD. SPEC.	RB	-	HVR	RNS
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

C.I.	CAST IRON
cm ³	CUBIC CENTIMETRES
IS	INDIAN STANDARD
Kgs.	KILOGRAMS
Kg/cm ²	KILOGRAM/ SQUARE CENTIMETRES
mm	MILLIMETRE
M.S.	MILD STEEL

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- 5.0 LOWERING, LAYING AND JOINTING
- 6.0 TESTING OF CAST IRON PIPE LINES
- 7.0 RESTORATION OF DAMAGED SURFACE AND CLEANING THE SITE
- 8.0 PAYMENT

1.0 SCOPE

This Specification covers all works involved in providing underground C.I. piping system as per drawings and specifications. Rates quoted shall include transportation of materials from Owner's stores to the site, in cases where the owner issues materials. All other items of work, such as cutting, laying, jointing and testing etc., are included in the quoted rates. The work shall also include erection of all valves and in line instruments etc., which forms part of the system.

2.0 CODES & STANDARDS

IS: 638	Sheet rubber jointing and rubber insertion jointing.
IS: 780	Sluice valves for water work purposes (50 to 300 mm size).
IS: 782	Caulking lead.
IS: 1367	Technical supply conditions for threaded steel fasteners.
IS: 1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
IS: 1537	Vertically cast iron pressure pipes for watering, gas and sewage.
IS: 1538	Cast iron fittings for pressure pipes for water, gas and sewage.
IS: 2906	Sluice valves for water works purposes (350 to 1200 mm size).
IS: 3114	Code of practice for laying of cast iron pipes.
6-65-0006	Standard Specification for Earth Work for Under Ground Piping System.

NOTE:- Latest Edition of all Codes and Standards shall be followed.

3.0 MATERIALS

3.1 Cast Iron Socket and Spigot Pipes

All centrifugally cast (spun) iron pipes shall conform to IS: 1536 class A. The pipes shall have standard weight as specified in Indian Standard. No payment shall be made for extra weight of the pipes, if any. The socket of pipe shall be of modified design, such that socket & spigot shall be jointed with tyton or other similar coupling.

3.2 Cast Iron Double Flanged Pipes

All cast iron flanged pipes shall conform to IS: 1537 Class A. The pipes shall have standard weight as specified in Indian standard. No payment shall be made for extra weight of the pipes, if any.

All C.I. fittings shall conform to IS: 1538, medium duty.

Rubber gasket for flanged joints shall be 3mm thick, conforming to IS: 638, Type-B, Grade 2.

M.S. hexagonal bolts and nuts shall conform to IS: 1367.

All flanges shall conform to IS: 1537.

3.3 Cast Iron Sluice Valves

Cast Iron Sluice Valves are double flanged, non-rising spindle type, conforming to IS: 780 up to 300mm dia & IS: 2906 for more than 300mm dia.

Rubber gasket for flanged joints shall be 3mm thick, conforming to IS: 638. M.S. hexagonal bolts and nuts shall conform to IS: 1367.

4.0 EARTHWORK IN EXCAVATION, BACKFILLING AND TRANSPORTATION

- 4.1 All earthwork involved in laying of cast iron pipes shall be deemed to have been included in the quoted rates for laying of C.I. pipes.
- 4.2 All earth work shall be carried out as per EIL Standard specification No. 6-65-06 "Earthwork for underground piping".
- 4.3 The bed of trench, if in soft or made up earth, shall be well watered and rammed before laying the pipes and the depressions, if any, shall be properly filled with earth and consolidated in 20 cm layers.
- 4.4 If the trench bottom is extremely hard or rocky or loose stony soil, the trench shall be excavated at least 150 mm below the trench grade. Rocks, stone or other hard substances from the bottom of the trench shall be removed and the trench brought back to the required grade, by filling with selected fine earth or sand (fine murrum, if fine sand or soil is not available) and compacted, so as to provide a smooth bedding for the pipe.

Where excavation requires blasting operations, it shall be ensured that no pipes are stacked in the vicinity and complete pipelines in the vicinity have already been covered before starting of blasting operation.

- 4.5 The trench shall be kept free from water. Shoring and strutting / timbering shall be done, wherever required. Excavation below water table shall be kept dry by dewatering the trenches, if required.
- 4.6 After excavation of the trench is completed, hollows shall be cut at the required position to receive the socket of the pipes and these hollows shall be of sufficient depth to ensure that the barrels of the pipes shall rest throughout their entire length on the solid ground and that sufficient spaces left for jointing the underside of the pipe joint. These hollows shall be refilled with sand after jointing the pipe.

5.0 LOWERING, LAYING AND JOINTING

5.1 General

The trench shall be checked for proper level, gradient and alignment before lowering the pipes. The contractor shall get the trench approved from Engineer-in Charge, before lowering the pipes.

In case of flanged pipes, it shall be checked that holes of two joining flanges are concentric.

Before laying, each pipe shall be inspected carefully. Broken or cracked pipes shall be rejected. The inside of the pipes shall be cleaned of all foreign materials.

5.2 Lowering

The C.I. pipes shall be lowered cautiously to prevent disturbance to the bed and sides of the trench. The heavy pipes shall be lowered by means of proper shear legs, chain pulley blocks or as directed by Engineer-in-Charge.

5.3 Laying

Laying of pipes shall proceed up grade of slope. In case of socket and spigot pipes, the pipes shall be laid with socket ends facing up stream. The spigot shall be pushed well home to the full depth of the socket. The collars shall be slipped on before the next pipe is laid. Pipes shall be carefully laid over the alignment, levels and gradient as shown in the drawings. The levels shall be checked with the help of sight rails and bonding rods and with the help of levelling instruments, as directed by Engineer-in-Charge.

No sand, earth or other matter shall enter the pipes during laying. The error of grade shall not be rectified by packing up earth underneath the pipe. If required, concrete M-10 shall be used for packing, at contractor's own cost.

The ends of the pipe shall be kept closed to keep dirt, mud and foreign materials out. Adequate provision shall be made to prevent floating of pipe in the event of flooding of trenches.

Contractor shall provide thrust blocks of concrete M-15 at all changes in direction or as shown in drawings.

5.4 Jointing

5.4.1 C.I. Socket and Spigot Pipes (Socket & Spigot Joints)

The socket and spigot shall be jointed with tyton or other similar make instantaneous jointing couplings. These couplings shall be used only on the manufacturer recommended brand of pipes.

5.4.2 Double Flanged C.I. Pipes (Flanged Joints)

Flanged joints shall be made by painting the facing of the flanges with red lead and bolting up evenly on all sides with packing of rubber insertion in between the two flanges. The packing shall be of full diameter with proper holes to suit the flange's bolt holes.

5.4.3 Jointing Using Lead

Best blue pig lead, conforming to IS: 782 shall be used for joints.

The spigot shall be carefully centered in the socket and sufficient spun yarn shall be thoroughly caulked to leave a specified depth for lead caulking. The minimum depth of joint lead caulking shall be as per IS: 3114.

The depth left for joint shall be checked before running the lead, by passing a notched wooden gauge around the pipe, the notch being held close up against the face of the socket. After checking the alignment and levels of pipe, the space left for caulking in the socket shall be filled in by pouring molten lead as per directions of Engineer-in-Charge. The lead shall be rendered thoroughly fluid and each joint shall be caulked in three stages, with proper caulking tools of increasing thickness and a hammer of 2 kgs. weight, in such a manner as to make the joint sound and water tight.

The junctions of the pipeline with the manhole / valve pit / catch basin walls shall be grouted with 1:2 cement mortar, to the entire satisfaction of Engineer-in-Charge.

6.0 TESTING OF CAST IRON PIPELINES

6.1 General

6.1.1 Contractor shall carry out testing of all cast iron pipe lines laid by him as a part of the quoted rates.

6.1.2 Test manifolds, connection piping and all other necessary appurtenances for testing shall be provided and installed by the contractor, at his own cost, at the time of test. Pumps, if required, for filling the pipe line with water for the test shall also be provided and installed by the contractor, at his own cost.

6.2 Testing

6.2.1 Pressure Pipelines

C.I. double flanged and socket & spigot pressure pipelines shall be tested in suitable sections before back filling. After all lines are tested in sections, a final test shall be performed before commissioning the system. Test pressure shall be as indicated in drawings or specifications.

6.2.2 Gravity Pipelines

Gravity Cast Iron pipes shall be tested in sections, to a pressure of 1 kg/cm².

6.2.2.1 Procedure

End of the pipes shall be suitably blanked and the line pressurised to 1 kg/cm². After 1 hr. repressurizing upto 1 kg/cm² shall be done using measured quantity of water, which shall be less than or equal to $ND/3.3 \text{ cm}^3$, where N is the number of joints in the pipeline and D is the diameter of the pipeline in mm.

6.2.3 Failure of Test

In case of failure of test, contractor shall identify the reason for leakage and take action for redoing of joints, at his own cost.

The contractor shall remove the water from the pipeline and clean it after testing, at his own cost, without flooding the adjoining areas.

7.0 RESTORATION OF DAMAGED SURFACE AND CLEANING THE SITE.

7.1 All pavements, structures, pipelines, cables, etc. removed, damaged or disturbed during the pipe laying work, shall be restored to original condition.

7.2 Surplus excavated soil or rubbish material shall be removed to a place, as directed by the Engineer-in-Charge.

8.0 PAYMENT

- 8.1 Measurement of pipeline work for the purpose of payment shall be taken in running meters of the laid pipe measured along the centerline, inclusive of spigot and socket etc. No extra payment shall be made for providing and laying of fittings like bends, tees, etc. (except valves) that may be necessary for completion of work. The rate quoted shall be inclusive of excavation, lowering, laying, jointing, connecting the pipe to Inspection Chambers etc. and grouting to chamber walls, testing, cleaning of pipelines, backfilling and any other operation involved in the pipeline work.

भूमिगत मल-निर्यास पद्धति
प्रबलित सीमेन्ट पूर्वनिर्मित कंक्रीट पाइपों के
लिए
मानक विनिर्देशन

STANDARD SPECIFICATION
FOR
UNDERGROUND SEWER SYSTEM
PRE CAST RCC PIPES

2	05.04.06	REVISED & ISSUED AS STD. SPEC.	SKC	NK	VDS	VJN
1	1.9.98	REVISED & ISSUED AS STD. SPEC.	RC	NK	MMK	A SONI
0	31.3.82	ISSUED AS STD. SPEC.	RP	RP	RPB	RCPC
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

cm	CENTIMETRE
°	DEGREE
“	INCH
IS	INDIAN STANDARD
Litres/km/hr/cm	LITRES/ KILOMETRE/ HOURS/ CENTIMETRE
mm	MILLIMETRE
RCC	REINFORCED CEMENT CONCRETE

General Civil Standards Committee

Convenor : Mr.V.D. Soni

Members : Mr.N. Kaul
Mr.S.K. Chawla
Mr.R. Chutani
Mr.M.B. Lal (Strl.)
Mr.V.S. Chhaya (Env.Engg.)
Mr.R. Jain (Constn.)
Mr.PVR. Murti (Piping)
Mr. S. Kaul (Proj.)

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- 6.0 JOINTING
- 7.0 TESTING
- 8.0 RESTORATION OF DAMAGED SURFACES AND CLEARING THE SITE
- 9.0 PAYMENT

1.0 SCOPE

This specification covers the supply, laying, cutting, jointing and testing of Precast RCC pipes and related works.

2.0 CODES & STANDARDS

IS: 458 Pre Cast Concrete Pipes (with and without reinforcement)

6-65-0006 Standard Specification for Earth Work for Under Ground Piping System.

NOTE:- Latest Edition of all Codes and Standards shall be followed.

3.0 MATERIALS

3.1 The pipes shall be centrifugal cast concrete pipes, socket and spigot type, with reinforcement conforming to IS: 458. The class of pipes shall be as specified on drawings. The pipes shall be accepted on the basis of Test Certificates from Manufacturers. Additional testing shall be done, if directed by Engineer-in Charge.

3.2 The surfaces and edges of the pipes shall be well defined and their ends shall be perpendicular to longitudinal axis

4.0 EARTHWORK IN EXCAVATION, BACKFILLING AND TRANSPORTATION

4.1 All earthwork involved in laying of RCC pipes and related works is deemed to have been included in the quoted rates for the laying of RCC pipes.

4.2 All earthwork shall be carried out as per specification No.6-65-0006 "Earthwork for underground piping system".

4.3 The bed of trench, if in soft or made up earth, shall be well watered and rammed before laying the pipes and the depressions, if any, shall be properly filled with earth and consolidated in 20 cm layers.

4.4 If the trench bottom is extremely hard or rocky or loose stony soil, the trench shall be excavated at least 150 mm below the trench grade. Rocks, stone or other hard substances from the bottom of the trench shall be removed and the trench brought back to the required grade, by filling with selected fine earth or sand (fine murrum, if fine sand or soil is not available) and compacted, so as to provide a smooth bedding for the pipe.

Where excavation requires blasting operations, it shall be ensured that no pipes are stacked in the vicinity and complete pipelines in the vicinity have already been covered before starting of blasting operation.

4.5 The trench shall be kept free from water. Shoring and strutting / timbering shall be done, wherever required. Excavation below water table shall be kept dry by dewatering the trenches, if required.

4.6 After excavation of the trench is completed, hollows shall be cut at the required position to receive the socket of the pipes and these hollows shall be of sufficient depth to ensure that the barrels of the pipes shall rest throughout their entire length on the solid ground and that sufficient spaces left for jointing the underside of the pipe joint. These hollows shall be refilled with sand after jointing the pipe.

5.0 LOWERING & LAYING

- 5.1 The pipes shall be lowered when the trench is ready and the bottom has been properly graded as per drawings.
- 5.2 Before lowering, the pipes shall be inspected carefully. Broken or cracked pipe shall be rejected. The inside of the pipe shall be cleaned off from sand, earth or any other matter.
- 5.3 The pipe shall be lowered carefully so as not to disturb the bed and sides of the trench. Heavy pipes shall be lowered with chain pulley blocks or crane.
- 5.4 Pipes shall be set according to line and grade. Prior to making joints, all surfaces shall be thoroughly cleaned and prepared as required, for the type of joint to be made. Pipe shall be carefully centered so that the complete sewer will have a smooth uniform invert.
- 5.5 In socket & spigot pipes, the socket end shall face the upstream direction.
- 5.6 Railway authorities or other appropriate authorities shall be consulted wherever the pipeline crosses a railway line, canal, etc.
- 5.7 Connection to existing sewer shall be done through a manhole.
- 5.8 The ends of the pipeline shall be kept sealed to prevent entry of any foreign materials. The seals shall be broken before / after the testing is done.
- 5.9 Wherever the joining material is cement, six or more lengths of pipe shall be laid in advance of each joint before it is finished.
- 5.10 In cases, where the natural foundation is inadequate, the pipes shall be laid either in concrete cradle supported on proper foundations or any other suitably designed structure. If a concrete cradle bedding is used, the depth of concrete below the bottom of pipe shall be at least 1/4th of the internal dia of the pipe subject to the min. of 10cm and a maximum of 30 cm, the concrete shall extend up to the sides of the pipe at least to a distance of 1/4 of the outside diameter of pipes 300mm and above in dia. The pipes shall be laid in this concrete bedding before the concrete has set. Pipes laid in trenches in earth shall be bedded evenly and firmly and as far as possible, up the haunches of the pipes, so as to safely transmit the load expected from the backfill through the pipe to the bed.

This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under and around the curve of the pipe from an even bed. Necessary provision shall be made for joints, wherever required.

6.0 JOINTING

- 6.1 Joint in the pipeline shall be of socket and spigot type and conforming to relevant Indian standards.
- 6.2 As per IS: 458, joints in pressure pipes shall be flexible rubber ring joints only. Contractor shall provide pipes of socket and spigot type, meeting the above requirements.
- 6.3 The groove in between the pipe ends is to be filled with jute, impregnated with bitumen and rolled in the form of gasket ring centrally around the pipe, to ensure uniform annular space between the collar and the pipe.

6.4 Cement mortar of proportion 1:2 shall be used for caulking the annular space. Care shall be taken to see that the bottom of the collar joint is also caulked properly.

6.5 The joint shall be finished at an angle of 45° and shall be kept wet for 10 days for curing.

7.0 TESTING

7.1 The pipeline shall be tested for water tightness of joints. The test shall be carried out from manhole. Pipe ends shall be closed and filled with water so that water level is up to the top of the manholes.

7.2 The line shall be kept full for 24 hours. Observations shall be taken at one hour interval and if leakage is within 2.5 liters/km/hr/cm of diameter of pipeline, it shall be deemed to have passed the test.

7.3 Engineer-in-Charge may at his own discretion, ask the subcontractor to test the laid pipe line in sections, in which case the subcontractor will do the same, as per the procedure to be decided by the Engineer-in-Charge, without any extra cost to Owner. The procedure adopted in such cases, however, will be to test the pipeline according to the criteria mentioned in 7.2 above.

7.4 In case joints are found to leak, they shall be repaired or redone and test shall be repeated until the joints are approved by Engineer-in-Charge.

7.5 After completion of the test, all temporary seals shall be removed, the test water shall be drained / pumped out and the line cleaned properly.

7.6 Before commissioning, the cleanliness of the pipeline shall be checked by following tests.

7.6.1 Torch & Mirror Test

In this method of testing, a torch will be held at one end of the pipeline inside a manhole and its image through the pipeline will be reflected and seen on a mirror held at the opposite end of the pipeline, inside the next manhole. Any obstruction / debris / major misalignment will not give a clear image, in which case the pipeline shall again be cleaned, rectified and the test redone.

7.6.2 Ring Test

In this method of testing, two steel / wooden rings of suitable thickness and design shall be fixed facing each other, at a distance of 2 feet or more. The block of rings shall be inserted from one end of the pipeline, inside manhole and pulled by a rope fixed to the block from the other end of the pipeline, inside the next manhole. The rings shall be of dia. 2" less than the inside dia of pipe under testing. The rope used for pulling the ring block may be inserted in the pipeline by the sub-contractor either during construction or afterwards by suitable means. Any obstruction/ debris/ major mis-alignment will prevent the ring to pass through the pipeline in which case the pipeline shall again be cleaned / rectified and the test redone.

The ring test shall be performed for the complete network of the sewer system, before the same is put in commission.

8.0 RESTORATION OF DAMAGED SURFACES AND CLEARING THE SITE

8.1 All pavements, structures, pipelines, cables, etc. removed, damaged or disturbed during the pipe laying work shall be restored to original conditions.

- 8.2 Surplus excavated soil or rubbish material shall be removed to a place, as directed by Engineer-in-Charge.

9.0 PAYMENT

- 9.1 Measurement of pipeline work for the purpose of payment shall be taken in running metre of the laid pipe measured along centre line, inclusive of joints. The rate quoted shall be inclusive of excavation, lowering, laying, jointing, connecting the pipe to manholes and grouting the pipe to manhole wall, testing, cleaning of pipelines, backfilling, commissioning and any other operation involved in the pipeline work.

तकनीकी विनिर्देशन सिविल एवं संरचनात्मक कार्य

TECHNICAL SPECIFICATION CIVIL AND STRUCTURAL WORKS

सामान्य परिधि GENERAL SCOPE

3	26.02.08	REAFFIRMED AND REISSUED AS SPECIFICATION	PKB	PKM	VK	VC
2	08.06.01	REAFFIRMED AND REISSUED AS SPECIFICATION	DPN	RPM	SCJ	MI
1	02.03.94	ISSUED AS STD. SPECIFICATION		HM	GPL	AS
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	

Abbreviations:

Structural Standards Committee

Convenor : Mr Vinay Kumar

Members : Mr SK Kapoor

Mr S Chaturvedi

Mr SB Jain

Mr PK Mittal

Mr S Debnath

Mr Samir Das

Mr S Kaul (Project)

Mr Amarjeet Singh(Const.)

1. These specifications establish and define the material and constructional requirements for CIVIL and STRUCTURAL WORKS.
2. Methods of measurements are indicated in these specifications; where not so specified, latest revision of IS:1200 shall be applicable.
3. Providing and operating all necessary measuring and testing devices including all materials and consumables are included in the scope of work. No separate measurement or payment for testing the quality of work and materials shall be made, but rates quoted for various items shall be deemed to include the cost of such tests which are required to ensure achievement of specified quality.
4. All materials shall be of standard quality, manufactured by renowned concerns conforming to Indian Standards or equivalent, and shall have IS mark as far as possible unless otherwise approved by the Engineer-in-Charge. The Contractor shall get all materials approved by the Engineer-in-Charge prior to procurement and use. The Contractor shall furnish manufacturer's certificates for the materials supplied by him when asked for. Further to that he shall get the materials tested from an approved test house if asked for by the Engineer-in-Charge. The cost for all the tests and test certificates for the material procured by the Contractor shall be borne by the Contractor. No separate payment shall be made for the testing. The Engineer-in-Charge shall have the right to determine whether all or any of the materials are suitable. Any materials procured or brought to site and not conforming to specifications and satisfaction of the Engineer-in-Charge shall be rejected and the Contractor shall have to remove the same immediately from site at his own expense and without any claim for compensation due to such rejection.
5. Wherever referred to in the tender document, only the latest revision of Specifications, Codes of Practice and other publications of Bureau of Indian Standards shall be applicable.
6. Wherever the Contractor executes civil and structural works involving buildings, equipment foundations, supporting structures, pipe racks, etc., the following works are deemed to have been included in the quoted rates for various works.
 - Marking of centre lines of foundations etc.
 - Establishing layout and levels of foundations and superstructure etc., including establishment of reference lines, bench marks on various floors, platforms etc.
 - General upkeep of the plant site.
 - Preparation of "As-Built" scheme of structural drawings indicating constructed details including levels, centre lines, layouts, member sizes etc. complete.
7. The provisions of schedule of rates, specifications and drawings shall be read in conjunction with each other and in case of conflict amongst them, clarification shall be obtained from the Engineer-in-Charge whose decision shall be final and binding. However, the following procedure may generally be followed.
 - Description of items in schedule of rates shall be followed when provisions therein are different from those in specifications.
 - Where the description of item does not call for some specific requirement but the same is given in specifications, the specifications shall be followed in addition to the requirement given in description of item.



- Where drawings call for requirements different from or additional to those given in item description and specifications, the decision of the Engineer-in-Charge shall be obtained as to what shall be followed.

मानक विनिर्देशन सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION CIVIL & STRUCTURAL WORKS

सामग्री MATERIALS

3	19.06.09	REAFFIRMED & REISSUED	AS	SCH	VINAY KUMAR	N. DUARI
2	18.02.00	UPDATED & REISSUED	DPN	SKP	SC JAIN	A. SONI
1	JUNE'94	ISSUED AS STANDARD SPECIFICATION		SKP	GPL	A. SONI
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

API	:	American Petroleum Institute
ASTM	:	American Society for Testing & Materials
BIS	:	Bureau of Indian Standards
BS	:	British Standard
DIN	:	Deutsches Institut' für Normung
IS	:	Indian Standards
PCC	:	Plain Cement Concrete
PVC	:	Poly Vinyl Chloride
RCC	:	Reinforced Cement Concrete

Structural Standards Committee

Convenor : Mr Vinay Kumar

Members : Mr SK Kapoor
Mr S Chaturvedi
Mr PK Mittal
Mr S Debnath
Mr Samir Das
Mr RK Bhandari (Proj.)
Mr. Ravinder Kumar (Construction)

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1.0 SCOPE

- 1.1 This specification establishes and defines the requirements of various materials to be used in Civil and Structural works.
- 1.2 Whenever any reference to BIS Codes is made, the same shall be taken as the latest revision (with all amendments issued thereto) as on the date of submission of the bid.
- 1.3 Apart from the BIS Codes mentioned in particular in the various clauses of this specification, all other relevant codes related to specific job under consideration regarding quality, tests, testing and/or inspection procedures shall be applicable. Reference to some of the Codes in the various clauses of this specification does not limit or restrict the scope of applicability of other referred or relevant codes.
- 1.4 In case of any variation/contradiction between the provision of BIS Codes and this specification, the provision given in this specification shall be followed.
- 1.5 All materials shall be of standard quality and shall be procured from renowned sources/manufacturers approved by the Engineer-in-Charge. It shall be the responsibility of the Contractor, to get all materials/ manufacturers approved by the Engineer-in-Charge prior to procurement and placement of order.
- 1.6 Whenever called for by the Engineer-in-Charge all tests of the materials as specified by the relevant BIS Codes shall be carried out by the Contractor in an approved laboratory and test reports duly authenticated by the laboratory, shall be submitted to the Engineer-in-Charge for his approval. If so desired by the Engineer-in-Charge, tests shall be conducted in the presence of the Engineer-in-Charge or his authorised nominee.
- 1.7 Quality and acceptability of materials not covered under this specification shall be governed by the relevant BIS Codes. In case BIS code is not available for the particular material, other codes e.g. BS or DIN or API/ASTM shall be considered. The decision of Engineer-in-Charge, in this regard, shall be final and binding on the Contractor.
- 1.8 Whenever asked for, the Contractor shall submit representative samples of materials to the Engineer-in-Charge for his inspection and approval. Approval of any sample does not necessarily exempt the Contractor from submitting necessary test reports for the approved material, as per the specification/relevant BIS Codes.
- 1.9 The Contractor shall submit manufacturer's test reports on quality and suitability of any material procured from them and their recommendation on storage, application, workmanship etc. for the intended use. Submission of manufacturer's test reports does not restrict the Engineer-in-Charge from asking fresh test results from an approved laboratory of the actual material supplied from an approved manufacturer/source at any stage of execution of work.
- 1.10 All costs relating to or arising out of carrying out the tests and submission of test reports and or samples to the Engineer-in-Charge for his approval during the entire tenure of the work shall be borne by the contractor and included in the quoted rates.
- 1.11 Materials for approval shall be separately stored and marked, as directed by the Engineer-in-Charge and shall not be used in the works till these are approved.
- 1.12 All rejected materials shall be immediately removed from the site by the Contractor at his own cost.

2.0 REFERENCES

As mentioned in the respective clauses.

3.0 WATER

- 3.1** Water used in construction for all civil & structural works shall be clean and free from injurious amount of oil, acids, alkalies, organic matters or other harmful substances which may be deleterious to concrete, masonry or steel. The pH value of water sample shall be not less than 6. Potable water shall be considered satisfactory. Underground water can also be used with the prior approval of Engineer-in-Charge, if it meets all the requirements of IS:456.
- 3.2** Tests on water samples shall be carried out in accordance with IS:3025 and they shall fulfil all the guidelines and requirements given in IS:456.
- 3.3** The Engineer-in-Charge may require the Contractor to prove, that the concrete prepared with water, proposed to be used, shall have average 28 days compressive strength not lower than 90% of the strength of concrete prepared with distilled water.
- 3.4** The Engineer-in-Charge may require the Contractor to get the water tested from an approved laboratory before starting the construction work and in case the water contains any oil/organic matter or an excess of acid, alkalies or any injurious amount of salts etc., beyond the permissible maximum limits given in IS:456, the Engineer-in-Charge may refuse to permit its use. In case the water is supplied by the owner, contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense. In case there is any change in source of water, water samples shall be tested again to meet the specified requirements.
- 3.5** Water shall be stored in tin barrels, steel tanks or water-tight reservoirs made with bricks / stone or reinforced concrete. Brick/stone masonry reservoirs shall have RCC base slab and shall be plastered inside, with 1 part of cement and 4 parts of sand and finished with neat cement punning. These reservoirs shall be of sufficient capacity to meet the water requirement, at any stage of construction.
- 3.6** Water for curing shall be of the same quality as used for concreting and masonry works. Sea water shall not be used for preparation of cement mortar, concrete as well as for curing of plain/reinforced concrete and masonry works. Sea water shall not be used for hydrotesting and checking the leakage of liquid retaining structures also.

4.0 AGGREGATE

4.1 General

- 4.1.1** Coarse and fine aggregates for Civil and Structural Works shall conform in all respects to IS:383 (Specification for coarse and fine aggregates from natural sources for concrete). Aggregates shall be obtained from an approved source known to produce the same satisfactorily. Aggregates shall consist of naturally occurring (crushed or uncrushed) stones, gravel and sand or a combination thereof. These shall be chemically inert, hard, strong, dense durable, clean and free from veins, adherent coatings, injurious amount of alkalies, vegetable matter and other deleterious substances such as iron pyrites, coal, lignite, mica, shale, sea shells etc.
- 4.1.2** Source and type of aggregates shall be got approved by the Engineer-in-Charge prior to procurement. Change in source and type of aggregates, at later stage, shall not be generally permitted; but under specific circumstances, Engineer-in-Charge can allow a change in source and type of aggregate. Contractor shall produce necessary test certificates from approved laboratories regarding the quality and suitability of the proposed aggregates and submit fresh

mix design for approval of the Engineer-in-Charge. Any such change, if permitted by the Engineer-in-Charge, shall be without any time and cost implication to the owner.

- 4.1.3 Aggregates which may chemically react with alkalis of cement or might cause corrosion of the reinforcement, shall not be used. If so desired by the Engineer-in-Charge, the Contractor shall carry out alkali reactivity tests and submit the results to him for approval.
- 4.1.4 The maximum quantities of deleterious materials in the aggregates as determined in accordance with IS:2386 - Part II (Methods of Test for aggregates for concrete), shall not exceed the limits defined in IS:383. No special test is required to prove the absence of such deleterious matters if the aggregates are from a known source with satisfactory prior data on the properties of concrete made with them. In case of newly developed quarry sites, the contractor shall submit necessary test results as per IS:383 and IS:2386 to the Engineer-in-Charge prior to his acceptance and approval. The method of Sampling shall be in accordance with the requirements given in IS:2430.
- 4.1.5 Coarse and fine aggregates shall be batched separately. All-in-aggregate shall be used only where specifically permitted by the Engineer-in-Charge.

Separate sieve analysis and grading curves shall be prepared by the Contractor for any/all batches of coarse and fine aggregates, and submitted to the Engineer-in-Charge, whenever asked for, to ensure conformity with those submitted along with the mix design.

- 4.1.6 Whenever required by Engineer-in-Charge, the aggregates (coarse/fine) shall be washed and/or sieved by the contractor before use in the works to obtain clean and graded aggregate at no extra cost to the owner.
- 4.1.7 Aggregates not in conformity with the specifications shall be rejected and the Contractor shall immediately remove them from the site of work.

4.2 Coarse Aggregates

- 4.2.1 Coarse aggregates are the aggregates, which are retained on 4.75mm BIS Sieve. It shall have a specific gravity not less than 2.6 (saturated surface dry basis).
- 4.2.2 These may be obtained from crushed or uncrushed gravel or stone as per clause 3.1 and may be supplied as single sized or graded. The grading of the aggregates shall be as per IS:383 or as required by the mix design, to obtain densest possible concrete. For this purpose, the contractor shall submit to the Engineer-in-Charge at least three sets of mix design and test results, each with different gradings of coarse aggregates, proposed to be used. The Engineer-in-Charge may allow "All-in- aggregates" to be used provided they satisfy the requirements of IS:383.

4.3 Fine Aggregates

- 4.3.1 Fine aggregates are the aggregates which pass through 4.75mm BIS sieve but not more than ten percent (10%) pass through 150 micron BIS sieve. These shall comply with the requirements of grading zones I, II and III of IS:383. Fine aggregates conforming to grade zone IV shall not be used for reinforced concrete works.
- 4.3.2 Fine aggregates shall consist of material resulting from natural disintegration of rock and which has been deposited by streams or glacial agencies, or crushed stone sand or gravel sand. Sand from sea shores, creeks or river banks affected by tides, shall not be used for filling or concrete works.

4.4 Sampling and Testing

The Contractor shall carry out all tests including mix designs of concrete, at his own expense, at the start of work as well as during any stage of construction as required by the Engineer-in-Charge. Test shall be carried out in accordance with IS:516- Methods of test for strength of concrete and IS:2386-Methods of test for aggregates for concrete. Testing shall be carried out from laboratories approved by the Engineer- in-Charge. The method of sampling shall be in accordance with the requirements given in IS:2430.

4.5 Storage of Aggregates

- 4.5.1 Storage of all types of aggregates at site of work shall be at contractor's expense and risk and shall be stored as specified in IS:4082. Aggregates shall in no case be stored near to the excavated earth or directly over ground surface.
- 4.5.2 The Contractor shall maintain sufficient quantities of aggregates, near to the place of work, required for the continuity of the work. Each type and grade of aggregate shall be stored separately on hard, firm surface having adequate slope for drainage of water.
- 4.5.3 Aggregates delivered at site in wet condition or becoming wet due to rain or any other means, shall not be used for atleast 24 hours. The Contractor shall obtain prior approval of the Engineer-in-charge for the use of such aggregates and shall adjust the water content in accordance with IS:2386 to achieve the desired mix. In the absence of test results, and to allow variation in mass of aggregates and water content on account of moisture content,the Contractor can make suitable adjustment in the masses as per IS:456, for preparation of nominal mix concrete only.

5.0 SAND

5.1 Sand for Masonry Mortars

- 5.1.1 The sand shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these. The sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain the amount of clay, silt and fine dust more than specified in IS:2116.
- 5.1.2 The sand shall not contain any harmful impurities such as iron pyrites, alkalis, salts, coal or other organic impurities, mica, shale or similar laminated materials, soft fragments, sea shells in such form or in such quantities as to affect adversely the hardening, strength or durability of the mortar.
- 5.1.3 Unless found satisfactory as a result of further tests as may be specified by the Engineer-in-Charge, or unless evidence of such performance is offered which is satisfactory to him, the maximum quantities of clay, fine silt, fine dust and organic impurities in the sand, when tested in accordance with IS:2386, shall not be more than 5% by mass in natural sand, or crushed gravel sand or crushed stone sand. For organic impurities, when determined in accordance with IS:2386, colour of the liquid shall be lighter than that indicated by the standard solution specified in IS:2386.

5.1.4 Grading of Sand

The particle size grading of sand for use in mortars shall be within the limits as specified below:

GRADING OF SAND FOR USE IN MASONRY MORTARS

IS SIEVE DESIGNATION IS:460 (PART I)	PERCENTAGE PASSING BY MASS	REF. TO METHOD OF
4.75 mm	100	IS:2386(Part I)
2.36 mm	90 to 100	
1.18 mm	70 to 100	
600 micron	40 to 100	
300 micron	5 to 70	
150 micron	0 to 15	

In case of a sand whose grading falls outside the specified limits due to excess or deficiency of coarse or fine particles, this shall be processed to comply with the standard by screening through a suitably sized sieve and/or blending with required quantities of suitable sizes of natural sand particles or crushed stone screenings which are by themselves unsuitable. Based on test results and in the light of practical experience with the use of local materials, deviation in grading of sand may be considered by the Engineer-in-Charge. The various sizes of particles of which the sand is composed shall be uniformly distributed throughout the mass.

5.1.5 Sampling and Testing

The method of sampling shall be in accordance with IS:2430. The amount of material required for each test shall be as specified in relevant parts of IS:2386. Any test which the engineer-in-charge may require in connection with this, shall be carried out in accordance with the relevant parts of IS:2386.

If further confirmation as to the satisfactory nature of the material is required, compressive test on cement mortar cubes (1:6) may be made in accordance with IS:2250 using the supplied material in place of standard sand and the strength value so obtained shall be compared with that of another mortar made with a sand of acceptable and comparable quality.

5.2 Sand for Filling

Sand for filling shall meet the requirements of IS:383 and shall be natural sand, hard, strong, free from any organic and deleterious materials. Any sand proposed for filling, shall be used only after it is approved by the Engineer-in-Charge. Sand obtained from sea shores, creeks or river banks affected by tides, shall not be used for filling. Fine aggregates suitable for concreting works shall be suitable for filling also. No sand below grading zone-III as per IS:383 shall be allowed for filling.

6.0 CEMENT

Cement to be used for civil and structural works shall be one of the following. Specific requirement for the type of cement to be used shall be as shown in the drawings or as specified in the contract or as directed by the Engineer-in-Charge.

Specification for 33 grade ordinary portland cement	IS:269
Specification for 43 grade ordinary portland cement	IS:8112
Specification for 53 grade ordinary portland cement	IS:12269
Specification for portland slag cement	IS:455
Specification for Portland pozzolana cement (fly ash based)	IS:1489 Pt.1

Specification for Portland pozzolana cement (calcined clay based)	IS:1489 Pt.2
Specification for Masonry Cement	IS:3466
Specification for high alumina cement for structural use	IS:6452
Specification for rapid hardening portland cement	IS:8041
Specification for 43 grade ordinary portland cement	IS:8112
Specification for 53 grade ordinary portland cement	IS:12269
Specification for Sulphate Resisting Portland cement	IS:12330

6.1 Storage at Site

- 6.1.1 The storage of cement (lifted from the Owner's godown or procured by the Contractor himself) at the site of work shall be at contractor's expense and risk and shall meet the requirements of IS:4082. The cement shall be stored above ground in a suitable weather tight building or godown and in such a manner as to permit easy access for proper inspection and also to prevent deterioration due to moisture. In the event of any damage occurring to the quality of cement due to faulty storage or on account of negligence on the part of the contractor, such damages shall be borne by the contractor himself.
- 6.1.2 All approved cement shall be arranged in batches with type, brand and date of receipt flagged on them. A maximum of eight bags shall be stacked one over the other. Cement bags shall be used in the same order as received from the manufacturer/ owner. The contractor shall maintain a register, on day to day basis, giving the details of the receipt/consumption, source of supply and type of cement etc. The register shall always be accessible to the Engineer-in-Charge for verification.

6.2 Tests after Delivery

Each consignment of cement supplied by Owner or contractor, shall, after delivery at site and at the discretion of the Engineer-in-Charge, be subjected to any or all of the tests and analyses, required by the relevant Indian Standard Codes. In case the cement is supplied by the owner, the contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense. The contractor shall carry out and bear the cost of all tests and analyses required to ensure quality of cement before using in actual works, irrespective of the fact whether the cement is supplied by the Owner or procured by him.

6.3 Rejection

The Engineer-in-Charge may reject at his discretion any cement, notwithstanding the manufacturer's certificate or failing to meet the requirements of relevant BIS Codes for testing of cement. He may similarly reject any cement which has deteriorated owing to inadequate protection from moisture or due to intrusion of foreign matter or any other cause. Any cement which is considered defective, shall not be used and shall be promptly removed from the site by the contractor.

7.0 STEEL

7.1 General

All steel bars, sections, plates, and other miscellaneous steel materials, etc shall be free from loose mill scales, rust as well as oil, mud, paint or other coatings. The materials, construction specifications such as dimensions, shape, weight, tolerances, testing etc, for all materials covered under this section, shall conform to respective BIS Codes. Steel sections shall be conforming to IS:808 or IS:12778.

7.2 Reinforcement Bars

Reinforcement bars, to be used for civil and structural works shall be one of the following or in combination thereof.

Specification for hard drawn steel wire fabric for concrete reinforcement. IS:1566

Specification for plain hand drawn steel wire for prestressed concrete. IS:1785

Specification for High strength deformed steel bars and wires for concrete reinforcement. IS:1786

Steel for general structural purposes (Grade A). IS:2062

Specification for indented wire for prestressed concrete. IS:6003

7.3 Structural Steel

Structural steel to be used for general structural purposes shall be one of the following or in combination thereof.

Structural steel sections shall conform to following BIS Codes.

Steel tubes for structural purposes. IS:1161

Mild Steel Tubes, tubulars and other wrought steel fittings. IS:1239

Steel for general structural purposes (Grade A). IS:2062

Hollow steel sections for structural use. IS:4923

7.4 Miscellaneous Steel Materials

Miscellaneous steel materials shall be conforming to the following BIS Codes.

Expanded Metal Steel Sheets for General purposes. IS:412

Mild steel bars of anchor bolts, rungs, metal inserts, grating etc.) IS:2062

Hexagonal headbolts, screws & nuts of product grade C. IS:1363

Cold formed light gauge structural steel sections. IS:811

Technical supply conditions for threaded steel fasteners.	IS:1367
Plain washers	IS:2016
Steel wire ropes for general engineering purposes	IS:2266
Thimbles for wire ropes.	IS:2315
Bulldog grips.	IS:2361
Mild Steel Tubes, tubulars and other wrought steel fillings. (For Hand rail tubular sections).	IS:1239
Drop forged sockets for wire ropes for general engineering purposes.	IS:2485
Steel chequered plates.	IS:3502
Hexagonal bolts and nuts (M42 to M150).	IS:3138

7.4.1 Anchor Bolts

Material for Anchor Bolts such as MS bars, washers, nuts, pipe sleeves and plates etc. shall be as per relevant BIS Codes mentioned above.

7.5 Storage

The storage of all materials at site of work shall be at the contractor's expense and risk and shall be done as per the requirements given in IS:4082. The contractor shall maintain the proper records of receipt/consumption. The records shall always be accessible to the Engineer-in-Charge for verification.

The reinforcement bars, structural steel sections and other miscellaneous steel materials etc, shall be stored in such a way as to avoid and prevent deterioration, corrosion, bending, twisting and wrapping. In case of any damage occurring to the material on account of faulty storage or negligence by the contractor, same shall be borne by the contractor himself.

7.6 Tests after Delivery

Materials supplied by the Owner or Contractor, shall, after delivery at site and at the discretion of Engineer-in-Charge, be subjected to any or all of the tests, required by the relevant BIS Codes. The Contractor shall carry out and bear the cost of such tests irrespective of the fact whether the material is procured by the Owner or the contractor. In case steel is supplied by the Owner, the Contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense.

7.7 Rejection

The Engineer-in-charge may reject at his discretion any material, notwithstanding the manufacturer's certificate or failing to meet the requirements of relevant BIS Codes for testing of materials. He may similarly reject any material, which has deteriorated or corroded etc., due to improper storage, handling or transport. Defective materials shall not be used and removed from the site by the contractor at his own expense.

8.0 BRICK

8.1 General

Bricks for masonry works shall conform to IS:1077 - Specification for common burnt clay building bricks and shall be of class 5.0 (with minimum compressive strength of 5.0 N/mm^2). Specific requirement for any other class of bricks shall be as shown in drawings or as described in the contract for a particular site or type of work. Physical requirements, quality, dimensions, tolerances etc. of common burnt clay building bricks shall conform to the requirements of IS:1077.

Bricks shall be hand - moulded or machine moulded and shall be made from suitable soils. The bricks shall have smooth rectangular faces with sharp corners and shall be well burnt, sound, hard, tough and uniform in colour. These shall be free from cracks, chips, flaws, stone or humps of any kind.

8.2 Tests after Delivery

The Contractor shall take samples of each type of brick as directed by the Engineer-in-Charge as per the requirements of IS:5454 and tests shall be carried out as per IS:3495. The cost for carrying out any or all the tests, shall be borne by the Contractor. The bricks, when tested, as per IS:3495 shall have a minimum average compressive strength, as given in the Code, for a particular class of brick. Water absorption shall not be more than 20% by its dry weight, when soaked in cold water for 24 hours.

Brick samples so approved, shall be deposited with the Engineer-in-Charge. All subsequent deliveries shall be upto the standards of the approved samples.

8.3 Stacking of Bricks

Bricks shall be stored at site as per the requirements given in IS:4082 and shall not be dumped at site. They shall be unloaded from trucks to a place on a levelled surface near to the work site. They shall be stacked in regular tiers even as they are unloaded, to minimise breakages and defacement of bricks. The supply of bricks shall be so arranged that as far as possible, at least two days' requirements of bricks are available at site at any time. Bricks, of different class, shall be stacked separately.

8.4 Local Bricks/Class 3.5 Bricks.

Where shown on drawings, locally available bricks of non modular size (230mm x 115mm x 75mm) in place of bricks of modular size (190mm x 90mm x 90mm) can be used in case the bricks satisfy the other requirements of IS:1077. Minimum compressive strength of these bricks shall not be less than 3.5 N/mm^2 .

9.0 STONE

9.1 General

All Stones used for masonry works shall conform to the requirements of following BIS Codes.

Method of identification of natural building stones. IS:1123

Recommendations for dimensions and workmanship of natural building stones for masonry work. IS:1127

Recommendations for dressing of natural building stones. IS:1129

9.2 Quality of Stones

Stones shall be of approved quality, hard, dense, strong, sound, durable, clean and uniform in colour. They shall also be free from veins, adherent coatings, injurious amount of alkalies, vegetable matters and other deleterious substances such as iron pyrites, coal, lignite, mica, sea shells etc. Unless otherwise approved, stones from one single quarry shall be used for any one work. The strength of stones should be adequate to carry the imposed load and shall meet all the requirements of IS:1905, taking into account the appropriate crushing strength of stone and type of the mortar used. The percentage of water absorption, when tested in accordance with IS:1124, shall not exceed 5 percent.

Stones normally used, shall be small enough to be lifted and placed by hand. The length of the stone shall not exceed 3 times the height. Width of stone on base shall not be less than 150mm and in no case exceed 3/4th thickness of the wall. Height of the stone shall not be more than 300mm.

9.3 Unloading/Stacking

The stones shall be unloaded from the trucks to a site near to the place of work as defined in IS:4082 and shall be stacked on a firm ground having adequate slope for drainage. The supply of stones shall be so arranged that as far as possible, at least two days' requirements of stone are available at site at any time.

10.0 ADMIXTURES

10.1 General Requirements for Admixtures

- 10.1.1 All concrete admixtures shall in general comply with the following BIS Codes unless otherwise stipulated in this specification.

Specification for integral cement water proofing compounds.	IS:2645
Specification for other admixtures for concrete.	IS:9103

- 10.1.2 Generally, admixtures shall have ISI certification marks. However, even in case of BIS certified admixtures, Engineer-in-Charge may require the Contractor to carry out and submit any or all the tests (as specified in relevant BIS Codes), from approved laboratories, over and above the manufacturer's test certificate, before giving his final approval.

In case, admixtures certified by BIS are not available, the contractor shall submit to the Engineer-in-Charge the type and/or proprietary brand of the admixture from only reputed manufacturers along with necessary test certificates from recognised and approved laboratories or any other document directed by Engineer-in-Charge for the latter's final approval. In such cases, names of at least two manufacturers shall be submitted to the Engineer-in-Charge for his selection. In case, both the names are rejected, the contractor shall submit a fresh list of two manufacturers for approval by the Engineer-in-Charge.

The Engineer-in-Charge may direct the contractor to submit test results as required by IS:2645 or IS:9103 for any admixture proposed to be used in the concrete in any approved laboratory at his discretion at any stage of the work. The cost of any/all tests required to satisfy compliance with this specification shall be borne by the Contractor.

In case of non-availability of any BIS code for testing and acceptability criteria, relevant American, British or German Code shall be applicable.

- 10.1.3 Prior approval of the Engineer-in-Charge shall be obtained while using water reducing admixtures in the concrete (PCC/RCC) or mortar. Other type of admixtures such as accelerating admixtures, retarding admixtures or air entraining admixtures, shall not be used unless specified on the design drawings or prior approval taken from the design approving authority. Once approved, utmost care shall be exercised at site by the Contractor to maintain the consistency in the quality of admixture and the concrete/ mortar so produced.
- 10.1.4 The suitability and effectiveness of any admixture shall be verified by trial with the designed concrete mixes using cement, aggregates together with any other materials to be actually used in the works as per the direction of Engineer-in-Charge. If two or more admixtures are to be used simultaneously in the same concrete mix, the Contractor must submit necessary test results from an approved laboratory to show their interaction and compatibility. Any/all tests specified in BIS Codes shall be carried out only with the type of material and mix design, to be actually used in the work site.
- 10.1.5 No admixture shall impair the durability of the concrete nor combine with the ingredients to form harmful compounds nor increase the risk of corrosion of reinforcement. Use of admixtures shall not reduce the dry density of concrete. Once the proportion of admixture has been established, strict check shall be maintained not to alter the proportions of ingredients and water-cement ratio of the Design Mix during execution.
- 10.1.6 The chloride contents in admixtures shall not exceed 2% by mass of the admixture or 0.03% by mass of the cement.
- 10.1.7 Admixtures which do not meet the requirements stipulated in this specification shall be rejected and shall not be used.

10.2 Water Proofing Compounds

- 10.2.1 Water proofing compounds shall be mixed with only ordinary portland cement of grade 33, conforming to IS:269.
- 10.2.2 The permeability of the specimen with the admixture shall be less than half of the permeability with similar specimen without the use of these compounds. These compounds shall be used in such proportion as recommended by manufacturer but in no case it shall exceed 3% by weight of cement.
- 10.2.3 The initial setting time of the cement with the use of these compounds shall not be less than 30 minutes and final setting time shall not be more than 10 hours. Test shall be carried out in accordance with IS:4031.
- 10.2.4 Compressive strength of specimen at 3 days shall not be less than 160kg/sq.cm nor 80% of the 3 days compressive strength of mortar cubes prepared with same cement and sand only, whichever is higher. Similarly compressive strength at 7 days shall not be less than 220 kg/sq.cm nor less than 80% of the 7 days compressive strength prepared with the same cement and sand only, whichever is higher. The test to determine the compressive strength shall conform to IS:4031.

11.0 WATER BARS (WATER STOPS)

- 11.1 PVC water bars shall be used in reinforced concrete construction of liquid retaining structures or any other structure to safeguard them from hydrostatic pressure and water leakage and any relative movement between two parts of the structure due to thermal loading shrinkage or differential movement of foundations. Wherever desired or shown in the drawings, they shall be used at expansion/contraction/construction joints. These shall be pre-formed and shall provide a permanent water tight seal along the entire joint in the poured concrete structures.

These shall also be flexible enough to withstand deflection/displacements at joints arising due to variation of temperatures or settlement of foundations. The minimum thickness of water bar shall be as shown on drawings or described in the schedule of rates and unless otherwise mentioned, these shall be able to withstand a water head of at least 12 meters.

- 11.2** Performance requirements of PVC water bars shall meet the requirements of IS: 12200. These shall be of approved make and of ribbed/serrated/plane type with a bulb at the centre. The thickness and width of water bars shall be as per schedule of rates/ drawings but in no case the thickness shall be less than 5mm and width less than 150mm. The joining of the water bars shall be carried out by vulcanising strictly as per the manufacturer's specifications. Lapped joints shall not be allowed under any circumstances.

12.0 BITUMEN/BITUMINOUS MATERIALS

Bitumen to be used for various types of work shall meet all the requirements of relevant BIS Codes as given below:

Specification of Paving Bitumen.	IS:73
Specification for bitumen mastic for flooring.	IS:1195
Specification for Bitumen felts for water proofing and damp proofing.	IS:1322
Specification for Bituminous compounds for water proofing and caulking purposes.	IS:1834
Specification for preformed fillers for expansion joint in concrete pavements and structures.	IS:1838
Specification for bitumen mastic for use in water proofing of roofs.	IS:3037
Specification for bitumen primer for use in water proofing and damp proofing.	IS:3384
Specification for Bitumen Mastic for Tanking and Damp proofing.	IS:5871
Specification for Glass fibre base coal tar pitch & bitumen felts.	IS:7193
Code of practise for damp proofing using bitumen mastic.	IS:7198
Specification for bitumen Mastic, Anti Static and electrically conducting grade.	IS:8374

The type and grade shall be as shown on the drawings or as indicated in schedule of quantities or as directed by Engineer-in-Charge. Tests and acceptable criteria shall be as per relevant BIS Codes.

13.0 PVC PIPES

PVC Pipes shall conform to the requirements of IS:4985.

14.0 WOOD/TIMBER

- 14.1** Wood recommended for platforms of cold vessels or below cold vessels/ exchangers shall be hard and shall be of group A, grade I, and shall have safe permissible stress of $7N/mm^2$ in

compression, perpendicular to grains on outside location as per IS:883. General characteristics like durability, treatability etc. shall conform to IS:883 and IS:3629.

- 14.2** Timber required to be used for formwork shall be fairly dry before use. It should maintain its shape during the use and even when it comes into contact with moisture from the concrete. Storage of Wood/Timber shall be as per the requirements of IS:4082.

For proper identification and selection of suitable timber for formwork, following codes shall be referred.

Classification of commercial timbers and their zonal distribution	IS:399
Specification for ballies for general purposes.	IS:3337
Specification for Ply wood for concrete shuttering work.	IS:4990

15.0 EPOXY COMPOUNDS

Refer EIL Specification No. 6-68-0056.

16.0 PAINT

- 16.1** Refer EIL Specification No. 6-44-0004 or the job specification whichever applicable.

17.0 ANTITERMITE COMPOUNDS

- 17.1** Chloropyrifos emulsifiable concentrates (1%) conforming to IS:8944 shall be used for treatment of soil for protection of buildings against attack by subterranean termites.

18.0 POLYSULPHIDE SEALANTS

Polysulphide Sealants shall conform to IS:12118 and be of approved make. Test conditions and requirements shall be as given in the above referred BIS code.

मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य
STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS

मिट्टी का कार्य
EARTHWORK

4	19.06.09	REVISED & REISSUED	AS	SCH	VINAY KUMAR	N. DUARI
3	22.01.02	UPDATED & REISSUED	R SOOD	R SOOD	H MATHUR	GRR
2	AUG'94	UPDATED & REISSUED	-	H MATHUR	GP LAHIRI	A. SONI
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						



Abbreviations:

Structural Standards Committee

Convenor : Mr Vinay Kumar

Members : Mr SK Kapoor
Mr S Chaturvedi
Mr PK Mittal
Mr S Debnath
Mr Samir Das
Mr RK Bhandari (Proj.)
Mr. Ravinder Kumar (Construction)

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1.0 SCOPE

This specification deals with earth work in excavation and filling.

2.0 CLASSIFICATION OF SOIL

2.1 Ordinary Soil

2.1.1 Soft Soil / Loose Soil

Generally any soil which yields to the ordinary application of pick and shovel, or to phawra, rake or other ordinary digging implements such as:

Sand, gravel, loam, clay, mud, black cotton soil

Vegetables or organic soil, turf, peats, soft shale or loose murrum

Mud concrete below ground level

Any mixture of soil mentioned above.

2.1.2 Hard/ Dense Soil

Generally any soil, which requires close application of picks or jumpers or scarifier and rippers to loosen the same, such as:

- i) Stiff heavy clay, hard shale or compact murrum requiring grafting tool and/ or pick and shovel
- ii) Shingle and river or nallah bed boulders
- iii) Soling of roads, paths etc. and hard core
- iv) Macadam surface of any description (water bound, grouted tarmac etc.)
- v) Lime concrete, stone masonry in lime or cement mortar below ground level
- vi) Soft conglomerate when the stone can be detached from the matrix with picks and shovels

2.2 Soft Rock

This is fissured / disintegrated rocky strata, boulders (volume less than 0.4 m^3 and more than 0.028 M^3) and also which cannot be quarried/ excavated by using above manual tools but can be quarried/ excavated manually by using crow bars is classified as soft rock. Soft rock shall include all kinds of stiff and stratified rock, such as shales, thinly bedded phillites, laterite hard conglomerate, lime stone, sand stone and unreinforced cement concrete below ground level. Soft rock may be quarried or split with crow bar or picks and can also be excavated by rippers, dozers and other mechanical equipment, but without the aid of blasting. If required and permitted, light blasting may be restored to, for loosening the materials, but this will not, in any way entitle the material to be classified as "Hard Rock".

2.3 Hard Rock

2.3.1 Hard Rock (Not Requiring Blasting)

This shall include all types of hard and compact rock, having closely spaced fissures or joints, on account of which blasting is not considered necessary and shall not be resorted unless permitted by the Engineer-in charge.

2.3.2 Hard Rock (Requiring General Blasting)

This shall include all types of hard and compact rock occurring in unfissured masses or similar foundations, boulders (volume more than 0.4m^3) for excavation in which blasting is considered necessary such as quartzite, granite, basalt stones, reinforced cement concrete (reinforcement to be cut through but not separated from concrete) below ground level and the like.

2.3.3 Hard Rock (Requiring Controlled Blasting)

This type of excavation becomes necessary when excavation is done in formations, mentioned in Clause 2.3.2, in the vicinity of existing foundations/ structures. Mode of blasting shall be decided by Engineer-in-Charge, keeping in view the sensitivity of structures.

2.3.4 Hard Rock (Blasting Prohibited)

Hard rock requiring blasting as described in clause 2.3.2 above, but when blasting is prohibited for any reason and excavation has to be carried out by chiseling, splitter or any other agreed method.

The use of excavation shall not be considered as a reason for classification under hard rock requiring blasting unless clearly found necessary in the opinion of Engineer-in-Charge.

3.0 BACKFILLING MATERIAL

3.1 Suitable Materials:

3.1.1 Back filling suitable material shall be approved by the Engineer-in-charge. Additionally, they shall be free from refuse, large stones or rocks or other material which might prevent proper compaction or cause the compacted fill or embankment to perform inadequately or to have insufficient stability or bearing capacity for the superimposed loads to which it is likely to be subjected.

3.1.2 Back filling of excavation in trenches, foundations and elsewhere shall consist of one of the following materials as shown on drawing, or directed by the Engineer-in-charge.

- i) Soil
- ii) Selected earth from heaps or brought from borrow areas.

In case (i) or (ii) are not available, the Engineer-in-charge may approve use of any of the following:

- (iii) Stone/Gravel
- (iv) Sand
- (v) CNS material.

- 3.1.3 The material shall be free from rubbish, roots, hard lumps and any other foreign organic material.

3.2 Unsuitable Materials

Unsuitable material shall include particles in excess of 75mm size and that which is

- Organic material, logs, stumps and perishable materials.
- Material susceptible to spontaneous combustion
- Materials with undefined properties
- Materials having a moisture content greater than the maximum specified
- Building rubble and domestic and industrial wastes
- Soils and rock susceptible to deterioration/change of their properties.
- Clay, silt and other loose or soft soils not in accordance with compaction criteria.
- Dredged material
- Material containing gypsum or other soluble salts.

4.0 SETTING OUT

- 4.1 The Contractor shall be responsible for the true and proper setting out of the work in relation to original points, *lines** and *levels** of reference and for the correctness of the levels, dimensions and alignment of all parts of the work. If at any time during progress of the work any error appears or arises in the position of level, dimension, or alignment of part of the work, the Contractor at his own expense shall rectify such errors to the satisfaction of the Engineer-in-Charge. The checking of any line or level by the Engineer-in-Charge shall not in any way relieve the Contractor of his responsibilities.

4.1.1 Tolerances*

The grade shall be properly shaped to the required elevations and parallel to the required surface. The elevation of any point and the line of any edge or center of the earthworks shall conform to that shown on the drawings within the tolerances stated below:

	Tolerances from True Level	Tolerances from True Line
Basic Grading	- 25mm	- 75mm
Embankments	+75mm - 0	+ 75mm - 75mm

- 4.2 The Contractor shall lay out and construct one or more permanent bench marks in some central place before the start of the work, from which all important levels for the excavations will be set.

These permanent bench marks shall consist of masonry pillars with top neatly plastered and levelled as per the directions of the Engineer-in-Charge. Bench marks shall be well connected with triangular grid system or any other bench mark approved by the Engineer-in-Charge.

5.0 EARTHWORK IN EXCAVATION

- 5.1 Excavation shall be carried out in any material met on the site to the lines, levels and contours shown on the detailed drawings and the Contractor shall remove all excavated materials to spoil heaps on site or transport for use in filling on the site or stack them for reuse as directed.

- 5.2 Excavated material shall not be deposited within 1.5m from the top edge of the excavation.
- 5.3 The sides of the excavation may be cut sloping, or shored and strutted to hold the face of earth as per site requirements and as directed by the Engineer-in- Charge.
- 5.4 Foundation pits/trenches shall not be excavated to the full depth unless construction is imminent. The last fifteen (15) cm depth of the excavation shall not be done until concreting work is imminent. The full depth may at the discretion of the Engineer-in-Charge be excavated and the bed covered with a fifty (50) mm (minimum) thick (or as indicated on drawing) layer of lean concrete 1:5:10 mix (1 cement: 5 coarse sand:10 crushed stone aggregate) or as specified in schedule of rates/shown on drawing, after watering if required, and consolidating the bed.
- 5.5 If the bottom of any excavation has been left exposed by the Contractor and in the opinion of the Engineer-in-Charge, that has become badly affected by the atmosphere or by water, then the Contractor shall remove such portions of the deteriorated material as the Engineer-in-Charge may direct and shall make good with lean concrete 1:5:10 mix (1 Cement : 5 Coarse Sand : 10 Crushed Stone Aggregate). All expenses for such additional concrete and excavation shall be borne by the Contractor.
- 5.6 Where excavation is made in excess of the depth required, the Contractor shall, at his own expense, fill upto required level with lean concrete 1:5:10 mix (1 Cement : 5 Coarse Sand : 10 Crushed Stone aggregates) or as decided by Engineer-in-Charge.
- 5.7 The Contractor shall provide suitable drainage arrangement to prevent surface water from any source entering the foundation pits at his own cost.
- 5.8 The Contractor shall make all arrangements for dewatering during excavation and subsequent works, the accumulated water from any source (including subsoil water) in the excavated pits/trenches and keeping the excavated pits/trenches dry for subsequent works.
- 5.9 The Contractor shall make necessary arrangements for lighting, fencing and other suitable measures for protection against risk of accidents due to open excavation.
- 5.10 Where the excavation is to be carried out below the foundation level of an adjacent structure, the precaution to be taken such as under pinning, shoring and strutting etc. shall be determined by the Engineer- in-Charge. No excavation shall be done unless such precautionary measures are carried out as per directions of the Engineer-in-Charge. The payment for such precautionary measures shall, however, be made separately.
- 5.11 Loose or soft bed ground encountered in excavation at the required depth shall on the Engineers-in-Charge's instructions be excavated to a firm bed and difference made up to the required level with lean concrete 1:5:10 mix (1 Cement : 5 Coarse Sand : 10 Crushed Stone Aggregates).
- 5.12 In those cases where during excavation, side slips occur for reasons not attributable to the Contractor (e.g. side slips which take place on their own but not due to surcharge of earth kept near the edge of excavation and cracking of excavation top strata due to clay drying out leading to collapse of excavation sides), the Engineer-in-Charge shall admit payment at his discretion.
- 5.13 Any obstacle encountered during excavation shall be reported immediately to the Engineer-in-Charge and shall be dealt with as instructed by him. Removal of buried pipes or cables shall not be done without prior permission of the Engineer-in-Charge and the Contractor shall provide all measures to protect the same. Cost of such protective measures are deemed to be included in the rates for various items of excavation.

5.14 The Contractor shall not undertake any concreting in foundation until the excavation pit/trench is approved by the Engineer-in-Charge.

5.15 The specification for earth work shall also apply to excavation in rock in general.

5.16 In case of hardrock requiring blasting, the provisions mentioned below shall be strictly followed.

5.16.1 General

Where hard rock is met with and blasting operations are considered necessary, the Contractor shall intimate about the same to the Engineer-in-Charge, and obtain his approval in writing for resorting to blasting operation.

The Contractor shall obtain license from the district authorities for undertaking blasting work as well as for obtaining and storing the explosive as per Explosive Rules 1983, corrected upto date. He shall purchase the explosives, fuses, detonators etc. only from a licensed dealer. He shall be responsible for the safe custody and proper accounting of the explosive materials. The Engineer-in-Charge or his authorised representative shall have the access to check the Contractor's store of explosive and his accounts.

In case where explosives are required to be transported and stored at site, relevant clauses of the Explosive Rules, 1983 as amended subsequently, shall apply.

The Contractor shall be responsible for any accident to workmen, public or property, due to blasting operations.

5.16.2 Precautions

Blasting operations shall be carried out under the careful supervision of a responsible authorised and licensed blaster of the Contractor (referred subsequently as "blaster" only) during specified hours, as approved in writing by the Engineer-in-Charge. The blaster shall be fully conversant with the rules of blasting.

Proper precautions for safety of persons shall be taken. Red flags shall be prominently displayed around the area to be blasted and all the people on the work except those who actually light the fuses, shall withdraw to a safe distance of not less than 200 metres from the blast. Precautions as per Explosive Rules 1983 with amendment shall be followed.

5.16.3 Fuses

All fuses shall be cut to the lengths required before being inserted into the holes. Joints in fuses shall be avoided. Where these are unavoidable, a semicircular niche shall be cut in one piece of fuse about 2 cm. deep from the end and the end of other piece inserted into this niche, and the two pieces then wrapped together with a string. All joints exposed to dampness shall be wrapped with rubber tape. Fuse and detonators shall be kept separated from the explosives.

5.16.4 Blasting with Gun Powder

Blasting shall normally be done with gun powder. Dynamite, gelatine or any other high explosive shall only be used in special cases with the written permission of the Engineer-in-Charge.

In case of blasting with gun powder, the position of all bore holes to be drilled shall be marked out in circles with white paint. The bore holes shall be jumped or drilled in the rock face. The

depth of bore hole shall be about the same as that of the line of least resistance and its size shall be such that the cartridges can easily pass down to the bottom. The bore holes must be dried before being charged and these shall be inspected by the Contractor's agent.

Gun powder may be used in the form of pellet blasting cartridges or as powder or granules. Cartridges are provided with tapered central hole. One end of fuse is passed through the narrow end of the hole and a sufficient length of the fuse is doubled back so that when the fuse is pulled, it is held tight in the tapered hole of the cartridge. Other cartridges are then inserted in the fuse to make up the required charge. The cartridge along with the fuse is lowered down in the bore hole, placed in position and gently filled and pressed home with dry hay or turf. The rest of the bore shall then be filled with dry clay, which shall be tamped with copper or brass rod until it becomes compact. Care shall be taken to avoid any possibility of an air space around the fuse. The safety fuses shall be taken to the required distance so as to allow the blasting to take place after the person lighting the fuse has withdrawn to a safe distance.

Where gun powder is used in the form of powder or granules it shall be introduced in the bore hole by means of funnel or copper tube. The bore holes shall be loaded with two thirds of the quantity of charge required, and safety fuse then directly introduced over the charge. Remaining one third charge shall then be introduced, and gently filled and pressed home with dry hay or turf. The rest of the bore hole shall be filled with dry clay in the same way as for cartridges, and the safety fuse taken to the required distance.

The charges shall be fired by igniting the fuse. The number of charges to be fired and the actual number of shots heard, shall be compared, and the Contractor's blaster shall satisfy himself by examination that all the charges have exploded, before workmen are permitted to approach the site. The charge which has not exploded, shall not be permitted to be withdrawn. The tamping and charge shall be flooded with water and the holes marked with a red cross (X) over it. Another hole shall be jumped at a distance of about 45 cm from the old hole and fired in the usual way. This operation shall be continued, till the original and any subsequent unfired charges are exploded.

5.16.5 Blasting with Dynamite or any other High Explosive

In case of blasting with dynamite or any other high explosive the position of all bore holes to be drilled shall be marked out in circle with white paint. These shall be inspected by the Contractor's blaster. Bore holes shall be of a size that the cartridge can easily pass down. After the drilling operation, the blaster shall re-inspect the holes to see that the holes marked out by him have been drilled. He shall then prepare all charges necessary for the bore holes. The bore holes shall be thoroughly cleaned before a cartridge is inserted. Wooden tamping rods (not pointed but cylindrical throughout) shall be used, in charging holes. Metal rods shall never be used for tamping. One cartridge shall be first placed in the bore hole, gently pressed and not rammed down. Other cartridges shall then be added as may be required to make up the necessary charge for the bore hole. The top most cartridge shall be connected to the detonator which shall in turn be connected to the safety fuse of required length.

The maximum of eight bore holes shall be loaded and fired on each occasion. The charges shall be fired successively and not simultaneously.

Immediately before firing a blast, due warning shall be given and the blaster shall see that all persons have retired to a place of safety. The safety fuses of the charged holes shall be ignited in the presence of the blaster, who shall see that all the fuses are properly ignited.

Careful count shall be kept by him and others of each blast as it explodes. After the blast the blaster shall inspect the work and ascertain that all the charged holes have been exploded. In case of misfired holes, he shall inspect the same after half an hour and mark red crosses (X) over the holes. During this interval of half an hour, no body shall approach the misfired holes.

None of the drillers shall work near such holes, until one of the two following operations has been done by the blaster.

- a) Either the Contractor's blaster shall very carefully (when the tamping is of damp clay) extract the tamping with a wooden scraper and withdraw the fuse, primer and detonator, after which a fresh detonator, primer and fuse shall be placed in the misfired holes and fired.

OR

- b) The hole shall be cleaned for 30 cm of tamping and its direction ascertained by placing a stick in the hole. Another hole shall then be drilled 15 cm away and parallel to it. This hole shall be charged and fired. The misfired hole should also explode along with the new one.

Before leaving the work, the blaster of one shift shall inform another blaster relieving him for the next shift, of any cases of misfire, and shall point out their positions denoted by red crosses and also state the action, if any, to be taken in the matter.

The Engineer-in-Charge shall also be informed by the blaster of all cases of misfire, their causes and steps taken in that connection.

5.16.6 Controlled Blasting

Whenever required by the Engineer-in-Charge, rock blasting shall be carefully controlled so that vibrations generated during the blasting do not cause damage to the buildings and installation around. Similarly, the rock pieces should not fly off and endanger the buildings and installations around. Apart from the general precautions mentioned in the preceding paragraphs, following protective measures and limits for use of explosive are suggested as guidelines. Tenderers are requested to carefully check the site conditions and submit details of the scheme they propose to adopt for controlling the blast.

Following protective measures shall be adopted while carrying out blasting operations.

The hole shall be covered with mild steel plate of minimum 12mm thickness.

Reinforcement rod mesh not less than 20mm dia. at 150mm centre in both directions shall be placed over the steel plates.

Steel plate and reinforcement shall be inspected after every blasting operation and all twists shall be removed before reuse to the satisfaction of the Engineer-in-Charge.

Sand filled bags of 6 to 8 layers shall be placed over the mesh suitably covering the whole region under blasting operation.

The thickness of covering plate and the kind of dead weight is to be duly approved by the Engineer-in-Charge.

- 5.16.7 Hard rock requiring blasting as described under cl. no. 2.3.2 above, but where blasting is prohibited for any reason(s) breaking up of rock can be done by using Hydraulic Splitter and chemical substances of approved manufacturer (Lifton or equivalent) mixed in an appropriate proportion. The method involves drilling holes into rock and then inserting/injecting hydraulic splitter/chemical solvents into the holes. The breaking-up of rock takes place in a controlled fashion without much noise and spark.

- 5.17** Excavation in areas where existing under ground cables are envisaged, to be carried out carefully by manual means taking proper safety precautions.

The earth work machinery be deployed after ensuring from the trial pits that no cable is crossing the proposed area of excavation.

5.18 Payment

- 5.18.1** The payment clause shall be operated only if the earthwork is to be measured separately as per relevant tender item.

- 5.18.2** Payment for earth work in excavation shall be made on cubic meter (m³) basis on the measurement of volume of pit/trench of excavation with working space as per relevant Indian Standards (IS:1200) and slopes/steppings as permitted by the Engineer-in-Charge. The rate shall include cost of all the operations of blasting with explosives & accessories, making of all arrangements for dewatering the accumulated water from any source in the excavated pit or trench, removal and disposal of surplus excavated soil within a lead of 100m from construction areas. The rate shall also include setting out and line out work required for the excavation.

- 5.18.3** The following works shall not be measured separately and allowance for the same shall be deemed to have been made in the description of main item:

- a) Setting out works, profiles, etc.;
- b) Site clearance, such as cleaning grass and vegetation;
- c) Unauthorized battering or benching of excavation;
- d) Forming (or leaving 'dead men' or 'tell-tales' in borrow pits and their removal after measurements;
- e) Forming (or leaving) steps in sides of deep excavation and their removal after measurements;
- f) Excavation for insertion of planking and strutting;
- g) Unless otherwise specified, removing slips or falls in excavations;
- h) Bailing out or pumping of water in excavation from rains;
- i) Bailing out or pumping of water in excavation from sub-soil water, and
- j) Slings or supporting pipes, electric cables, etc, met during excavation.

- 5.18.4** Special pumping other than what is included in 5.18.2 (h and i) and well point dewatering where resorted to, shall each be measured separately, unless otherwise stated, in kilolitres of water against separate specific provision(s) made for the purpose.

- 5.18.5** The Contractor shall intimate to the Engineer-in-Charge as soon as different classification of soils are met with. The measurements of various soil classifications then shall be worked out by either of the following alternatives in the order of their decreasing importance.

- a) Joint levels shall be taken as to the levels of different soil classifications and volume worked out on the basis of levels only.

- b) Where levels of different strata cannot be clearly marked and defined, the Contractor shall stack different soils of various classifications separately for measurement purpose and then dispose it off.
- c) If the quantum of work involved in (b) above is extensively large & time consuming, then the total area may be divided into various zones and reasonably representative samples as in (b) above may be taken and quantities of soils of various classifications finalized for the entire zone based on the representative.

If soil of any classification other than that specified in the Schedule of Rates is met with during excavation, the decision of the Engineer-in-Charge as to the classification of soil, levels of the strata of different classifications and their location shall be binding.

In above case, the total quantity of excavation shall be computed from the measurement of the pit/trench excavated. The hard rock and soft rock shall be measured separately from the relevant stacks and each shall be reduced by fifty percent for voids, and paid under the relevant items. The balance, that is the total quantity of excavation minus the reduced (for voids) quantity of excavation for rocks shall be paid as soft/hard soil as per the direction of the Engineer-in-Charge (However, the maximum payment shall be limited to the volume of the excavated pit/trench as approved by Engineer-in-Charge).

6.0 SHORING AND STRUTTING

- 6.1 The shoring and strutting of the sides to withhold the face of excavation pits/trenches shall be done when approved or directed by the Engineer-in-Charge.
- 6.2 The shoring shall be of close or open timbering type depending upon the site requirements and as directed by the Engineer-in-Charge whose decision shall be final and binding as to the type of shoring to be used.
- 6.3 The arrangement of the shoring and strutting shall be sound and safe and shall be got approved from the Engineer-in-Charge before installation. The approval shall not absolve the Contractor of his responsibilities of safety and any other requirements of the contract.
- 6.4 The shoring and strutting shall be kept in position till all the relevant work in the excavated area is completed and approved. It shall be dismantled and removed only after the permission to do so is obtained from the Engineer-in-Charge.

6.5 Payment

Payment for shoring and strutting by close and open timbering shall be made on square meter (m²) basis as separate items. In both the cases, the measurement shall be done on the basis of the surface area of the sides of the excavation actually shored and strutted.

The rate shall include all labour, materials, erection of the poling boards, wales, struts, ballies etc., fixing and keeping the same in position as required, dismantling and removing the same after the work is over as directed.

7.0 BACK FILLING AROUND FOUNDATIONS AND IN PLINTH

- 7.1 Back filling around completed foundations, structures, trenches and in plinth shall be done to the lines and levels shown on the drawings including any trimming of the surfaces, as may be necessary. This shall be done with selected and approved earth from excavation or otherwise with materials described under clause 3.1 as directed by the Engineer-in-Charge. Where

sufficient suitable material is not available from the excavation, the Engineer-in-Charge may direct to import suitable earth from other sources. The filling shall be done in layers of thickness not exceeding 15 cm with watering, rolling and ramming by manual methods/mechanical compactors to grade and level as shown on drawings to obtain 90% laboratory maximum dry density.

7.2 The Contractor shall not commence filling in and around any work until it has been permitted by the Engineer-in- Charge.

7.3 Backfilling around liquid retaining structures and pipes shall be done only after approval of the Engineer-in- Charge is obtained.

7.4 Payment

Payment for backfilling with earth shall be based on volume in cubic meters (m^3) of consolidated fill. This volume shall be derived from the difference between the volume of excavation and the structure or trenches as the case may be. The rate shall include cost of extracting suitable approved earth from available excavated soil from spoil heaps within a lead of 100m, placing, watering, rolling, ramming compacting in layers, trimming and dressing finished surface and disposal of surplus material upto a lead of 100m.

However, backfilling done with materials other than earth shall be paid separately under relevant items.

8.0 TRANSPORTATION OF SURPLUS EARTH

8.1 Surplus earth and soil from excavation shall be removed from construction area to the area demarcated by the Engineer-in-Charge.

8.2 Payment

8.2.1 Payment shall be made only for the lead beyond initial 100m from construction area. Rate shall include re- excavation, loading, transportation, dumping, stacking or spreading (as per directions of the Engineer-in-Charge) the surplus earth and the soil in the area demarcated by the Engineer-in-Charge. Payment shall be made on cubic metre (m^3) basis on the difference of measurements of the volume of the excavated pits and the measurement of the back filling. Quantity generated due to voids in back filled volume of earth shall also be removed by the Contractor at no extra cost and this disposal of earth shall not be measured and paid under any item.

8.2.2 In exceptional circumstances the Engineer-in-Charge may direct the Contractor to remove surplus earth, concrete debris or any other waste material from site to the areas of disposal on the basis of truck measurement. In such cases volume of material shall be calculated on the basis of truck volume reduced by 30% for voids in case of soft/hard soils and 50% for soft/hard rock. All other provisions of disposal such as spreading, levelling, grading shall apply in this case also.

9.0 PROTECTION OF PROPERTY AND PERSONNEL

9.1 The Contractor shall protect all active utility lines shown on the drawings or encountered during the excavation. If he damages those lines, the Contractor shall repair or replace them. If existing utilities interfere with his work, the Contractor shall inform to the Engineer-in-charge and secure written instructions for further action.

- 9.2** The Contractor shall barricade open holes and depressions which he creates or exposes as part of this, and he shall post warning signs and lights on property adjacent to or with public access. He shall operate warning lights during hours from dusk to dawn each day and as otherwise required for safety.
- 9.3** The Contractor shall protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by his operations.
- 9.4** The Contractor shall plan and execute all aspects of the earthwork so that the safety of personnel, the work and adjacent property is guaranteed and such that a minimum of inconvenience is caused.

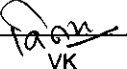
10.0 CLEAN UP

Upon completion of work, the Contractor shall leave the project site clear of debris and surplus materials off plant limits in a manner meeting all location authority requirements.

तकनीकी विनिर्देशन सिविल एवं संरचनात्मक कार्य

TECHNICAL SPECIFICATION CIVIL & STRUCTURAL WORKS

सादा एवं प्रबलित सीमेंट कांक्रीट PLAIN AND REINFORCED CEMENT CONCRETE

4	23 rd NOV 07	UPDATED & REISSUED	 YPC	 PKM	 VK	 VC
3	APR,01	UPDATED & REISSUED	RPM7097	SCS	SCJ1151	MI
2	AUG,95	UPDATED & REISSUED	RPM7097	SCJ1151	GPL2612	AS
1	JULY,90	UPDATED & REISSUED		AKV2515	GPL2612	RCPC
0	AUG,89	ISSUED AS STD. SPEC				
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	

Structural Standards Committee

Convenor: Mr Vinay Kumar

Members: Mr SK Kapoor
Mr, S. Chaturvedi
Mr. S.B. Jain
Mr. P.K. Mittal
Mr S.Debnath
Mr Samir Das
Mr S.Kaul (Project)
Mr Amarjeet Singh

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1.0 SCOPE

This specification is applicable for Concrete Grade up to M55 and establishes the requirements of materials, mix proportioning, placing, curing, etc. of all types of cast-in-situ and precast concrete used in foundations, underground and overground structures, floors, pavements etc. Any special requirements as shown or noted on the drawings shall supersede over the provisions of this specifications.

1.1 Reference Codes and Specifications

Apart from this specification, construction of plain and reinforced concrete works shall be in accordance with the Indian Standard Code of Practice for "Plain and Reinforced Concrete" IS:456 and other relevant codes mentioned therein.

1.2 For Liquid Retaining Structures EIL Specification No. 6-68-0005, shall be applicable.

1.3 For Structural Steel works EIL Specification No. 6-68-0006 & 0008, shall be applicable.

1.4 In case of conflict between the clauses mentioned in this specification and those in the Bureau of Indian Standards (BIS), this specification shall govern.

2.0 MATERIALS

2.1 Materials for concrete viz cement, Pozzolanas, Fly Ash, Ground Granulated Blast Furnace Slag, sand, coarse aggregate, water, etc. shall be as described in EIL Specification No.6-68-0002.

2.2 Materials for all reinforcements, embedment, inserts, water bars etc. shall conform to EIL Specification 6-68-0002.

2.3 Materials suggested to be used as additive to concrete shall conform to EIL specification 6-68-0002.

3.0 GRADES OF CONCRETE

Characteristic Compressive strength for different grades of concrete shall be as per Table-1.

TABLE – 1 GRADES OF CONCRETE	
Grade Designation	Specified Characteristic Compressive Strength of 150 mm cube at 28 days (N/mm ²)
M 15	15
M 20	20
M 25	25
M 30	30
M 35	35
M 40	40
M 45	45
M 50	50
M 55	55

Note for Table - 1: The characteristic strength is defined as the strength of material below which not more than five (5) percent of the test results are expected to fall.

4.0 TYPE OF CONCRETE MIX

4.1 Unless otherwise noted on drawings, all lean/plain and reinforced concrete shall be nominal mix and design mix types, respectively.

4.2 Nominal Mix Concrete

This concrete shall be made (without preliminary tests) by adopting nominal concrete mix with proportions of materials as specified in clause 9 of IS: 456.

4.3 Design Mix Concrete

The mix shall be designed as per IS: 10262 & SP: 23 to produce the grade of concrete having the required workability and characteristic strength not less than appropriate values given in Table-1. The target mean strength of concrete mix shall be equal to the characteristic strength plus 1.65 times the standard deviation.

As long as the quality of materials does not change, a mix design done earlier but not prior to one year may be considered adequate for later work. However, in case the quality of materials changes or there is a break in the continuity of construction and the same work is allocated to a new contractor, the Engineer-in-Charge shall ask for a new design mix.

Irrespective of the grade of concrete required to be produced as per characteristic strength criteria, the minimum cement content and maximum free water cement ratio in the design concrete shall be strictly maintained as stipulated in Table 2 for the corresponding grade of concrete.

5.0 CONCRETE MIX PROPORTIONING

Proportioning, as used in this specification, shall mean the process of determining the proportions of the various ingredients to be used to produce concrete of the required workability when fresh/green and strength, durability and surface finish, when hardened. The following information shall be collected prior to design of the concrete mix :

- a) Grade designation.
- b) Type of cement.
- c) Maximum nominal size of aggregate.
- d) Minimum cement content.
- e) Maximum free water cement ratio
- f) Workability requirements.
- g) Exposure condition as per Table 3 & Table 4 of IS:456
- h) Maximum temperature of concrete at the time of placing.
- i) Method of Placing.

The Engineer-in-Charge shall verify the strength of the concrete mix, before giving his sanction of its use. However, this does not absolve the Contractor of his responsibility as regards achieving the prescribed strength of the mix. If during the execution of the work, cube tests show lower strengths than required, the Engineer-in-Charge shall order fresh trial mixes to be made by the Contractor. 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 shall be established well ahead of start of work.

5.1 Maximum Density

Suitable proportions of sand and the different sizes of coarse aggregates for each grade of concrete shall be selected to give as nearly as practicable the maximum density. This shall be determined by mathematical means, laboratory tests, field trials and suitable changes in aggregate gradation. The contractor shall submit to the Engineer-in-Charge at least three sets of mix design and corresponding test results after varying the mix proportions and / or grading of aggregate so as to establish the maximum density of any particular grade of concrete.

5.3 Consistency

The concrete shall have a consistency such that it shall be workable in the required position and when properly vibrated it flows around reinforcing steel, all embedded fixtures, etc.

5.4 Workability

“Workability of Concrete” shall be as per clause 7 of IS: 456.

5.5 Durability

For achieving sufficiently durable concrete, strong, dense aggregates, low water-cement ratio and adequate cement content shall always be used. Workability of concrete shall be such that concrete can be completely compacted with the means available. Leak-proof formwork shall be used so as to ensure no loss of cement-slurry during pouring and compaction. Cover to reinforcement shall be uniform and as shown on drawings. Concrete mix design shall always take into account the type of cement, minimum cement content irrespective of the type of cement and maximum free water cement ratio and minimum grade of concrete conforming to the exposure conditions as given in Table-2.

TABLE - 2 MINIMUM CEMENT CONTENT, MAXIMUM FREE WATER CEMENT RATIO AND MINIMUM GRADE OF CONCRETE FOR DIFFERENT EXPOSURE CONDITIONS						
Exposure	Plain Concrete			Reinforced Concrete		
	Minimum Cement Content (kg/m ³)	Maximum Free Water Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content (kg/m ³)	Maximum Free Water Cement Ratio	Minimum Grade of Concrete
Mild	240	0.6	M 15	330	0.55	M 20
Moderate	265	0.6	M 15	330	0.50	M 25
Severe	275	0.5	M 20	350	0.45	M 30
Very Severe	280	0.45	M 20	375	0.45	M 35
Extreme	310	0.4	M 25	400	0.4	M 40

Note: Cement prescribed in this table is irrespective of grade of Cement and it is inclusive of pozzolanas, Fly Ash, Ground Granulated Blast Furnace Slag may be taken into account in the concrete composition within respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (part 1) and IS 455 respectively.

Generally, the following types of cement shall be used for Plain and Reinforced concrete works:

- a) 33 Grade Ordinary Portland Cement conforming to IS: 269.
- b) 43 Grade Ordinary Portland Cement conforming to IS: 8112.
- c) Rapid hardening Portland Cement conforming to IS 8041.
- d) Portland Slag Cement conforming to IS: 455.
- e) Portland Pozzolana Cement(fly ash based) conforming to IS:1489(Part 1)
- f) Portland Pozzolana Cement (calcined clay based) conforming to IS: 1489(Part-2).
- g) Sulphate Resisting Portland Cement conforming to IS: 12330

Sulphate Resisting Portland Cement shall be used only for specific requirements depending on environmental and process exposure conditions to which the structures may be subjected to like high sulphate concentrations, processes involving sulphur handling etc.

5.5.1 Free Water Cement Ratio

Once a mix, including its free water cement ratio, has been determined and approved for use by the Engineer-in- Charge, that free water cement ratio shall be maintained. The Contractor shall determine the water content of the aggregates frequently as the work progresses, and the amount of mixing water shall be adjusted so as to maintain the approved free water cement ratio. Maximum free water-cement ratio shall be as per Table-2 for different exposure condition.

The minimum cement content as mentioned in Table-2 shall be adjusted for aggregates other than 20mm nominal maximum size. The minimum cement content in the concrete mix shall be increased by 40kg/m³ and decreased by 30 kg/m³ for 10mm and 40mm nominal maximum size aggregates respectively.

For maximum cement content refer cl.8.2.4.2 of IS: 456.

5.6 Limits to Deleterious Constituents

Careful selection of the mix and the constituent materials shall be made to limit the presence of deleterious constituents in concrete. The total acid soluble chloride content calculated from the mix proportion and the measured chloride content of each of the constituents shall not exceed 0.6 kg/m³ at the time of placing of concrete. The total water soluble sulphate content of the concrete mix shall not exceed 4 percent by mass of the cement in the mix.

6.0 BATCHING

Refer clause 10.2 of IS: 456.

7.0 CONCRETE MIXING

- 7.1 The mixing of concrete shall be strictly carried out in an approved type of mechanical concrete mixer. The mixer shall be fitted with water measuring devices. The mixing shall be continued until there is a uniform distribution of the material and the mass is uniform in colour and consistency. If there is segregation after unloading from the mixer, the concrete shall be remixed.

Use of Ready Mixed Concrete supplied by Ready Mixed Concrete Plants or from on/off-site batching plants (IS: 4926) shall be preferred for structural concrete.

All records and charts for the batching and mixing operations shall be prepared and maintained by the contractor as per the instructions of Engineer-in-Charge.

7.2 Mixer

7.2.1 Mechanical Mixers shall comply with IS: 1791 and 12119 and shall be maintained in satisfactory operating condition. These shall be used only for producing lean/ plain concrete and/ or nominal mix concrete wherever permitted.

7.2.2 Mixing Time

Mixing time shall be as indicated in the following table. Excessive mixing requiring additions of water shall not be permitted. Time shall start when all solid materials are poured in the revolving 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 a change in the mixing time, if he considers such a change necessary.

MINIMUM MIXING TIME FOR MIXERS

Capacity of mixer	Minimum mixing time
2 m ³ or less	2 minutes
Above 2 m ³	3 minutes or as recommended by the mixer manufacturer.

7.3 Hand Mixing

Hand mixing of concrete shall not be permitted. However, for non-critical applications namely foundations for crossovers, isolated operating platforms etc., using concrete of maximum grade M20 and located at far away isolated places, this may be permitted by the Engineer-in-charge as a special case. Ten percent (10%) extra cement shall be added to the design proportion. Mixing shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. No extra payment shall be made to the Contractor for mixing by hand or for using extra cement due to hand mixing.

7.4 Additives

Additive in concrete shall be used only with the prior approval of the Engineer-in-Charge and shall comply with cl. 5.5 of IS: 456. Any additive used for obtaining proper workability or leak-proofness of concrete or repair/rendering works of concrete due to non-conformance to the specifications, shall not be measured and paid for. All costs relating to such usage shall be borne by the Contractor.

8.0 TRANSPORTATION, PLACING AND COMPACTION

8.1 General

The entire concrete placing programme including transportation arrangements, deployment of equipment, layout, proposed procedures and methods, shall be submitted to the Engineer-in-Charge 24 hours prior to concreting for approval. No concreting shall be

placed until his approval has been received. Approval of the Engineer-in-Charge for pouring concrete shall be taken as 'conveyed', when the concrete pour card is signed by him.

8.1.1 Chuting

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 the concrete. Open troughs and chutes shall be equipped with baffles and be in short lengths to avoid segregation. Chutes shall be designed so that the concrete is, to some extent, remixed at the lower end by passing down through a funnel shaped pipe or drop chute. Alternatively, they shall discharge into a storage hopper from which the concrete shall be transported to the point of placing by wheel barrows or other means. Where drop chutes are used, a sufficient number of these must be provided, so that the concrete discharged from the chute is not required to flow laterally more than 1.0 metre. Where a drop chute is swung from the vertical, the bottom two sections must be maintained in a vertical position to avoid segregation. 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 normally permitted to fall freely from a height of more than 1.5 metre nor to strike the forms at an angle. However, a deviation from this normal practice may be allowed provided proper precaution is taken, while placing concrete into the forms to avoid segregation, to the satisfaction of the Engineer-in-Charge.

8.1.2 Vibrators

- 8.1.2.1 Concrete shall be compacted with mechanical vibrating equipment supplemented, if necessary to obtain consolidation, by hand spreading, rodding and tamping. The vibrators shall be of immersion type with operational frequency ranging between 8,000 to 12,000 vibrations per minute. All vibrators shall comply with IS: 2505. Screed board concrete vibrators or concreting vibrating tables or form vibrators conforming to IS: 2506, 2514 and 4656, respectively, shall be used where specifically required and directed by Engineer-in-Charge.
- 8.1.2.2 Immersion type vibrators shall be inserted in a vertical position at intervals of about 600mm, depending upon the mix, the equipment used, and 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 vibration or under vibration shall not be permitted as both are harmful. Hand tamping in some cases may be allowed subject to the approval of the Engineer-in-Charge.
- 8.1.2.3 In placing concrete in layers which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, bonding and moulding of the concrete between the succeeding batches.
- 8.1.2.4 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.
- 8.1.2.5 Care shall be taken to prevent contact of vibrators against all embedded reinforcing steel or inserts. Vibrators shall not be allowed to come in contact with forms.
- 8.1.2.6 The use of form vibrators shall not be permitted for compaction of in-situ concrete without specific authorization of the Engineer-in-Charge.

8.1.2.7 The use of surface vibrators of screed board type shall not be permitted for consolidation of concrete under ordinary conditions. However, for thin slabs (of thickness less than 200mm) surface vibration by such vibrators may be permitted, upon approval of the Engineer-in-Charge.

8.1.2.8 Whenever vibration has to be applied externally, the design of formwork and the disposition of vibrators shall be carefully planned to ensure efficient compaction and to avoid surface blemishes.

8.2 Transportation

8.2.1 All concrete shall be conveyed from the mixer to the place of final deposit such as formwork as rapidly as possible using suitable buckets, dumpers, pumps, transit mixers containers or conveyors which shall be mortar leak tight. Care shall be taken to prevent the segregation or loss of the ingredients and maintaining the required workability. For structural concrete produced from Ready Mixed Concrete Plants as per cl. 7.1, concrete shall be transported from the plants to the sites only by transit mixers.

8.2.2 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. All equipment used for transporting and placing of concrete shall be maintained in clean condition. All buckets, hoppers, chutes, dumpers and other equipment shall be thoroughly cleaned after each use.

8.3 Placing and Compaction

8.3.1 Before placing concrete, all soil surfaces upon which or against which concrete is to be placed shall be well compacted and free from standing water, mud or debris. Soft or yielding soil shall be removed and replaced, with lean concrete or with selected soils/sand and compacted to the density as directed by Engineer-in-Charge. The surface of absorptive soil (against which concrete is to be placed) shall be moistened thoroughly so that moisture is not drawn from the freshly placed concrete. Similarly, for concrete to be placed on formworks, all chippings, shavings and sawdust etc. shall be removed from the interior of the forms before the concrete is placed.

8.3.2 Concrete shall not be placed until the formwork, the placement of reinforcing steel, embedded parts; pockets etc. have been inspected and approved by the Engineer- in-Charge. Any accumulated water on the surface of the bedding layer shall be removed by suitable means before start of placement. No concrete shall be placed on a water covered surface.

8.3.3 Concrete shall be discharged by vertical drop only and the drop height shall not normally exceed 1.5 metre throughout all stages of delivery until the concrete comes to rest in forms. For continuous concreting operation windows of suitable size shall be kept in the formwork or chutes shall be used to avoid segregation of concrete.

8.3.4 Concrete shall be deposited as near as practicable in its final position to avoid rehandling. Concrete shall be placed in successive horizontal layers. The bucket loads, or other units of deposit, shall be placed progressively along the face of the layer with such over-lap as will facilitate spreading the layer of uniform depth and texture with a minimum of hand shovelling. Any tendency to segregation shall be corrected by shovelling coarse aggregates into mortar rather than mortar on the coarse aggregates. Such a tendency for segregation shall be corrected by redesign of mix, change in process or other means, as directed by the Engineer-in-Charge.

8.3.5 All struts, stays and braces (serving temporarily to hold the forms in correct shape and alignment pending the placing of concrete at their locations) shall be removed when the

concrete placing has reached an elevation rendering their service unnecessary. These shall not be buried in the concrete. Concrete shall be thoroughly compacted with vibrators and fully worked around the reinforcement, embedded fixtures and into corners of formwork before setting commences and shall not be subsequently disturbed. Methods of placing shall be such as to preclude segregation and avoid displacement of reinforcement or formwork. The formation of stone-pockets or mortar bondage in corners and against face forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for thorough bonding as directed by the Engineer-in-Charge. Care shall be taken to avoid displacement of reinforcement and embedded inserts or movement of formwork.

- 8.3.6 Unless otherwise approved, concrete shall be placed in single operation to the full thickness of foundation rafts, slabs, beams and similar members. Concrete shall be placed continuously until completion of the part of the work between approved construction joints or as directed by the Engineer-in-Charge.
- 8.3.7 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.
- 8.3.8 During hot weather (atmospheric temperature above 40 degree Celsius) or cold weather (atmospheric temperature less than 5 degree Celsius, the concreting shall be done as per the procedure set out in IS: 7861).
- 8.3.9 Concrete that has set standing and becomes stiffened shall not be used in the work.

8.4 Items Embedded in Concrete

- 8.4.1 Concreting shall not be started unless the electrical conduits, pipes, fixtures etc., wherever required, are laid by the concerned agency. The Contractor shall afford all the facilities and maintain co-ordination of work with other agencies engaged in electrical and such other works as directed by the Engineer-in-Charge.
- 8.4.2 Before concreting, the Contractor shall provide, fabricate and lay in proper position all metal inserts, anchor bolts, pipes etc. (which are required to be embedded in concrete members) as per relevant drawings and directions of Engineer-in-Charge.
- 8.4.3 All embedment, inserts etc. shall be fully held and secured in their respective positions by the concerned agencies to the entire satisfaction of Engineer-in-Charge so as to avoid any dislocation or displacement during the concreting operations. The Contractor shall take all possible care during concreting to maintain these embedment/inserts in their exact locations.

9.0 CONSTRUCTION JOINTS

- 9.1 Construction joints shall be provided in position as shown or described on the drawings or as directed by the Engineer-in-Charge. Such joints shall be kept to the minimum. These shall be straight and at right angles to the direction of main reinforcement and shall be placed at accessible locations to permit cleaning out of laitance, cement slurry and unsound concrete. Construction joints shall comply with IS: 11817
- 9.2 In a column, the joint shall be formed about 100mm to 150mm below the lowest soffit of the beams framing into it. Concrete in a beam and slab shall be placed throughout without a joint but if the provision of a joint is unavoidable, the joint shall be vertical and located within 1/3 to 1/4 of the span, unless otherwise shown on the drawings.
- 9.3 When stopping the concrete on a vertical plane in slabs and beams, an approved stop board shall be placed with necessary slots for reinforcement bars. The construction joints shall be

keyed by providing a triangular or trapezoidal fillet nailed on the stop board. Inclined joints shall not be permitted. Any concrete flowing through the joints of stop board shall be removed soon after the initial set. When concrete is stopped on a horizontal plane, the surface shall be roughened and cleaned after the initial set and a triangular or trapezoidal groove shall be provided for keying with the new concrete later.

- 9.4 When the work has to be resumed on a surface which has hardened, such surface shall be cleared of any foreign materials and roughened to expose the tips of the coarse aggregate. This may be done by manual chipping of concrete, with a high pressure water jet or by any other appropriate means as per Engineer-in-Charge's directions. It shall then be swept clean and thoroughly washed and wetted before any new concrete is poured. Any set mortar or concrete sticking to the exposed reinforcing rods in and around such joints shall be thoroughly removed. The reinforcements shall be wire brushed and washed just before pouring any cement slurry or mortar. 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 15mm thick composed of cement and sand in the same ratio as the cement and sand in concrete mix. This layer of cement slurry or mortar shall be freshly mixed and applied immediately before placing new concrete.

- 9.5 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 dislodgement 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 layer of concrete not exceeding 150mm 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 normal way.

10.0 SEPARATION JOINT

- 10.1 Separation joint shall be obtained by using an approved alkathene sheet stuck on the surface against which concrete shall be placed. Adequate care shall be taken to cause no damage to the sheet.

11.0 EXPANSION JOINTS/ISOLATION JOINT

- 11.1 Expansion/ Isolation joints in structures shall be formed in the positions and to the shapes shown in the relevant drawings. Joints shall be filled with joint filling material as stipulated in the drawings/schedule of rates. Isolation joints shall be provided around all equipment foundations, columns, pedestals, trenches etc. on grade.

12.0 WATER STOPS

PVC water stops as per EIL Specification No. 6-68-0002 for materials shall be accurately cut, fitted and integrally joined as per manufacturer's specifications to provide a continuous, watertight diaphragm at all points.

The water stops shall be located and embedded at expansion/contraction/ construction joints as indicated in the drawings or directed by the Engineer-in-Charge.

Adequate provision shall be made for the support and protection of water stops during the progress of the work. Damaged water stops shall be replaced and/or repaired as directed.

13.0 PROTECTION OF FRESHLY LAID CONCRETE

- 13.1 Newly placed concrete shall be protected, by approved means, from rain, sun and wind. 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.

14.0 CURING

- 14.1 Concrete shall be cured by keeping it continuously moist wet for the specified period of time to ensure complete hydration of cement and its hardening. Curing shall be started after 8 hours of placement of concrete in normal weather, and in hot weather after 4 hours. The water used for curing shall be of the same quality as that used for making of concrete.

Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliances such as hose, sprinklers etc. A layer of sacking, canvas, hessian, or other approved material, which will hold moisture for long periods and prevent loss of moisture from the concrete, shall be used as covering. Type of covering which would stain, disfigure or damage the concrete, during and after the curing period, shall not be used. Only approved covering shall be used for curing.

Exposed surfaces of concrete shall be maintained continuously in a damp or wet condition for at least the first 7 days after placing of concrete.

The Contractor shall have all equipment and materials required for curing on hand and ready to use before concrete is placed.

For curing the concrete in pavements, floors, flat roofs or other level surfaces, the ponding method of curing shall be used. For the first 24 hours after concreting the concrete shall be cured by use of wet sacking, canvas, hessian etc. The minimum water depth of 25mm for ponding shall be maintained. The method of containing the ponded water shall be approved by the Engineer-in-Charge. The ponded areas shall be kept continuously filled with water, and leaks, if any, shall be promptly repaired. Areas cured by ponding method shall be cleared of all debris and foreign materials after curing period is over.

Alternatively, membrane curing may be used in lieu of moist curing with the permission of the Engineer-in-Charge. Such compounds shall be applied to all exposed surfaces of the concrete by spraying or brushing as soon as possible after the concrete has set. Minimum film thickness of such curing compounds shall be as per the recommendation of the manufacturer so as to obtain an efficiency of 90% as specified by BS-8110. This film of curing compound shall be fully removed from the concrete surface after the curing period specified earlier. Engineer-in-Charge may not allow curing by curing compounds for those surfaces where use of curing compound may be detrimental to application of future finishes over the concrete. Impermeable membranes such as polyethylene sheeting closely covering the concrete surface may also be used.

- 14.2 For concretes containing Portland pozzolana cement or Portland slag cement, the curing period as given in 14.1 shall be doubled. Curing by ponding shall, however, commence after the first 24 hours of concreting.

15.0 FIELD TESTS

15.1 Grading Test

Grading test on fine and coarse aggregates shall be carried out as per IS: 2386 at intervals specified by the Engineer-in-Charge.

The mandatory tests and their frequencies shall be done on sand and stone aggregates as given in Table-3

TABLE – 3
MANDATORY TESTS ON SAND & STONE AGGREGATES

S. No	MATERIAL	TEST	FIELD / LAB TEST	MIN. QTY. OF MATERIAL / WORK FOR CARRYING OUT THE TEST	FREQUENCY OF TESTING
1.	Sand	(a) Bulking of sand	Field	20 m ³	Every 20 m ³ or part thereof or more frequently as decided by the Engineer-in-Charge
		(b) Silt content	Field	20 m ³	
		(c) Particle size distribution	Field or Lab as decided by the Engineer-in-Charge	40 m ³	1) Every 40 m ³ of fine aggregate/ sand required in RCC works only 2) Every 80 m ³ of fine aggregate/sand required for other items
2.	Stone aggregate	a) Percentage of soft or deleterious materials	General visual inspection, laboratory test where required by the Engineer-in-Charge or as specified	As required by Engineer-in-Charge	For all quantities
		b) Particle size distribution	Field or lab. as required by Engineer-in-Charge	45 m ³	For every 45 m ³ or part thereof as decided by Engineer-in-Charge
		Ten percent Fine value	Laboratory	45 m ³	Initial test and subsequent test as & when required by Engineer-in-Charge

15.2 Vee-Bee Test/Slump Test of Concrete

15.2.1 For structural quality concrete (excluding pavements, flooring etc.) at least one Slump Test shall be made for every compressive strength test carried out. More frequent tests shall be made if there is a distinct change in working conditions or if required by the Engineer-in-Charge.

15.2.2 For structural quality concrete for pavements & floorings, measurement of workability shall be by determination of compacting factor. Value of compacting factor of 0.75 to 0.8 shall generally be acceptable.

15.3 Strength Test of Concrete

15.3.1 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.

15.3.2 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 shall be arrived at based on actual testing. In all cases, the 28 days compressive strength specified in Table-1 shall alone be the criterion for acceptance or rejection of the concrete.

15.3.3 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.

15.3.4 Frequency of Sampling

The minimum frequency of sampling of concrete for each grade shall be in accordance with Table-4.

TABLE - 4
FREQUENCY OF CONCRETE SAMPLING

Quantity of concrete in the work in m ³	Number of samples
1-5	1
6-15	2
16-30	3
31-50	4
51 & above	4 plus one additional sample for each additional 50m ³ or part thereof.

At least one sample shall be taken from each shift. Where concrete is produced at continuous production units such as ready mixed concrete plants, frequency of sampling may be agreed upon mutually by Engineer-in-Charge.

15.3.5 Test Specimen

Three test specimens shall be made from each sample for testing at 28 days. Additional cubes may be required for various purposes such as to determine the strength of concrete at 7 days or at the time of striking the formwork or to check the testing error. Additional samples may also be required for testing samples cured by accelerated methods as described in IS: 9013. The specimen shall be tested as described in IS: 516.

15.3.6 Identification mark on concrete test cubes:

The following numbering system shall be adopted on each 150mm cube:

- First line: ZZ (Alpha code assigned by the Engineer –in-Charge to the Contractor for a particular contract starting with AA and progressing to AB, AC and so on).
- Second line: XXXX (Unique integer in ascending order starting from 1).
- Third line: DD-MM-YY (Date of casting of cube).

15.3.7 Test Results of Sample

The test results of the sample shall be the average of the strength of three specimens. The individual variation should not be more than ± 15 percent of the average. If the individual variation is more than ± 15 percent, the test results of the sample shall be considered invalid.

15.3.8 Standard Deviation

- i) Standard deviation based on test results of samples:
 - a) The total number of test samples required to constitute an acceptable record for calculation of standard deviation shall be not less than 30. Attempts shall be made to obtain the 30 samples, as early as possible, when a mix is used for the first time.
 - b) For design of mix in the first instance, the value of standard deviation given in Table-8 of IS: 456 may be assumed.
 - c) As soon as sufficient results of samples are available, actual calculated standard deviation shall be used and the mix design revised/ updated.

15.3.9 Acceptance Criteria

15.3.9.1 Compressive Strength

The concrete shall be deemed to comply with the strength requirement when both the conditions as given in Table-11 of IS: 456 for that particular grade of concrete are simultaneously met. For working out standard deviation compressive test result of date wise serially logged 30 sample test result will be used.

15.3.9.2 Flexural Strength

The concrete shall be deemed to comply with flexural strength requirements when both the following conditions are simultaneously met:

- a) The mean strength determined from any group of four consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm^2 .
- b) For non overlapping consecutive compressive test result any one alternate set of four samples shall be used for verification of compliance to clause no 16.1.a of IS 456.
- c) The strength determined from any test result is not less than the specified characteristic strength less 0.3 N/mm^2

15.3.9.3 Quantity of Concrete Represented by Strength Test Results

The quantity of concrete represented by group of four consecutive test results shall include the batches from which first and last samples were taken together with all intervening batches. Acceptance of concrete shall be applicable for serially logged 30 samples. In case serially logged samples are less than 30 then standard deviation of adjoining previous sample sets standard deviation will be used for establishing acceptance criteria as per clause no 16.1.a of IS 456.

For the individual test result requirements given in Table 5 or in item (b) of 15.3.9.2, only the particular batch from which the sample was taken shall be at risk.

Where the mean rate of sampling is not specified, the maximum quantity of concrete that four consecutive test results represent shall be limited to 60m^3 .

15.3.9.4 If the concrete is deemed not to comply pursuant to 15.3.9.3, the structural adequacy of the parts affected shall be investigated and any consequential action as needed shall be taken (Refer cl. 16.0 & 17.0).

15.3.9.5 Concrete of each grade shall be assessed separately.

15.3.9.6 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 and tests to the fullest satisfaction of the Engineer-in-Charge.

16.0 INSPECTION AND TESTING OF STRUCTURES

16.1 Inspection

To ensure that the construction complies with the design, an inspection procedure shall be set up by the contractor and duly approved by Engineer-in Charge covering materials used, receipt of materials, their test results, records, workmanship and construction etc.

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

16.3 Testing

In case of doubt regarding the grade or soundness of concrete used, either due to poor workmanship or based on results of cube strength, compressive strength tests of concrete on the basis of clause 17.4 and/or load test as per clause 17.6 of IS:456 shall be carried out.

The Engineer-in-Charge shall be the final authority for interpreting the results of all tests and shall decide upon the acceptance or otherwise. The decision of the Engineer-in-Charge shall be final and binding on the contractor. In case the results of the tests are unsatisfactory, the Engineer-in-Charge may instruct the contractor to demolish and reconstruct the structure or part thereof without any extra cost to the Owner.

16.4 Members other than Flexural Members

Members other than flexural members like columns etc. shall be referred to the designer to investigate the structural adequacy. The decision of the designer shall be final and binding on the contractor.

16.5 Non - destructive Tests

Non-destructive tests using Ultrasonic Pulse Velocity and Rebound Hammer methods shall be resorted to for checking the soundness of concrete placed and shall be as per the directions of Engineer-in-Charge. The testing shall be based on IS: 13311, Part-1. However, the Rebound Hammer test (IS: 13311, Part-2) shall only be used in combination with other tests (Destructive or Non-Destructive) for checking the concrete quality.

17.0 FINISHING OF CONCRETE

- 17.1 On striking the formwork, all surface defects such as bulges, ridges and honey-combing etc. observed shall be brought to the notice of the Engineer-in-Charge. The Engineer-in-Charge may, at his discretion allow rectification by necessary chipping and packing or grouting with concrete or cement mortar. However, if honey-combing or sagging is 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, demolishing and reconstructing the structure. However, quantity of cement actually used for this purpose may be considered for reconciliation of materials. 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 similar to that of the rubbed down shuttered faces. Concealed concrete faces shall be left as from the formwork except that honey-combed surface shall be made good as specified above. The top faces of slabs not intended to be covered shall be levelled and floated to a smooth finish to the rises or falls shown on the drawings or as directed. 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 finishes, shall be left with a rough finish.

17.2 Repair and Replacement of Unsatisfactory Concrete

- 17.2.1 Repair shall be made as soon as possible after the forms are removed and before the concrete becomes too hard with prior permission from the Engineer-in-Charge, in writing. Stone pockets, segregation patches and damaged areas shall be chipped out and the edges undercut slightly to form a key. All loose material shall be washed out before patching. No excess water shall be left in the cavity, but the concrete shall be damp. A good bond between the patch and parent concrete shall be obtained by sprinkling dry cement on the wet surface or by throwing mortar with force on to the wetted concrete, or by brush in a coat of thick cement grout of about 1:1 (1 cement:1 sand) just before applying the patching material. Before this has dried, the remainder of the patch shall be filled with mortar or concrete, depending on the extent of the repair.
- 17.2.2 Cement concrete/mortar used in repair of exposed surfaces shall be made with cement from the same source as that used in concrete and blended with sufficient amount of white Portland cement to produce the same colour as in the adjoining concrete. The proportions of ingredients shall be same as those used in parent concrete. The mortar shall be as dry as possible and well compacted into the cavity. All filling shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the filling has been cured and dried.
- 17.2.3 For larger repairs to hardened concrete, necessary formwork bearing tightly at the edges of the cavity shall be provided. Concrete shall be chipped out to a depth of at least 100mm and preferably 150mm. Mortar shall be scrubbed into all surfaces with a wire brush before placing the concrete. Damaged reinforcement shall be adequately spliced with new steel so as to maintain the original strength. Additional reinforcement, if required in the patch, shall be provided as per the instructions of Engineer-in-Charge.
- 17.2.4 In case in the opinion of the Engineer-in-Charge defects in the concrete is excessive or beyond repair, the contractor shall either redo the structure or take other remedial measures as instructed by the Engineer-in-Charge. The decision of the Engineer-in-Charge shall be final and binding to all in this respect.

17.2.5 Approved epoxy formulation for bonding fresh concrete used for repairs with already hardened concrete shall be used by the Contractor if asked by the Engineer-in-Charge. Epoxy shall be applied in strict accordance with EIL Specification 6-68-0056 and the instructions of the manufacturer.

17.2.6 All repair works due to non-conformance or non-adherence to specification, if allowed by the Engineer-in-Charge, shall be carried out free of cost to the owner.

17.3 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.

18.0 CEMENT WASH

If not otherwise provided with protective coating due to architectural and/ or geo-technical requirements, all concrete elements (whether cast-in-situ or precast) exposed to atmosphere shall be provided with three coats of cement based waterproof paint as per IS:5410. Prior to application of the paint, the surface shall be prepared to remove all foreign particles, loose materials, extra deposited concrete lumps, etc. using appropriate mechanical/ manual means.

19.0 FORM WORK

19.1 General

19.1.1 Forms for concrete shall be of plywood conforming to IS: 6461 or steel or as directed by the Engineer-in-Charge and shall give smooth and even surface after removal thereof.

19.1.2 If it is desired by the Engineer-in-Charge, the Contractor shall prepare, before commencement of actual work, design and drawings for formwork and get them approved by the Engineer-in-Charge. For details regarding design, detailing etc., reference may be made to IS:14687.

19.1.3 Form work and its supports shall maintain their correct position and be to correct shape and profile so that the final concrete structure is within the limits of dimensional tolerances specified below, unless required otherwise, for functional/aesthetic reasons. The decision of the Engineer-in-Charge shall be final and binding in this regard.

(a) Deviation from specified dimensions - 6mm to +12mm
of cross section of columns and beams.

(b) Deviation from dimensions of footings (see Note below)

- i. Dimensions in plan -12mm to +50mm
- ii. Eccentricity 0.02 times the width of the footing in the
 1. direction of deviation but not
 2. More than 50 mm.
- iii. Thickness ± 0.05 times the specified thickness.

Note: These tolerances apply to Cast-in-situ concrete dimensions only, not to positioning of vertical reinforcing steel or dowels.

(c) Deviation in length (major dimension of single unit)

upto 3m	+6mm
3m to 4.5m	+9mm
4.5m to 6m	+12mm
Additional deviation for every subsequent 6m.	+6mm

- (d) Deviation in straightness or bow (deviation from specified line) for a single or continuous member) e.g. beam, column or slab edge.

upto 3m	6mm
3m to 6m	9mm
6m to 12m	-12mm
additional for every subsequent 6m.	-6mm

- (e) Deviation in squareness shall be measured taking the longer of two adjacent sides as the base line.

The shorter side shall not vary in its distance from a perpendicular so that the difference between the greatest and shortest dimensions exceeds 6mm. For this purpose, any error due to lack of straightness shall be ignored. Squareness shall be checked with respect to the straight lines that are most nearly parallel with the features being checked. When the nominal angle is other than 90 degree, the included angle between check lines shall be varied accordingly.

- (f) Deviation in twist shall be within a limit such that any corner shall not be more than the limit given below from the plane containing other three corners:

upto 600mm wide and upto 6m in length	-6mm
over 600mm wide and for any length	-12mm

- (g) Maximum deviation in flatness from a 1.5m straight edge placed in any position on a nominally plain surface shall not exceed 6mm.

- (h) The tolerance limits for concrete columns/pedestals shall be same as given in part A of ANNEXURE-A of EIL Specification No. 6-68-0006.

19.2 Form Requirement:

- 19.2.1 The formwork shall be true, rigid and adequately braced both horizontally as well as diagonally. The forms shall have smooth and even surface and be sufficiently strong to carry, without deformation, the dead weight of the green concrete, working load, wind load and also the side pressure exerted by the green concrete. As far as practical, clamps shall be used to hold the forms together. Where use of nails is unavoidable minimum number of nails shall be used. Projected part of nail shall not be bent or twisted for easy withdrawal.
- 19.2.2 Where through tie rods are required to be put to hold the formwork and maintain accurate dimension, they shall always be inserted through a precast concrete block (of same mix proportion as is to be used for concreting) with a through hole of bigger diameter. The Precast block shall tightly fit against in inner faces of formwork. The holes left after the withdrawal of tie rods shall be fully grouted with cement-sand mortar of same proportion as that used for concrete. However, use of such precast block shall in no case impair the desired appearance or durability of the structure. No such tie rods shall be used in any liquid retaining or basement structure.
- 19.2.3 Tie wires shall be permitted only upon approval of the Engineer-in-Charge and shall be cut off flush with the face of the concrete or counter sunk, filled and finished in the manner specified in clause 17.

- 19.2.4 Form joints shall not permit any leakage. The formwork shall be strong enough to withstand the effect of vibrations practically without any deflection, bulging, distortion or loosening of its components.
- 19.2.5 Forms for beams and slabs (span more than 6.0m) shall have camber of 1 in 500 so as to offset the deflection and assume correct shape and line after deposition of concrete. For cantilevers, the camber at free end shall be 1/100th of the projected length. Where architectural considerations and adjunctive work are critical, smaller form cambers shall be adopted as decided by the Engineer-in-Charge.
- 19.2.6 All vertical wall forms may be designed and constructed for the following minimum pressure. The pressures listed in Table-6 are intended as guide only and the Contractor shall ensure that the formwork is adequately strong and sturdy.

**TABLE - 6
MINIMUM DESIGN PRESSURE FOR WALL FORMWORK**

Rate of pour in meter/hour	Pressure in kN/m ²	
	at 10° (in Celsius)	at 24° (in Celsius)
0.6	36.0	29.0
0.9	40.0	32.0
1.2	44.0	35.0
1.5	46.0	37.0

All horizontal forms shall be designed and constructed to withstand the dead load of the green concrete, reinforcement, equipment, material, embedment and a minimum live load of 2.0 kN/m².

19.3 Inspection of Forms

Temporary openings shall be provided at the base of column and wall forms and other places necessary to facilitate cleaning and inspection. 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. The complete form work shall be inspected and approved by the Engineer-in-Charge before the reinforcement bars are placed in position. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the work shall be stopped until the defects have been corrected as per the instructions of the Engineer-in-Charge.

19.4 Cleaning and Treatment of Formwork

The surfaces of forms that would come in contact with concrete shall be well treated with approved non- staining form release agents such as soft soap, oil, emulsions etc. Release agents shall be applied so as to provide a thin uniform coating to the forms without coating the reinforcement.

19.5 Chamfers and Fillets

All corners and angles shall be formed with 45 degree mouldings to form chamfers or fillets on the finished concrete. The standard dimensions of chamfers and fillets, unless otherwise detailed or specified shall be 25x25mm. For heavier work chamfers or fillets shall be 50x50mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaced to the same texture as the forms to which it is attached.

19.6 Reuse of forms

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

19.7 Removal of Forms/Stripping Time

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

Forms and their supports shall not be removed without the approval of the Engineer-in-Charge. Forms shall not be released until the concrete has achieved a strength of at least twice the stress to which the concrete may be subjected at the time of removal. The formwork shall be removed without shock and methods of form removal likely to cause over stressing or damage to the concrete, shall not be adopted. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

In normal circumstances when average air temperature exceeds 15 degree Celsius during the period under consideration after pouring of concrete and where ordinary Portland cement is used, forms may generally be removed after expiry of following periods.

- | | |
|---|---|
| (a) Walls, columns and vertical faces of all structural members | 16 to 24 hours as may be decided by the Engineer-in-Charge. |
| (b) Slabs (props left under) | 3 days. |
| (c) Beam Soffits (props left under) | 7 days. |
| (d) Removal of props under slabs: | |
| Spanning upto 4.5m. | 7 days. |
| Spanning over 4.5m. | 4 days. |
| (e) Removal of props under beams and arches: | |
| Spanning upto 6m | 14 days. |
| Spanning over 6m | 21 days |
| (f) Cantilever Construction Formwork shall remain till structures for counter acting or bearing down have been erected and have attained sufficient strength (minimum 14 days). | |

Notes:

- For other cements, the stripping time recommended for ordinary Portland cement shall be suitably modified as per the instructions of the Engineer-in-Charge.
- The number of props left under, their sizes, supporting arrangement, 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 together with any live load likely to occur during curing or further construction.

3. Where the shape of the element is such that the formwork 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.
4. For rapid hardening cement, 3/7 of the above mentioned periods shall be considered subject to a minimum of 16 hours.

19.8 Staging/Scaffolding

19.8.1 Staging/Scaffolding shall be properly planned and designed by the Contractor. Use of only steel tubes is permitted for staging/scaffolding. The Contractor shall get it reviewed by Engineer-in-Charge before commencement of work. While designing and during erection of scaffolding/staging, the following measures shall be considered:

- (a) Sufficient sills or under pinnings in addition to base plates shall be provided particularly where scaffolding are erected on soft grounds.
- (b) Adjustable bases to compensate for uneven ground shall be used.
- (c) Proper anchoring of the scaffolding/staging at reasonable intervals shall be provided in each direction with the main structure wherever available.
- (d) Horizontal braces shall be provided to prevent the scaffolding/staging from rocking.
- (e) Diagonal braces shall be provided continuously from bottom to top between two adjacent rows of uprights.
- (f) The scaffolding/staging shall be checked at every stage for plumb line.
- (g) Wherever the scaffolding/staging is found to be out of plumb line it shall be dismantled and re-erected afresh and effort shall not be made to bring it in line with a physical force.
- (h) All nuts and bolts shall be properly tightened and care shall be taken that all clamps/couplings are firmly tightened to avoid slippage
- (i) Erection work of a scaffolding/staging under no circumstances shall be left totally to semi-skilled or skilled workmen and shall be carried out under the supervision of a technically qualified civil engineer of the Contractor.

19.8.2 For smaller works or works in remote areas, wooden ballies may be permitted for scaffolding/staging by the Engineer-in-Charge at his sole discretion. The contractor must ensure the safety and suitability of such works as described under clause 19.8.1 above.

20.0 EXPOSED/ARCHITECTURAL CONCRETE WORK

20.1 Form Work

Other things remaining same as per clause 19.0, formwork shall be of high quality. Care shall be taken to arrange the forms so that the joints between forms correspond with the pattern indicated in the drawings. The forms shall be butting with each other in straight lines, the corners of the boards being truly at right angles. The joints between the forms shall cross in the two directions at right angles. The size of forms shall be so selected as to exactly match with the pattern of forms impression on the concrete face indicated in the drawings. Maximum care shall be taken to make the form work watertight. Burnt oil shall not be used

for treatment of forms. The Contractor shall be permitted reuse of forms brought new on the work for exposed concrete work as specified below.

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

a) Plywood Forms 6 Reuses (max.)

b) Steel Forms 10 Reuses (max.)

The Engineer-in-Charge may, at his absolute discretion, order removal of any forms considered unfit for use in the work irrespective of the number of uses specified above.

20.2 Finishing

Repairing to exposed concrete work shall be avoided. Rendering and plastering shall not be done. Minor repairing, if unavoidable shall be done as specified in clause 17.0 with the written permission of the Engineer-in-Charge.

21.0 REINFORCEMENT

21.1 The Contractor shall develop the bar bending schedule for all RCC structures/ structural parts at no extra cost to the Owner and shall get it reviewed by the Engineer-in-charge. Reinforcement shall be cut and bent to shape as per dimensions shown in the bar bending schedule/ drawings.

If protective fusion bonded epoxy coating is required to be applied on reinforcement bars, the same shall be done as per IS: 13620. All repairs to applied protective coating required due to mishandling and/ or bending of reinforcement bars shall also be done as per relevant clauses of IS:13620.

21.2 Straightening, Cutting and Bending

Procedure for cutting and bending shall be as given in IS: 2502. In case bars are supplied in coils, they shall be smoothly straightened without any kinks.

Cold twisted deformed bars shall be bent cold. Bars larger than 25mm in size (except cold twisted deformed bars) may be bent hot at cherry red heat to a temperature not exceeding 850° Celsius as per the instructions of the Engineer-in-Charge. The bars shall be allowed to cool gradually without quenching.

Bars shall be bent in a slow and regular movement to avoid fractures. Bars which develop cracks or splits after bending shall be rejected. A second bending of reinforcement bars shall be avoided but when reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be taken to ensure that at no time is radius of the bend less than 4 times bar diameter for plain mild steel or 6 times bar diameter for high strength deformed bars. Care shall also be taken when bending back bars to ensure that concrete around the bars is not damaged. All bars shall be properly tagged for easy identification.

21.3 Placing and Fixing

All reinforcement shall be cleaned to ensure freedom from loose mill scale, loose rust, oil, form releasing agents, grease or any other harmful material before placing them in position. Reinforcement shall not be surrounded by concrete unless it is free from all such materials. Rough handling and dropping of reinforcement from a height shall be avoided

All reinforcement shall be fixed in the correct position and shall be properly supported to ensure that displacement will not occur when the concrete is placed and compacted.

The uncoated reinforcement bars shall be tied at every intersection by two strands of 16 SWG black soft annealed binding wire. The Epoxy coated reinforcement bars shall be tied with 2 strands of PVC coated GI 18 SWG wire at every intersection. Crossing bars shall not be tack welded for assembly of reinforcement. The reinforcement bars shall be kept in position by using the following methods:

- a) In case of beam and slab construction, precast cover blocks (having the same sand contents as the concrete which shall be placed) of size 40 x 40 mm and thickness equal to the specified covers shall be placed firmly in between the bars and forms so as to secure and maintain the specified covers over the reinforcement.

When reinforcement bars are placed in two or more layers in beams, the vertical distance between the horizontal bars shall be maintained by introducing spacer bars at 1 to 1.2m centre to centre.

- b) In case of thick rafts & pile caps having two or multilayers of reinforcement, the vertical distance between the horizontal bars shall be maintained by introducing suitable chairs, spacers, etc.
- c) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them. The templates shall be removed after the concreting has been done below it.
- d) Exposed portions of reinforcement bars shall not be subjected to impact or rough handling and workmen will not be permitted to climb on extending bars until the concrete has attained sufficient strength so that no movement of the bars in the concrete is possible.

21.4 Special requirements for Handling, Stacking, Placing of Epoxy coated Reinforcing bars.

Epoxy coated reinforcing bars shall be carefully handled and it shall be ensured that these do not rub on any hard surface or against another epoxy coated/uncoated reinforcing bar whether during conveying/transportation, stacking or placing.

During transportation and while stacking the epoxy coated reinforcing bars shall be placed on wooden planks not spaced farther than 600mm. When placed in stacks the epoxy coated reinforcing bars shall be neatly tied in bundles using PVC binding material.

The cut ends of bars shall be touched up with special touch up material of specifications as provided by the coating agency. After cutting of the bar the application of touch up material shall be completed within four hours.

While bending the bars the pins of work bench(s) shall be provided with a PVC or plastic sleeve. Each bending operation on epoxy coated reinforcing bar shall be completed in time not less than 90 seconds.

Epoxy coated reinforcing steel bar shall not be directly exposed to sun rays or rain, and shall be protected with opaque polyethylene sheets or similar means as approved by the Engineer in Charge.

While doing concreting the workmen or machinery shall not rest or move on the epoxy coated reinforcing bars. Wooden planks shall suitably be placed to create proper gang-way.

21.5 Splicing/Overlapping

Only bars of full length shall be used as shown in the drawings. But where this cannot be done, overlapping of bars shall be done as directed by the Engineer-in- Charge. Where practicable, the overlapping bars shall not touch each other, but these shall be kept apart by 25mm or 1.25 times the maximum size of the coarse aggregate whichever is greater. But where this is not possible, the overlapping bars shall be tied with two strands of 16 SWG black soft annealed binding wire for uncoated bars and with PVC coated GI 18 SWG wire for Epoxy coated bars. The overlaps shall be staggered for different bars and located at points along the span where neither shear nor bending moment is maximum.

21.6 Welded Joints

Welding of reinforcing bars shall not be permitted without the written permission of the Engineer-in- Charge. If Fusion Bonded Epoxy coated bars are used, welding of reinforcing bars shall generally not be permitted. However, if permitted, the joint shall be coated with epoxy as per BS: 7295. Where welding of uncoated reinforcing bars is permitted, it shall be in accordance with the recommendations of IS: 2751 and IS: 9417. Welded joints shall be located at suitable staggered positions. Tests shall be made as directed by the Engineer-in-Charge to prove that the joints are of the full strength of the bars. Maximum one welded joint shall be allowed per bar.

21.7 Mechanical Connections

The mechanical splices in reinforcement by means of couplers, clamps etc. shall be used (as per manufacturer's specifications) with the written approval of the Engineer-in-Charge. However, tests shall be made as directed by Engineer-in-Charge to prove that such connections are of the full strength of the bars on trial joints. Mechanical connections for Fusion Bonded Epoxy coated bars shall not be used.

21.8 Tolerances on Placing of Reinforcement

Unless otherwise directed by the Engineer-in-Charge, reinforcement shall be placed within the following tolerances:

- | | |
|--|-------------------|
| a) For effective depth 200mm or less | $\pm 10\text{mm}$ |
| b) For effective depth more than 200mm | $\pm 15\text{mm}$ |

21.9 Substitution

When indicated diameter of reinforcement bar is not available, the Contractor shall use other diameter of reinforcement bars on written approval of the Engineer-in-Charge.

21.10 Tolerance to Cover

The actual concrete cover shall not deviate from the required nominal cover by – 0 mm to + 10 mm measured over the steel reinforcement including links.

22.0 PRECAST CONCRETE

- 22.1 Specifications contained in clauses above regarding concrete, formwork and reinforcement shall apply in addition to the clauses given as under. The Contractor shall get the precasting bed approved by the Engineer-in-Charge.
- 22.2 Necessary lifting hooks of suitable (but not less than 12mm dia) diameter M.S. rounds shall be provided for handling, as indicated in drawings or as directed by the Engineer-in-Charge.
- 22.3 Unless otherwise specified, the exposed surfaces of precast members shall be integrally finished smooth. For precast slabs or planks, the top surface shall be finished with 1:3 (1 cement: 3 sand) cement mortar. Surface used as walkways shall be given a non-skid finish.
- 22.4 The precast concrete units shall be marked clearly on top surface with the letter "T" for identification of surfaces at the time of erection and shall be stored properly until required for erection. The precast units shall be handled and erected by methods approved by the Engineer-in-Charge to protect them from damage.
- 22.5 Precast concrete elements shall not be removed from the casting bed until the concrete has developed its characteristic compressive strength based on cube test results.
- 22.6 The units shall be suitably handled, transported, stored and placed taking all necessary safety precautions to avoid development of undue stresses caused by vibrations, impact or lateral forces. During shipment and while in storage, the units shall be placed on suitable blocks to provide clearance from bed/ground.
- 22.7 The Contractor shall take all necessary precautions for safe handling during the course of erection. The Contractor shall replace at his own expense all such units which are damaged during the course of erection. Cement used for a damaged/rejected precast elements shall not be taken into account for material reconciliation.
- 22.8 The inspection for precast concrete units during casting shall be same as applicable to normal concrete works. However, additional inspection checks shall be made during and after erection of units to ensure its suitability for the required service as a structural member. These checks shall include inspection to detect chipping, cracks, warpages in the precast units etc due to improper handling and storage, improper jointing (if required) of the precast unit with the structure and improper finishing.
- 22.9 Fabricated precast concrete units containing defects originating due to use of improper materials or workmanship, excessive repair and not conforming to design drawings shall be rejected. Such rejected units shall not be taken into account for material reconciliation or payment.

23.0 CONTINUOUS CONCRETING

- 23.1 Where called out on the drawings, continuous concreting shall be done in a single operation as per the requirements of IS: 456 and IS: 2974. It shall be ensured that clause 8.3 of these specifications is not violated in case of continuous concreting. Sufficient "Windows" shall be left in the formwork for pouring & compaction of concrete and inspection. These windows shall be fixed tight once the level of concrete reaches their levels.

24.0 CONCRETING UNDER SPECIAL CONDITIONS

- 24.1 Work in extreme weather conditions during hot or cold weather, the concreting shall be done as per procedure set out in IS: 7861(Part 1) or IS: 7861 (Part2).

- 24.2 Under water concreting.
Concreting shall be as per clause 14.2 of IS: 456.

25.0 PAYMENT

25.1 Plain and Reinforced Concrete

- 25.1.1 Payment for plain and reinforced cement concrete (cast- in-situ) shall be made on cubic metre basis of the volume of the actual finished work done or as per approved construction drawings, whichever is less and shall be inclusive of providing pockets, openings, recesses of all sizes, chamfers, fillets, grooves, separation/ expansion/ isolation/ construction/ movement joints, cement wash, curing by normal moist curing or using curing compound etc. as directed by Engineer-in-Charge etc. The rates shall be deemed to include complete cost of getting the respective mix designs approved, making and testing concrete cubes and carrying out other tests including tests of various ingredients, as per specifications and as directed by Engineer-in-Charge. Payment shall, however, be separately made for tests on concrete cubes done by accelerated methods of curing as defined in IS: 9013.
- 25.1.2 No separate payment shall be made for any additive/ admixture used by the contractor for accelerating or retarding the strength of concrete or for achieving specified workability/water tightness. The rate quoted shall be deemed to be inclusive of all costs related to any such additive/ admixture.
- 25.1.3 The rate shall however be exclusive of reinforcement, metal inserts, pipe sleeves, formwork, water stops and any filler material in expansion/isolation joints.
- 25.1.4 Where the strength of concrete mix as indicated by tests, lies in between the strengths of any two grades given in Table-1 and it is accepted by the Owner/Engineer-in-Charge, such concrete shall be classified as a grade belonging to the lower of the two grades between which it lies. In case the cube strength shows higher results than those specified for the particular grade of the concrete, it shall not be placed in the higher grade nor shall the Contractor be entitled for any extra payment on such account. The concrete giving lower strength than specified may be accepted at reduced rates after satisfying the safety of the structure by checking it with tests as specified or rejected entirely at the discretion of the Engineer-in- Charge. The rejected concrete shall be dismantled at no extra cost to the owner and no payment or extension of time shall be granted for the concrete so rejected and the formwork and reinforcement used for the same. Cost of any material supplied by the Owner free of cost shall be recovered from the Contractor at double the prevailing market rate. In case the concrete of lower strength can be improved by carrying out some strengthening measures entirely at the discretion of the Engineer-in-Charge, then the said measures including all related tests shall be carried out by Contractor at his own cost. If the Contractor is able to make up the strength to the required grade by such improvement measures to the entire satisfaction of Engineer-in-Charge, payment shall be made for the grade achieved. However, if the strength of concrete is not made up to the strength of required grade, payment shall be made only for the lower strength if such concrete is accepted by the Engineer-in-Charge.
- 25.1.5 Deductions for openings, pockets etc. shall be as specified in relevant Indian Standard Codes.
- 25.1.6 Payment under continuous concreting item in the schedule of rates shall be made only where the total quantity of concrete between two consecutive construction joints specifically called-out on the drawings exceeds 250 cubic metres. For any foundation/structure involving concrete quantity upto 250 cubic metres between two consecutive construction joints shown on drawings, the concrete shall not be measured or paid for under this category (i.e. continuous concreting), although the same is required to be constructed in single pour.

The rate quoted against this item shall be inclusive of all extra costs incurred by the Contractor for arranging continuous pouring of concrete and others as specified complete.

25.2 Form Work

Unless otherwise specified, payment for form work shall be on square metre basis of the actual area in contact with the concrete cast. The rates shall be inclusive of keeping the formwork for the full period as specified in the above clauses and removing the same after the period is over. No extra payment shall be made for providing scaffolding/staging/access/stairways/ladders etc.

The rates shall be inclusive of any provision to be made or kept in the formwork for providing dowels, inserts etc.

Superior quality formwork for exposed/architectural concrete work shall be measured and paid separately under the relevant item in the schedule of rates.

25.3 Reinforcement

25.3.1 Payment for plain round mild steel reinforcement bars and high strength deformed steel bars shall be on the basis of weight of bare steel irrespective of any coating applied in metric tons. The weight of the bar shall be derived from the sizes and corresponding unit weights given in handbook of Bureau of Indian Standards. Standard hook lengths, chairs, spacer bars and authorised laps only shall be included in the weight calculated. Binding wire shall not be weighed nor otherwise measured. Measurements for weight shall not include cutting allowance etc.

25.3.2 Rate quoted for uncoated reinforcement shall include cost of supplying, decoiling, straightening, cleaning, cutting, bending, placing, binding, welding, if required, and providing necessary cover blocks of concrete.

25.3.3 Rate quoted for Fusion Bonded Epoxy Coated bars shall also include, apart from those mentioned in Cl. 25.3.2, cost of coating of the bars, all necessary tools and tackles and any repairs required due to damage to coating as per IS:13620.

25.3.4 Payment for mechanical threaded couplers shall be made on number basis (each). The rate shall include supply of complete assembly, fixing, testing etc. all complete.

25.4 Water Stops/Water Bars & Expansion/Isolation Joints

25.4.1 Payment for PVC water bars shall be made on running metre (RM) basis of the water stops provided in position. Rate shall include supplying cutting, fixing, jointing by vulcanising or any other approved method, wastage, etc. complete.

25.4.2 Payment for filler materials in Expansion/Isolation joints shall be made on running metre basis of the joint provided. For boards provided at expansion/isolation joints, the measurement shall be made on square metre basis. Rate shall be inclusive of supply, cutting, fixing, jointing, wastage etc. complete.

25.5 Pre-cast Concrete

25.5.1 Payment for precast concrete members shall be made on cubic metre basis of the volume of the finished member. The rate quoted shall include cost of formwork, preparation of casting yard, finishing as specified, curing, handling, fixing in position, breaking masonry and/or concrete surfaces and making good the same etc. Reinforcement shall be paid separately

under relevant items. Lifting hooks shall be paid on the same basis as reinforcement. Metal inserts shall be paid as per relevant clauses of Specification No. 6-68-0008 (Miscellaneous Steel Works).

- 25.5.2 The quoted rate shall be inclusive of providing pockets, openings, recesses of all sizes, chamfers, fillets grooves, holes, cement wash, curing (hot, cold or by using curing compounds). The rate shall be deemed to include complete cost of taking and testing concrete cubes and carrying out other tests including tests of various ingredients as per specification and as directed by the Engineer-in-Charge.
- 25.5.3 The rate shall however be exclusive of reinforcement, metal inserts, pipe sleeves. Where the strength of concrete mix as indicated by tests, lies in between the strengths of any two grades given in clause 3.0 and it is accepted by the Owner/Engineer-in-Charge, such concrete shall be classified as a grade belonging to the lower of the two grades between which it lies. In case the cube strength shows higher results than those specified for the particular grade of the concrete, it shall not be placed in the higher grade nor shall the Contractor be entitled for any extra payment on such account. The concrete giving lower strength than specified may be accepted at reduced rates after satisfying the safety of the structure by checking it with tests as specified or rejected entirely at the discretion of the Engineer-in-Charge. The rejected concrete shall be dismantled at no extra cost to the owner and no payment or extension of time shall be granted for the concrete so rejected and the formwork and reinforcement used for the same. In case the concrete of lower strength can be improved by carrying out some strengthening measures entirely at the discretion of the Engineer-in-Charge, then the said measures shall be carried out by Contractor at his own cost. If the Contractor is able to make up the strength to the required grade by such improvement measures to the entire satisfaction of Engineer-in-Charge, payment shall be made for the grade achieved. However, if the strength of concrete is not made up to the strength of required grade, payment shall be made only for the lower strength if accepted by the Engineer-in-Charge.

25.6 Cement Wash

- 25.6.1 No payment shall be made for cement wash separately and is deemed to be covered in cl. 25.1.1 & 25.5.2.

25.7 Continuous Concreting

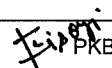
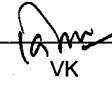
Payment shall be made as per clause 25.1 of this specification. The rate shall be deemed to be inclusive of all extra cost related to labor, shuttering, staging and making all other arrangements for such continuous casting e.g. provisions for adequate movement and storage spaces, special gangways, scaffolding, additional construction equipments, adequate lighting and supervision while the work continues round the clock etc. The rate shall also be inclusive of all costs related to concreting in any thickness, shape and position and at any height or depth so as to avoid any cold joint between specified construction joints.

मानक विनिर्देशन सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION CIVIL & STRUCTURAL WORKS

विभिन्न इस्पात कार्य

MISCELLANEOUS STEEL WORKS

5	10.06.08	REVISED & REISSUED		PKB		PKM		VK		VC
4	18.04.00	UPDATED & REISSUED		DPN	RS	SCJ	MI			
3	MAY'94	UPDATED & REISSUED		DPN	RS	GPL	AS			
Rev. No	Date	Purpose		Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman	Approved by		

Abbreviations:

BIS	:	Bureau of Indian Standards
IS	:	Indian Standard
M.S.	:	Mild Steel
PCC	:	Plain Cement Concrete
RCC	:	Reinforced Cement Concrete

Structural Standards Committee

Convenor : Mr Vinay Kumar

Members : Mr SK Kapoor
Mr S Chaturvedi
Mr SB Jain
Mr PK Mittal
Mr S Debnath
Mr Samir Das
Mr S Kaul (Project)
Mr Amarjeet Singh (Constn.)

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1.0 GENERAL

- 1.1 All materials supplied by the Contractor shall conform to specifications given in EIL Specification No.6-68-0002.
- 1.2 The Contractor shall furnish test certificates for all materials prior to their use in the works. Structural steel materials not supported by mill test certificates may be used after confirming their quality by carrying out appropriate tests in accordance with the method specified in IS:1608.
- 1.3 Other requirements not covered under this specification shall be in accordance with EIL Specification No.6-68-0006.

2.0 REFERENCES

As mentioned in the respective clauses.

3.0 MATERIAL

As mentioned in the respective clauses.

4.0 ANCHOR BOLTS

4.1 Material

Materials for anchor bolts, nuts, locknuts, washers, pipe sleeves and anchor plates shall conform to their respective clauses given in EIL Specification no.6-68-0002.

4.2 Fabrication

Fabrication of anchor bolts and their complete assemblies shall be strictly in compliance with the specifications and drawings/standards.

4.3 Placement

Anchor bolt assemblies shall be placed in position strictly as per drawings and securely held during pouring and vibrating of concrete with necessary templates and other dummy structures to prevent their dislocation.

4.4 Tolerances

Tolerances allowed for anchor bolts positioning shall be as below:

- For sleeved bolts, one tenth of the bolt nominal diameter.
- For bolts without sleeves, one twentieth of the bolt nominal diameter.

4.5 Protection

The exposed surfaces of bolts shall be properly covered (after greasing of bolts and packing of sleeves) with jute cloth so as to protect them from damage till final erection of structure/equipment is over.

4.6 Payment

This clause shall apply to Item Rate tender only.

- 4.6.1 Payment shall be made on the basis of actual weight in metric tons of the anchor bolt/anchor bolt assembly. The rate shall include supply (as per scope of supply conditions given in the tender) of all materials, handling, transporting, fabrication, turning from available size refer 6.6.2 round to required diameter, threading, welding, fixing in position at all levels and locations, providing necessary templates, greasing, packing of sleeves, covering with jute cloth and other protective measures etc. all complete.
- 4.6.2 The rate shall cover bolt of any diameter and nomenclature.
- 4.6.3 Payment for fixing anchor bolt assembly (already fabricated and supplied by the Owner as free issue) in position shall be made on the basis of actual weight of anchor bolts/bolt assemblies in metric tons. The rate shall include handling, transporting, fixing in position at all levels and locations, welding if required, providing necessary templates, greasing, packing of sleeves, covering with jute cloth and other protective measures etc. all complete.
- 4.6.4 No separate payment shall be made for templates, dummy structures, supports etc. and the rate quoted shall be inclusive of all cost related to such provision required for correct and accurate installation of anchor bolts/anchor bolt assembly.

5.0 METAL INSERTS

5.1 Material

Materials required for fabricating metal inserts shall conform to their respective specification given in EIL Specification no. 6-68-0002.

5.2 Fabrication

Fabrication of inserts shall be done strictly as per drawings/standards and in compliance with the requirements given in EIL Specification no. 6-68-0006.

5.3 Placement

Metal inserts shall be correctly embedded (in plain concrete/reinforced concrete) as per their location shown on the drawings. Care shall be taken that these are securely held in position and do not get disturbed during concreting. Where necessary, these may be welded to the reinforcement bars. Suitable templates, spacers, dummy structures and temporary staging shall be provided. Necessary cutting in the formwork and adjustment of reinforcement bars shall be done for the placement of metal inserts where required.

5.4 Painting

The exposed surfaces of metal inserts shall be cleaned and given one coat of primer as per EIL Specification no. 6-44-0004 or job specification, as specified, after fabrication.

5.5 Payment

This clause shall apply to Item Rate tender only.

- 5.5.1 Payment shall be made on the basis of actual weight in metric tons of the metal inserts. The rate shall include supply (as per supply conditions given in the tender) of all materials, handling, transporting, fabrication, welding, fixing in position at all levels and locations,

providing necessary templates, spacers, dummy structures, adjusting the formwork and reinforcement, staging, preparation of surface for painting, applying one coat of primer as per EIL Specification no. 6-44-0004 or job specification, as specified, etc. all complete.

6.0 CHEQUERED PLATES

6.1 Material

Material required for chequered plates shall conform to the specifications given in EIL Specification No. 6-68-0002. Chequering shall be closed or open-ended or of any other pattern as shown on drawings.

6.2 Fabrication Drawings

Refer clause 4.0 of EIL Specification No. 6-68-0006.

6.3 Fabrication

Chequered plates shall be fabricated as per the "Approved for Construction" fabrication drawings (prepared by the Contractor based on design drawings). These shall be perfectly flat and without any dents/deformations and shall be cut to the required size and shape. Holes/notches/openings of the required size, if any, shown on drawings shall be made. Nosing for staircase treads shall be made by cold bending of chequered plates. All edges shall be made smooth and even. All chequered plate units shall be given distinct erection marks in accordance with the marking drawings. Stiffeners of any description shall be welded with the chequered plates where shown on drawings.

6.4 Erection/Fixing

Chequered plates shall be fixed to the bearing members by welding/ bolting/ screwing as shown on drawings. All bolts/screws shall be of counter-sunk type so that the heads remain flush with the top of plate. Where welding is used for fixing, stitch welds of minimum 50mm length with a pitch of 150mm shall be used. Continuous sealing run of weld shall be provided along the junction of two consecutive chequered plates parallel to the span. For removeable flooring, details as shown on drawings shall be followed.

6.5 Painting

Chequered plates shall be cleaned (both the surfaces) and given one coat of primer as per EIL Specification No. 6-44-0004 or job specification, as specified, on both surfaces.

6.6 Payment

This clause shall apply to Item Rate tender only.

6.6.1 Payment shall be made on the basis of admissible weight in metric tons (determined as described in clause 6.6.3) of the chequered plates accepted by the Engineer-in-Charge. If any stiffening sections are provided below the chequered plates for strengthening, the same shall be separately measured & paid under Structural Steel item (Refer EIL Specification No. 6-68-0006).

6.6.2 The rate shall include supplying (as per supply conditions given in the tender), fabricating, erecting M.S. chequered plates including transporting, handling, straightening if required, cutting to required size and shape, making holes/notches/opening of required size and nosing, smoothening the edges, fixing by welding/bolting/screwing, at all levels and locations, preparing detailed fabrication drawings, surface cleaning, removal of rust, scale,

grease and applying one coat of primer as per EIL Specification No. 6-44-0004 or job specification, as specified, etc. all complete.

6.6.3 The weight for payment shall be determined from the fabrication drawings and respective bill of materials prepared by the Contractor. The bill of materials shall be checked and approved by the Engineer-in-charge before making the payment. The weight shall be calculated on the basis of BIS Handbook. No allowance in weight shall be made for rolling tolerances.

6.6.4 Welds, bolts, nuts, screws, washers, clips shall not be measured. The quoted rate shall be deemed to include the same.

7.0 GRATINGS

7.1 Categories

The gratings shall be of two categories:

- i) Category 'A' - Fabricated by the Contractor as per EIL design drawings/standards.
- ii) Category 'B' - Ready made bought out from an approved manufacturer.

7.2 Material

Materials for fabrication and fixing of Gratings shall conform to specifications given in EIL Specification No. 6-68-0002.

7.3 Fabrication Drawings

Refer clause 4.0 of EIL Specification No. 6-68-0006.

7.4 Fabrication

7.4.1 Category 'A' Gratings

These shall be fabricated strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on design drawings and standards. All units shall be given distinct erection marks in accordance with the marking drawing. All notchings in the flats shall be punched and not flame-cut. Continuous around welding shall be done along the contact-lines between two flats on both the surfaces. All fabrication shall be done in a shop under strict supervision. Clamps shall be fabricated as shown on drawing/standards.

7.4.2 Category 'B' Gratings

These shall be as per manufacturer's details designed to carry loads as specified on the design drawing supplied to the contractor. The deflection shall not exceed span/200 or 6mm whichever is minimum. The maximum clear size of voids in the grating shall be limited to 30mm x 55mm. Thickness of grating shall be 25mm. The Contractor shall make necessary notches/ opening in the gratings as shown in the drawings. All edges affected by such notches/openings shall be suitably stiffened by welding additional flats of the requisite size. All units shall be given distinct erection marks in accordance with the marking drawings. Before procurement the Contractor shall submit the design calculations, drawings and manufacturer's literature/ catalogues and get the same reviewed by the Engineer-in-charge.

The Contractor shall submit sample gratings for inspection and approval by the Engineer-in-Charge whenever asked for.

7.5 Erection/Fixing

Gratings shall be fixed to the bearing members by welding/clamping and bolting as indicated in the drawings. Minimum length and maximum pitch of welds shall be 50mm and 150mm respectively where stitch welding is used for fixing along the lines of supports. The edges of two consecutive gratings shall be bolted with minimum two bolts on each side of the grating panel.

7.6 Painting/ Galvanising

7.6.1 Grating with paints

Gratings and the fixing clamps, bolts, nuts etc. shall be cleaned and given one coat of primer as per EIL Specification No. 6-44-0004 or job specification, as specified, after fabrication.

7.6.2 Grating with Galvanisation

Gratings and the fixing clamps, bolts, nuts shall be cleaned as per EIL Specification No 6-44-0004 or job specification, as specified and galvanisation shall be done as specified in accordance with IS:2629 and tested as per IS:2633 & 6745. Quantity of zinc coating shall be minimum 900 gms/sq.m. of surface area (0.12mm uniform thickness).

7.7 Payment

This clause shall apply to Item Rate tender only.

7.7.1 Payment shall be made on the basis of admissible weight in metric tons (determined as described in clause 7.7.3) of the gratings accepted by the Engineer-incharge.

7.7.2 The rate shall include supplying, fabricating, erecting M.S. gratings (of the specified category) including transporting, handling, cutting to required size and shape, making holes/notches/openings, smoothening the edges, fabricating clamps, fixing by welding/clamping/ bolting, at all levels and locations, preparing detailed fabrication drawings, surface cleaning, removal of rust, scale, grease and applying one coat of primer as per EIL Specification no. 6-44-0004, as specified, or galvanising as required, all complete.

7.7.3 The weight for payment shall be determined from the fabrication drawings and respective bill of materials prepared by the Contractor. The bill of materials shall be checked and approved by the Engineer-incharge before making the payment. The weight, shall be calculated on the basis of BIS Handbook as mentioned above. No allowance in weight shall be made for rolling tolerances.

7.7.4 Welds, bolts, clamps, nuts and washers shall not be measured. The quoted rate shall be deemed to include the same.

8.0 TUBULAR HAND RAILING

8.1 Material

Materials for fabrication and fixing of Tubular Hand Railing shall confirm to specification given in EIL Specification no. 6-68-0002.

8.2 Fabrication Drawings

Refer clause 4.0 of EIL Specification no. 6-68-0006.

8.3 Fabrication

8.3.1 Handrailing shall be fabricated strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on design drawings and standards. All tubes shall be straight and without any dents/deformations. Tubes shall be cut and ends shall be prepared to a neat and workman-like finish. All elements shall be directly welded. All welded joints shall be cleaned and filed or ground smooth, if required, to have a smooth surface and aesthetically pleasant appearance. Splicing of top rail shall not be allowed. Tubes shall be cold bent to shape and curvature in case of discontinuous ends of handrails. Ripples, kinks and/or dents at bends shall not be accepted.

8.3.2 Lower ends of vertical posts shall be cut and splayed (for grouting in pockets in the concrete members). For removable type of handrailing, suitable base plates (with provision for bolting) shall be welded to the lower end of vertical posts. All units shall be given distinct erection marks in accordance with the marking drawing.

8.4 Erection/Fixing

Handrailing, shall be fixed to the bearing members by welding/ bolting/ grouting as indicated on the drawings. Local notching shall be made in the floor plate/ grating to accommodate vertical posts/their base plates which shall always be welded to the main supporting member. When the posts are to be fixed in concrete members, suitable pockets shall be made in concrete for grouting as shown on drawings/standards.

8.5 Painting

All handrailing components shall be cleaned and given one coat of primer as per EIL Specification No. 6-44-0004 or job specification, as specified, after fabrication.

8.6 Payment

This clause shall apply to Item Rate tender only.

8.6.1 Payment shall be made on the basis of measured length in meters (m) of top rail only (Horizontal and/or inclined lengths). The rate shall include preparation of fabrication drawings, supply of all materials, handling, transporting, straightening if required, cutting to required size, bending, welding, bolting, fixing in position at all levels and locations, grouting with 1:2 (cement:sand) mortar, surface cleaning, removal of rust, scale, grease and applying one coat of primer as per EIL Specification no. 6-44-0004 or job specification, as specified, after fabrication etc. all complete.

8.6.2 The rate shall include making suitable notches in floor plates/gratings and pockets in concrete structures for fixing the vertical posts.

9.0 MILD STEEL RUNGS

9.1 Material

All materials shall conform to specifications given in EIL Specification no. 6-68-0002.

9.2 Fabrication

Rungs shall be fabricated as per EIL standards/drawings. Mild steel bars shall be straightened if required, cut, bent to shape and given one coat of primer and two coat of finish paints per EIL Specification No. 6-44-0004 or job specification as specified, on exposed portions after fabrication.

9.3 Fixing

Rungs shall be fixed in position as per detailed drawing and firmly tied/welded with reinforcement to prevent their displacement during vibration of concrete.

9.4 Payment

This clause shall apply to Item Rate tender only.

- 9.4.1 Payment shall be made on the basis of actual weight in kilograms (Kgs.) of the M.S. rungs. The rate shall include supply of all materials handling, transporting, straightening if required, cutting to required size, bending to shape, tying/welding with reinforcement bars, fixing at all levels and locations, adjustment of formwork, applying one coat of primer and two coats of finish paint as per EIL Specification no. 6-44-0004 or job specification, as specified, on the exposed portion of rungs etc. all complete.

10.0 LIGHT GAUGE STEEL STRUCTURAL SECTIONS

10.1 Material

All materials required for fabrication and fixing in position of Light Gauge Steel Structural Sections shall conform to the specifications given in EIL Specification no. 6-68-0002.

10.2 Fabrication Drawings

Refer clause 4.0 of EIL Specification no. 6-68-0006.

10.3 Fabrication

- 10.3.1 Fabrication of members shall be done strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on the latest design drawings and in accordance with IS:800, IS:801 and other relevant BIS Codes.

- 10.3.2 All members shall be straight and free from any dents/deformations/ twists. Members shall be cut to the required sizes and ends prepared to a neat and workman like finish. Holes (for sag rods and cleat bolts) of appropriate size shall be drilled and all members/ components shall be given distinct erection marks in accordance with the marking drawings. Holes shall not be formed by gas cutting process.

10.4 Erection

Structural members shall be erected in proper sequence and aligned properly without causing any twist. Permanent bolting/welding shall be done only after proper alignment has been achieved. Proper access, working platforms and safety arrangements shall be provided by the Contractor for working and inspection.

10.5 Painting

All structural components shall be cleaned and given one coat of primer as per EIL Specification No. 6-44-0004 or job specification, as specified, after fabrication.

10.6 Payment

This clause shall apply to Item Rate tender only.

- 10.6.1 Payment shall be made on the basis of admissible weight in metric tons (determined as described in clause 10.6.2) of the structure accepted by the Engineer-in-Charge. The rate shall include supplying, fabricating, erecting, at all levels and locations, testing of bolted and/or welded Light Gauge structural steel works including cleats, crook bolts, splices/sleeves, all other fixtures and accessories, straightening if required, cutting, edge preparation, welding and bolting of joints, fixing in line and level with temporary staging and removal of the same after final alignment, handling, transporting, storage, preparation of detailed fabrication drawings and getting them reviewed by the Engineer-in-Charge, surface cleaning, removal of scale, rust, oil or grease and painting as per 8.5 above etc., all complete.
- 10.6.2 The weight for payment shall include all structural members, cleats, splices, gussets and sag rods and shall be determined from the fabrication drawings along with respective bill of materials prepared by the Contractor. The bill of materials shall be checked and approved by the Engineer-in-Charge before making the payment. The weight shall be calculated on the basis of BIS Handbook. Manufacturer's catalogues/ charts shall be adopted in case relevant weights of sections used are not covered in BIS Handbook. No allowance in weight shall be made for rolling tolerances.
- 10.6.3 All welds, bolts, nuts, washers, fixtures and accessories shall not be measured. The quoted rate shall be deemed to include the same.

11.0 EXPANSION FASTENERS

11.1 Material

Expansion fasteners (medium and heavy duty) shall be of mild steel/high tensile steel with rust proof coating including both mechanical & chemical fasteners.

11.2 Classification

The expansion fasteners shall be designated as medium and heavy duty depending on their usage. The broad classification is given below for general guidance.

11.2.1 Medium Duty (Mild steel/High tensile steel)

- Ladders and stairs supports.
- Cables and cable trays supports.
- Electrical panels and fixtures.
- Hangers for pipes and cable trays.
- Pipe supports.

11.2.2 Heavy Duty (Mild steel/High tensile steel).

- Platform supports (beam and columns)
- Knee brackets for pipes/multi tiers cable trays/walkways etc.

Note:- Expansion fasteners shall not be used for

1. Members supporting equipment and pipes subjected to vibrations.
2. Cantilever connections designed to cater for effective cantilever spans greater than 1000mm and 1000Kgs. of concentrated load at the free end.

11.3 Selection

The Contractor shall submit to the Engineer-in-Charge manufacturer's catalogues along with the specimens of expansion fasteners (proposed to be used for the job) for his selection and approval. Selected fasteners shall be capable to carry the specified loads.

11.4 Testing

If so desired by the Engineer-in-Charge, the Contractor shall carry out all the requisite tests (pullout test, torque test etc.) of specimen expansion fasteners (representative of those to be used) from approved laboratory/ test house and submit the report to him for approval. The decision of the Engineer-in-Charge regarding the adequacy of strength and load carrying capacity of the expansion fastener shall be final and binding to all. The cost of all such tests shall be borne by the Contractor.

11.5 Installation

The Contractor shall install the expansion fasteners at their correct location (to suit the requirement of fixtures as shown in drawings) as per the procedure laid down by the manufacturer. Location of all holes shall be premarked on the concrete surfaces and then holes drilled carefully with an electric drill to the correct recommended size and depth. Holes shall be exactly round and true perpendicular to the concrete surface. Edge distance and pitch of fasteners shall be as recommended by the manufacturer. The contractor shall suitably shift the hole with the approval of the Engineer-in-Charge in case any reinforcement bar is met with while drilling the hole in RCC structure. Necessary staging shall be provided for working and the Contractor shall take requisite safety precautions so as not to cause any damage to the existing structure/ equipment. Any damage done while executing the job shall be made good by the Contractor at his cost.

11.6 Protection

The exposed surfaces of expansion fasteners shall be properly greased & covered with jute cloth so as to protect them from damage.

11.7 Payment

This clause shall apply to Item Rate tender only.

- 11.7.1 Payment for installing rust proof expansion fasteners shall be made on number basis (each). The rate shall include supply of complete assembly, handling, transporting, providing necessary temporary staging, installing (as per manufacturer's specifications) in PCC/RCC structures, at all levels and locations, testing, drilling, cleaning, covering with jute cloth, relocating and redrilling in case of any obstruction, making good any damage done to the structure, grouting the abandoned holes and any gap left between the contact surfaces of PCC/RCC and fixtures to be added, etc. all complete.

INSPECTION & TEST PLANS (ITPs) FOR MECHANICAL WORKS (ITEM RATE CONTRACTS)

1	14/08/2007	REVISED & UPDATED	Amge AS	MPJ	RSG	VC
0	18/12/2002	ISSUED AS STANDARD SPECIFICATION	AB	MPJ	RSG	GRR
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

AFC	:	Approved For Construction
A/G	:	Above Ground
AS	:	Alloy Steel i.e. Cr-Mo steels like A335 Gr P11, P5, P9,P22,etc.
CFB	:	Ceramic Fibre Blankets
CS	:	Carbon Steel
CSO	:	Car Seal Open
FD	:	Free Draught
GAD	:	General Arrangement Drawings
HIC	:	Hydrogen Induced Cracking
IBR	:	Indian Boiler Regulations
ID	:	Induced Draught
I/S	:	Inner Side
LO/ LC	:	Lock Open/ Lock Close
LT	:	Longitudinal Traverse
LTCS	:	Low Temperature Carbon Steel
MT	:	Magnetic Particle Testing
NACE	:	National Association of Corrosion Engineers
NDT	:	Non Destructive Testing
NRV	:	Non Return Valve
ODC	:	Over Dimension Consignment
O/S	:	Outer Side
PMI	:	Positive Material Identification
PQR	:	Procedure Qualification Record
PT	:	Penetrant Testing
PWHT	:	Post Weld Heat Treatment
RF	:	Reinforcement
RT	:	Radiographic Testing
SS	:	Stainless Steel like A312 TP 304, 316, 321, 304L, 316L, 316Mo, etc.
SSCC	:	Sulphide Stress Corrosion Cracking
TSR	:	Tray Support Ring
UDFC	:	Under Down Flow Clearance
WPS	:	Welding Procedure Specification

Construction Standards Committee

Convenor : Sh. V.N. Prasad, GM (Construction)

Members : Sh. A.K. Mittal, DGM (Projects)
Sh. M.P. Jain, AGM (Construction)
Sh. R. Kannan, AGM (Construction)
Sh. Rakesh Nanda, Sr. Manager (Piping)

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3.	Fired Heaters (Fabrication & Erection)	6 – 82 - 1130 Rev 1	14/08/2007	20
4.	Refractory & Insulation Works (Fired Heaters)	6 – 82 - 1140 Rev 1	14/08/2007	25
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SECTION - A

GENERAL NOTE

The enclosed ITP's shall be followed for the works to be performed by the contractor. The provisions indicated for stagewise inspection by EIL/Owner are the minimum and the Engineer-In-Charge may decide to increase Hold Points/ Witness Points. Activities for which ITP's are not given, contractor to develop and get the same approved by EIL/Owner well before start of the work.

Contractor to submit required reporting formats and job procedures for each activity listed in ITP's and submit to EIL/Owner for approval, well before commencement of the activity. If the contractor has to deviate from the given ITP for a valid reason, he shall obtain prior written approval of EIL/Owner. Contractor to carry out 100% examination of all activities.

LEGEND

HP : Hold Point ;

A point which requires witnessing/inspection/verification and acceptance by Owner/EIL before any further processing is permitted.

The Contractor shall not process the activity/item beyond a Hold Point without written approval by Owner/EIL except where prior written permission for further processing is available.

W : Witness Point ;

An activity which requires witnessing/inspection/verification by Owner/EIL when the activity is performed.

After proper notification has been provided (notification modalities and period shall be finalized before hand), the Contractor is not obliged to hold further processing if Owner/EIL is not available to witness the activity or does not provide comments before the date notified. Basis of acceptance shall be as per relevant technical specification.

Rw : Review of Contractor's documentation.

S : Surveillance Inspection by Owner/ EIL.

Monitoring or making observations to verify whether or not material/items or services conform to specified requirements. Surveillance activities may include audit, inspections, witness of testing, review of quality documentation & records, personnel qualifications, etc.

WC : 100% Examination by Contractor.

Responsibility for execution of the inspection/testing is with the Contractor; Owner/EIL only verifies examination or testing done by the Contractor at important stages.

(Sheet 1 of 12)

ITP NO. : 1110 REV 1
ABOVE GROUND PIPING

Sl. No	Activity	Contractor	EIL	Records to be Submitted/ Format No.
A. PRIOR TO FABRICATION				
1.	Incoming Material			
	a) Owner's supply	WC	Rw	Format M2
	b) Contractor's supply including check testing	WC	HP	Format M2
2.	Welding Filler Material Approval/Qualification			
	a) Manufacturing Test Certificate/Documents	WC*	Rw*	Yes
	b) Testing, if any			
	i) Carbon Steel	WC	W	Format M3, M4
	ii) Alloy Steel/Stainless Steel	WC	W	Format M3, M4
3.	WPS/PQR			
	a) Review of proposed procedure	WC	HP	Format M5
	b) Testing			
	i) Carbon Steel	WC	HP	Format M6
	ii) Alloy Steel/Stainless Steel	WC	HP	Format M6
	c) Approval of final WPS/PQR	WC	HP	Format M5, M6
4.	Welder performance Qualification Test	WC	W	Format M7
5.	Certification & approval of welders	WC	HP	Format M8
6.	NDT Procedure Qualification			
	a) Review of proposed procedure	WC	HP	Yes
	b) Witnessing of Proposed Procedure Testing	WC	HP	
	c) Approval of Qualified Procedure	WC	HP	Yes
7.	Review of Joint numbering in Isometrics (Big & Small bore)	WC	HP	Yes
8.	Lines where Isometrics not available			
	a) Preparation of sketches	WC	Rw	Yes
	b) Joint Numbering in sketches	WC	HP	Yes
9.	Material traceability & Transfer of Heat Nos.			
	- C.S. piping < 600# rating	WC	S	Format M9
	- C.S. piping 600# rating and above	WC	W	Format M9
	- A.S. Piping, S.S Piping, NACE piping, H ₂ service piping	WC	HP	Format M9

- * Notwithstanding any other tests/documentation required for qualification/approval of filler metals :
- For Alloy Steel & Stainless Steel welding filler metals, chemical analysis to be carried out for every batch.
 - For LTCS welding filler metals, Impact test to be carried out for every batch
 - For NACE filler metals, corrosion tests like HIC, SSCC, etc. to be carried out for every batch.

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1110 REV 1
ABOVE GROUND PIPING

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
B.	FABRICATION (SHOP & FIELD)			
1.	Material as per piping class (check w.r.t. approved colour coding procedure)	WC	W	Format M10
1a.	Dimensional checks	WC	S	---
1b.	Fit-up check for butt joints and socket joints	WC	W	Format M10
1c.	Fit-up checks for branch joints	WC	W	Format M10
2.	Pre-heat (if any)	WC	S	---
3.	Certificate of purity of purging/shielding Gas (if any)	WC	Rw	Yes
4.	Purging rate (if any) and arrangement	WC	S	---
5.	Shielding rate (if any)	WC	S	---
6.	Baking of Electrodes	WC	S	---
7.	Inter-pass cleaning & Temperature check.	WC	S	---
8.	Visual check of completed welds having			
	- Random Radiography	WC	W	Format M11
	- 100% Radiography	WC	S	Format M11
9.	Monitoring of PWHT Cycle	WC	S	---
10.	Review of Time – Temperature graph	WC	HP	Yes
11.	Hardness Check			
	a) For C.S. Materials	WC	S	Format M12
	b) For A.S. Materials Piping	WC	W	Format M12
12.	PT/MT	WC	W	Format M13, M14
13.	Radiography marking (for Random Radiography only)	WC	HP	Format M15

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1110 REV 1
ABOVE GROUND PIPING

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
14.	Radiography Interpretation/ Review			
	a) For Carbon Steel Piping	WC	HP	Format M16
	b) For Alloy Steel/SS Piping	WC	HP	Format M16
15.	Check Shot for Radiography	WC	W	Format M16
16.	Surface cleaning and primer application	WC	S	Format M17
C.	ERECTION			
1.	Lifting arrangement (for critical piping only)	WC	Rw	Yes
2.	Test certificates for lifting tackles	WC	Rw	Yes
3.	Location and orientation of Branch connections	WC	Rw	Annex-1
4.	Provision of Inst. Tappings	WC	HP	Annex-1
5.	Provision of vents and drains	WC	Rw	Annex-1
6.	Correctness of type of supports, Anchors, Guides	WC	HP	Annex-1
7.	Correctness of gaskets/ fasteners			
	- C.S. piping	WC	W	Annex-1
	- A.S. Piping, S.S Piping, NACE piping	WC	W	Annex-1
8.	Correctness of valves (NRV, Gate, Globe, control Valves etc), steam traps and their direction of flow			
	- C.S. piping	WC	HP	Annex-1
	- A.S. Piping, S.S Piping, NACE piping	WC	HP	Annex-1
9.	Provision of cold pull, if any.	WC	HP	Annex-1

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

(Sheet 4 of 12)

ITP NO. : 1110 REV 1
ABOVE GROUND PIPING

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
D	PROOF TESTING			
1.	Procedure Review	WC	HP	Annex-2
2.	Correctness of Testing arrangements	WC	W	Annex-2
3.	Check all valves kept open and confirm that testing is not done against closed valve seat	WC	W	Annex-2
4.	Isolation of equipments, control valves, Instruments, bellows. Removal of flappers from check valves	WC	W	Annex-2
5.	Scrutiny of test packs for Mechanical & NDT Clearance	WC	HP	Annex-I, Format M21
6.	Positive Material Identification as per specification after completion of installation.	WC	HP	Format M18
7.	a) Review of Calibration certificates of pressure Gauges b) Field Calibration, if any	WC	HP	Format M1
		WC	W	Yes
8.	Preparation of check list (Punch list)	WC	HP	Annex-3
9.	Liquidation of check list	WC	HP	Annex-3
10.	Air/Water Flushing (preliminary)	WC	W	---
11.	Visual inspection of all weld joints for leak during Pneumatic/ Hydrotesting	WC	HP	---
12.	Draining of Water & Air Drying	WC	S	Annex-2
13.	Removal of temporary blinds/supports.	WC	S	Annex-2

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1110 REV 1
ABOVE GROUND PIPING

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
14.	Pickling of system, if required	WC	W	Format M19
15.	Boxing up including reinstallation of flappers of check valves	WC	W	Annex-2
16.	Review of Records of fasteners & gaskets	WC	HP	Yes
17.	Torque tightening/ tensioning of flange joints, wherever applicable	WC	S	Yes **
18.	System testing	WC	HP	Format M20
19.	Setting of spring supports	WC	HP	Annex-2
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

** Refer Procedure for Identification and Boxing up of flange joints not subjected to hydrostatic test at site No. 5-7700-0120, enclosed elsewhere in the contract.

NOTES :

- For painting works, refer ITP for Painting works No. 6-82-1501
- For insulation works, refer ITP for Insulation works No. 6-82-1505

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1110 REV 1
ABOVE GROUND PIPING

ANNEX – 1

Checklist for Mechanical Clearance - A/G Piping

Project : _____		Report No : _____	
Plant/Unit : _____		Date : _____	
Contractor : _____		Area : _____	
Loop No : _____		INCH MTR : _____	

Line No (Isometric No.)	Rev.	GAD No.	Rev.	P&ID No.	Rev.

Items to be checked	Accept Contractor	Witness by Owner/ PMC as required by ITP
1. Installation checked as per Isometric w.r.t. CONFIGURATION : Route, plumb, elevation, Clearance for thermal expansion/ insulation BRANCH : Location, angle, orientation, type, RF pad, etc. STEAM TRAP : Direction		
2. Installation checked as per GAD w.r.t. CONFIGURATION : Route, clearance for thermal expansion/insulation		
3. Installation checked as per P&ID		
4. Isometrics completed for (enclosed):		
a. Joint Numbering (Shop & Field Welds)		
b. Spool Numbering		
c. As-built routing & dimensions		
5. Valves (Check Rating, Gaskets, Flow Direction, Sheet No., Tag No., Spindle direction, CSO LO/LC, Damage, etc)	Nos	
Gate Valves		
Globe Valves		
Check Valves		
Control Valves Tag Nos.:		
Safety Valves Tag Nos.:		
Any other valves :		
6. Strainers : Check for clearance, flow direction, elements		

FORMAT NO: _____ (Sht 1/4)

Job No. ----

(Sheet 7 of 12)

ITP NO. : 1110 REV 1
ABOVE GROUND PIPING

ANNEX – 1

Checklist for Mechanical Clearance - A/G Piping

	Item to check	Accept	Witness by Owner/PMC as required by ITP
		Contractor	
7.	Flanged Joints		
	Total Nos.		
	Check for type of flange		
	Check for Rating		
	Check for Alignment, (proper gap & parallelity		
	Check for Correct Studs & nuts – dia., length, Material, uniform protrusion of studs, anti seize compound		
	Check for correct gasket (type, size, spec., thickness, etc.)		
	Torque values used for tightening		
8.	Seal Welding of Screwed Connections (if Required)		
9.	Vents/Drains as per Drg and Provision of additional high point Vents and/or low point Drains, if reqd.		
10.	Reinforcement pads as per piping class		
11.	Orifice Flanges :		
	Check for Tag No., tapping orientation, tap valve, jack screw, straight run length of upstream & downstream		
12.	Local Gauges : Check for accessibility		
13.	Slope (When Applicable)		
14.	Supports		
	a) Guides, Cross Guides, Trunnion, etc.		
	i) Check for correct type, material & dimension		
	ii) Check welding		
	iii) Check for vent hole on pads (if applicable)		
	iv) Check offset for thermal expansion		
	v) Check clearance of guide		
	vi) Check U bolt for slide support		
	b) Spring Support		
	i) Verify tag no. and check details as per data sheet/spring set		
	ii) Check for locking arrangement and any damage during transit, etc.		
	iii) Check for completeness of installation as per drg. including welding of mounting cleat/ bracket		
	iv) Check for locking during installation and pressure test		
	c) Bracket Support & Inserts with Anchor Fasteners :		
	i) Check for members dimensions and materials		
	ii) Check for welding		
	iii) Check for bolting		
	iv) Check for appearance/ damage		
15.	Vents/ Drains :		
	- As per drg.		
	- Orientation of valve handles		
	- Clearance for hose		
	- Requirement of additional vents/ drains (highest/lowest pt.)		

FORMAT NO: _____ (Sht 2/4)

Job No. ----

(Sheet 8 of 12)

ITP NO. : 1110 REV 1
ABOVE GROUND PIPING

ANNEX – 1

Checklist for Mechanical Clearance - A/G Piping

	Item to check	Accept	Witness by Owner/ PMC as required by ITP
		Contractor	
16.	Earthings :		
	a) Check for location		
	b) Check for dimension of lug welding		
17.	Joists History sheets enclosed for :		
17.1	Material Traceability as per Specification No: _____ (refer enclosed suggested Format)		
17.2	Fit ups checked		
17.3	NDT Complete (Radiography, MT, PT)		
17.4	Stress Relieving & Hardness check complete		
17.5	Positive Material Identification (PMI)		
	Checked for Removal/Blinding-off of:		
	a. Control, Safety and Check Valves		
	b. In-Line Instruments		
	c. Rupture Discs		
	d. Equipment Nozzles		
	e. Others		
18.	Supports and Weld/Flanged/Screwed connections free from insulation or other coverage		
19.	Checked Installation of (Indicate Location in Drawings)		
	a. Temporary Blinds/Spades		
	b. Temporary Strainers		
	c. Temporary Dummy-Spools		
	d. Temporary Gaskets		
	e. Others		
20.	Expansion Bellows -		
	a) Checks prior to installations		
	- Physical damages		
	- Transit locks are intact		
	- Dimensions as per drgs.		
	b) Check during installation		
	- Parallelity of mating flanges		
	- Face to face dimension of mating flanges		
	- Concentricity of mating flanges		
	- No stress on expansion bellows		
	- Record		
	c) Isolation during pressure tests		
	- Bellow mfg. recommendations on isolation of bellow during pr. Test to be followed		
	- If recommended expn. bellow to be dropped during pr. test.		

FORMAT NO: _____ (Sht 3/4)

Job No. ----

(Sheet 9 of 12)

ITP NO. : 1110 REV 1
ABOVE GROUND PIPING

ANNEX – 1

Checklist for Mechanical Clearance - A/G Piping

	Item to check	Accept	Witness by Owner/ PMC as required by ITP	
		Contractor		
21.	Cleanliness Internally and Externally			
22.	Rotating Equipment Final Alignment Checked with piping			
23.	Removal of unwanted construction supports			
24.	Instrument tapings provided as per Drawing			
25.	Physical-Walk-Through – The – Line , checked for gross irregularities including physical damages, unwanted tacks, arc strikes, spatters and space for thermal expansion.			
26.	Cold pull, if any			
Other :				
Remarks				
Contractor :				
Sign. :				
Date :				
Name : Designation :				
EIL		Review by Area Coordinator (PMC)		
Sign :		Sign :		
Date :		Date :		
Name : Designation :		Name : Designation :		

FORMAT NO: _____ (Sht 4/4)

Job No. ----

(Sheet 10 of 12)

ITP NO. : 1110 REV 1
ABOVE GROUND PIPING

ANNEX – 2

Piping Hydro Test Release/Acceptance Record – A/G Piping

Project : _____		Report No : _____	
Plan : _____		Date : _____	
Contractor : _____		Area : _____	
Loop No : _____		REF P & ID No. : _____	
		INCH MTR : _____	
		From _____ To _____	

	Line No. (s)	Isometric No. (s)	P&ID No. (s)

Test Medium :		Test Duration :		Design/Test Pressure :	
Test Pressure Gauge No.	Range	Calibration Certificate No.:		Gauge Calibration Date:	

Items to check	Accept Contractor	Witness EIL	
Field Installation Checklist Prior to Hydrotest Signed			
Punch list Prepared	Yes ☐ No ☐		
Pre – Hydrotest Punch items Cleared			
Accessibility to Inspection/Witness Locations			
Capacity of pressurizing pump checked			
Cordon off area for high pressure testing, as required			
Pre-hydrotest flushing carried out			
IBR/Others test Witnessing Required	Yes No		

System Released for Pressure Testing :

Contractor :		EIL:	
Sign :	Name :	Sign :	Name :
Date :		Date :	
Designation :		Designation:	

FORMAT NO: _____ (Sht 1/2)

(Sheet 11 of 12)

ITP NO. : 1110 REV 1
ABOVE GROUND PIPING

ANNEX – 2

Piping Hydro Test Release/Acceptance Record – A/G Piping

ACTIVITY	Date	Time
Water Filling and Venting started at		
Water Filling Completed		
Vents Closed		
Isolation of Pressurizing pump		
Test completed at :		
- Water drained		
- Air		
- Temp Blinds Removed		
- Checked for reinstallation of a. Control & Safety vales b. On line Instruments c. Rupture disks d. Deblinding e. Others		
- Cold setting of spring supports carried out		
Contractor :	EIL :	
Sign :	Sign:	
Date :	Date:	
Name : Designation	Name:	Designation:

FORMAT NO: _____ (Sht 2/2)

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(Sheet 1 of 2)

ITP NO. : 1120 REV 1
INSTALLATION OF COLOUMN INTERNALS

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
A. Before Installation				
1.	Availability of Vendor's representative at site	WC	HP	---
2.	Material inspection			
	a) Manufacturer's Test Certificate	WC	Rw	Yes
	b) Testing, if any	WC	S	Yes
	c) Positive Material Identification	WC*	S*	Format M18
3.	Fabricated materials receipt	WC	Rw	Format M2
4.	Level check on TSRs	WC	S	Format M49
5.	Check for downcomer clearance and Tray clearance	WC	S	Format M49
6.	Distance between TSRs	WC	S	Format M49
B. After Installation				
<i>Check for</i>				
1.	Exit weir height	WC	S	Format M49
2.	Under Down Flow Clearance (UDFC)	WC	S	Format M49
3.	Tightness of bolts	WC	S	Format M49
4.	Orientation and tightness of clamps	WC	S	Format M49

* Third party/EIL certification required

NOTE : All activities pertaining to material receipt, identification, pre-installation checks and installation to be carried out in the presence of Vendor's representative and duly certified and documented for submission as final document

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

(Sheet 2 of 2)

ITP NO. : 1120 REV 1
INSTALLATION OF COLOUMN INTERNALS

Sl. No	Activity	Contractor	EIL	Records to be Submitted/ Format No.
5.	Provision of lock nuts/seal plates	WC	S	Format M49
6.	Correctness of installation of shimming/bolting for top downcomer	WC	S	Format M49
7.	Correctness of gasketing (if any)	WC	S	Format M49
8.	Tray to tray distance and level of trays	WC	S	Format M49
9.	Leak testing of seal pans as applicable	WC	HP	Format M49
10.	Damaged, missing valves and valve movements for valve trays	WC	S	Format M49
11.	Fitting of proper valve combination	WC	S	Format M49
12.	Damage to deck components	WC	S	Format M49
13.	Level and alignment of inlet weir and exit weir	WC	S	Format M49
14.	Check for slots on tray components to be fully covered	WC	S	Format M49
15.	Gaps at downcomer ends	WC	S	Format M49
16.	Removal of temporary plugs after testing	WC	S	Format M49
17.	Cleaning of all trays & inside of equipment	WC	S	Format M49
18.	Certification of installation by Vendor's representative and operation groups of EIL/ Owner	WC	HP	Format M50
19.	Final boxing up, if any	WC	W	---
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

(Sheet 1 of 5)

ITP NO. : 1130 REV 1
FIRED HEATERS (FABRICATION & ERECTION)

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
A. PRIOR TO FABRICATION				
1.	Incoming Material			
	a) Owner's supply	WC	Rw	Format M2
	b) Contractor's supply including check testing	WC	HP	Format M2
2.	Welding Filler Material Approval/Qualification			
	a) Manufacturer's Test Certificate/Documents	WC	Rw*	Yes
	b) Testing, if any			
	i) Carbon Steel	WC	W	Format M3, M4
	ii) Alloy Steel/Stainless Steel	WC	W	Format M3, M4
3.	WPS/PQR			
	a) Review of proposed Procedure	WC	HP	Format M5
	b) Testing			
	i) Carbon Steel	WC	HP	Format M6
	ii) Alloy Steel/ Stainless Steel	WC	HP	Format M6
	c) Approval of final WPS/PQR	WC	HP	Format M5, M6
4.	Welder performance Qualification Test	WC	W	Format M7
4a.	Certification & approval of welder	WC	HP	Format M8
5.	NDT Procedure Qualification			
	a) Review of proposed Procedure	WC	HP	Yes
	b) Witnessing of Proposed Procedure Testing	WC	HP	---
	c) Approval of Qualified Procedure	WC	HP	Yes
6.	Availability of AFC drawings	WC	HP	Yes
7.	Joint Numbering for coils/ pressure parts	WC	HP	Yes
8.	Structural member's identification	WC	Rw	---
9.	Layout Checking of structural fabrication	WC	S	---

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

(Sheet 2 of 5)

ITP NO. : 1130 REV 1
FIRED HEATERS (FABRICATION & ERECTION)

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
B. FABRICATION				
STEEL WORK				
1	Materials as per AFC drawing	WC	S	---
2.	Dimensional check	WC	S	---
3.	Fit-up check	WC	W	Yes
4.	Weld Visual Inspection	WC	W	Yes
5.	Radiography, as applicable			
	a) RT Marking (for random/spot radiography only)	WC	HP	Yes
	b) RT Interpretation	WC	HP	Yes
6.	Completion of structures as per AFC drawings	WC	HP	---
7.	Surface cleaning for primer painting	WC	W	Format M17
8.	Primer Coating as applicable	*	*	Format M17
COIL WORK				
1.	Material as per piping class (check w.r.t. approved colour coding procedure)	WC	W	Yes
1a.	Dimensional checks	WC	S	---
1b.	Fit-up check for butt joints and socket joints	WC	W	Format M10
1c.	Fit-up checks for branch joints	WC	W	Format M10
2.	Pre-heat (if any)	WC	S	---
3.	Certificate of purity of purging/shielding Gas (if any)	WC	Rw	Yes
4.	Purging rate (if any) and arrangement	WC	S	---
5.	Shielding rate (if any)	WC	S	---
6.	Baking of Electrodes	WC	S	---
7.	Inter-pass cleaning & Temperature check.	WC	S	---
8.	Visual check of completed welds having			
	- Random Radiography	WC	W	Format M11
	- 100% Radiography	WC	S	Format M11

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

(Sheet 3 of 5)

ITP NO. : 1130 REV 1
FIRED HEATERS (FABRICATION & ERECTION)

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
9.	Monitoring of PWHT Cycle	WC	S	---
10.	Review of Time – Temperature graph	WC	HP	---
11.	Hardness Check			
	a) For C.S. Materials, if applicable	WC	S	Format M12
	b) For A.S. Materials	WC	W	Format M12
12.	PT/MT	WC	W	Format M13, M14
13.	Radiography marking (for Random Radiography only)	WC	HP	Format M15
14.	Radiography Interpretation/ Review			
	a) For Carbon Steel Piping	WC	HP	Format M16
	b) For Alloy Steel/SS Piping	WC	HP	Format M16
15.	Check Shot for Radiography	WC	W	Format M16
16.	Clearance for Hydrostatic testing	WC	HP	Format M21
17.	Hydrostatic testing	WC	HP	Format M22
C. ERECTION				
1.	Foundation check as per AFC drawing	WC	Rw	---
2.	Lifting arrangements	WC	Rw	Yes
3.	Test certificates for lifting tools and tackles	WC	Rw	Yes
4.	Lifting of radiant section columns and their alignment	WC	W	Yes
5.	Bottom plate fit-up & welding	WC	W	Yes
6.	Radiant shell courses fit-up and welding	WC	W	Yes
7.	Weld visual inspection	WC	W	Yes
8.	Radiography as required	WC	HP	Yes
9.	Cutout			
	a) Marking for burners, sight doors, soot blowers	WC	HP	----
	b) Marking for balance cut outs	WC	W	---
	c) Cutting	WC	S	---
10.	Coil erection in Radiant section			
	a) Fixing of coil support castings	WC	W	---
	b) Erection of coil work	WC	S	---
	c) Alignment of completed coil work	WC	HP	---

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

(Sheet 4 of 5)

ITP NO. : 1130 REV 1
FIRED HEATERS (FABRICATION & ERECTION)

Sl. No	Activity	Contractor	EIL	Records to be Submitted/ Format No.
11.	Assembly and erection of convection box			
	a) Erection Procedure	WC	HP	Yes
	b) Structural including plate work	WC	S	---
	c) End tube sheets and intermediate tube sheets with support brackets	WC	W	---
	d) Coil work	WC	S	---
	e) Erection of box (if applicable)	WC	S	---
12.	Check Shot for radiography for coil field joints	WC	HP	Format M15, M16
13.	Clearance for Hydrostatic test	WC	HP	Format M23
14.	Hydrostatic test for field joints	WC	HP	Format M23
15.	Erection, fit-up & welding of stack			
	a) Erection procedure	WC	HP	Yes
	b) Erection	WC	S	---
16.	Erection Fit-up, welding of ducts and its support structural	WC	S	Yes
17.	Radiography, as required on steel work			
	a) RT Marking	WC	HP	Yes
	b) RT Interpretation	WC	HP	Yes
18.	FD & ID Fan	**	**	
19.	Installation of auxiliary equipment			
	a) Burner alongwith ignition system and transformer	WC	HP	Yes
	b) Soot blower alongwith sequential control panel and electrical wirings	WC	W	---
	c) Damper with control panel and winch	WC	W	---
	d) Air pre-heater (cast, glass, plate) and steam air heater	WC	W	---
	e) Skin thermocouples	WC	HP	---
20.	Erection of all Platforms, ladders, Hand rails & miscellaneous structures	WC	S	Yes
21.	Insulation/ refractory lining	***	***	
22.	Final Painting	*	*	
23.	Liquidation of checklist	WC	HP	Format M26
24.	Final inspection and acceptance	WC	HP	Yes

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

(Sheet 5 of 5)

ITP NO. : 1130 REV 1
FIRED HEATERS (FABRICATION & ERECTION)

Sl. No	Activity	Contractor	EIL	Records to be Submitted/ Format No.
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

- * For painting, refer ITP no. 6 - 82 - 1501
- ** For FD & ID Fan, refer ITP no. 6 - 82 - 1160
- *** For Insulation/ Refractory Lining, refer ITP No. 6 - 82 - 1140

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

(Sheet 1 of 5)

ITP NO. : 1140 REV 1
REFRACTORY & INSULATION WORKS (FIRED HEATERS)

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
A. RADIANT SECTION				
1.	<i>Radiant shell</i>			
	Fixing of Ceramic fibre blanket			
i)	Material inspection			
	- Manufacturing test certificates	WC	Rw	Format M2
	- Testing, if any	WC	W	Yes
ii)	Clearance for hot work	WC	HP	---
iii)	Marking of studs	WC	S	Yes
iv)	Welding of studs with approved WPS&PQR	WC	S	Yes
v)	Surface cleaning	WC	S	Yes
vi)	Check for individual layers of ceramic fibre blankets and SS foils	WC	W	Yes
vii)	Check for overlap of ceramic blanket	WC	S	Yes
viii)	Fixing of speed fix washer and cup lock	WC	S	Yes
ix)	Cleaning and final inspection	WC	HP	Yes
2.	<i>Arch Plate</i>			
i)	Material inspection			
	- Manufacturing test certificates	WC	Rw	Format M2
	- Testing, if any	WC	W	Yes
ii)	Clearance for hot work	WC	HP	---
iii)	Marking of studs/anchors	WC	S	Yes
iv)	Welding of studs/anchors with approved WPS & PQR	WC	S	Yes
v)	Surface cleaning	WC	S	Yes
vi)	Check for individual layers of Ceramic Fibre Blankets (CFB) modules and SS foils	WC	S	Yes
vii)	Check for overlap of CFB and modules	WC	S	Yes
viii)	Cleaning and final inspection	WC	HP	Yes
3.	<i>Floor Plate</i>			
	Laying of castable/fire bricks			
i)	Material inspection			
	- Manufacturing test certificates	WC	Rw	Format M2
	- Testing, if any	WC	W	Yes

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1140 REV 1
REFRACTORY & INSULATION WORKS (FIRED HEATERS)

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
ii)	Clearance for hot work	WC	HP	---
iii)	Surface cleaning	WC	S	Yes
iv)	Check Shelf life prior to application	WC	HP	Yes
v)	Check for undulations on floor	WC	S	Yes
vi)	Check for castable mix	WC	W	Yes
vii)	Check for proper compaction	WC	S	Yes
viii)	Check for thickness of castable	WC	S	Yes
ix)	Curing	WC	S	Yes
x)	Cleaning after laying of castable	WC	S	Yes
xi)	Check for cracks and repair	WC	W	Yes
xii)	Fixing of tar paper, if applicable	WC	S	Yes
xiii)	Cleaning and final inspection	WC	HP	Yes

B. CONVECTION SECTION

1) Convection walls

Laying of castable

i)	Material inspection			
-	Manufacturing test certificates	WC	Rw	Format M2
-	Testing, if any	WC	W	Yes
ii)	Clearance for hot work	WC	HP	---
iii)	Marking of studs/anchors	WC	S	Yes
iv)	Welding of studs/anchors with approved WPS & PQR	WC	S	Yes
v)	Surface cleaning	WC	W	Yes
vi)	Check for undulations on wall	WC	S	Yes
vii)	Check for castable mixing	WC	W	Yes
viii)	Check for proper compaction	WC	S	Yes
ix)	Check for thickness of castable	WC	S	Yes
x)	Curing	WC	S	Yes
xi)	Cleaning after laying of castable	WC	S	Yes
xii)	Check for cracks and repair	WC	W	Yes
xiii)	Cleaning and final inspection	WC	HP	Yes

2) End tubesheets

Laying of castable

i)	Material inspection			
-	Manufacturing test certificates	WC	Rw	Format M2
-	Testing, if any	WC	W	Yes
ii)	Clearance for hot work	WC	HP	---

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1140 REV 1
REFRACTORY & INSULATION WORKS (FIRED HEATERS)

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
iii)	Marking of studs/anchors	WC	S	Yes
iv)	Welding of studs/anchors with approved WPS & PQR	WC	S	Yes
v)	Surface cleaning	WC	S	Yes
vi)	Check for castable mixing	WC	W	Yes
vii)	Check for proper compaction	WC	S	Yes
viii)	Check for thickness of castable	WC	S	Yes
ix)	Curing	WC	S	Yes
x)	Cleaning after laying of castable	WC	S	Yes
xi)	Check for cracks and repair	WC	W	Yes
xii)	Cleaning and final inspection	WC	HP	Yes

3) Breeching Plate

Laying of castable

i)	Material inspection			
-	Manufacturing test certificates	WC	Rw	Format M2
-	Testing, if any	WC	W	Yes
ii)	Clearance for hot work	WC	HP	---
iii)	Marking of studs/anchors	WC	S	Yes
iv)	Welding of studs/anchors with approved WPS & PQR	WC	S	Yes
v)	Surface cleaning	WC	S	Yes
vi)	Check for undulations on plate	WC	S	Yes
vii)	Check for castable mixing	WC	W	Yes
viii)	Check for proper compaction	WC	S	Yes
ix)	Check for thickness of castable	WC	S	Yes
x)	Curing	WC	S	Yes
xi)	Cleaning after laying of castable	WC	S	Yes
xii)	Check for cracks and repair	WC	W	Yes
xiii)	Cleaning and final inspection	WC	HP	Yes

4) Header box

Laying of castable

i)	Material inspection			
-	Manufacturing test certificates	WC	Rw	Format M2
-	Testing, if any	WC	W	Yes
ii)	Clearance for hot work	WC	HP	---
iii)	Marking of studs/anchors	WC	S	Yes
iv)	Welding of studs/anchors with approved WPS & PQR	WC	S	Yes
v)	Surface cleaning	WC	S	Yes
vi)	Check for undulations on box	WC	S	Yes

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1140 REV 1
REFRACTORY & INSULATION WORKS (FIRED HEATERS)

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
vii)	Check for castable mixing	WC	W	Yes
viii)	Check for proper compaction	WC	S	Yes
ix)	Check for thickness of castable	WC	S	Yes
x)	Curing	WC	S	Yes
xi)	Cleaning after laying of castable	WC	S	Yes
xii)	Check for cracks and repair	WC	W	Yes
xiii)	Cleaning and final inspection	WC	HP	Yes

C. STACK

Laying of castable

i)	Material inspection			
-	Manufacturing test certificates	WC	Rw	Format M2
-	Testing, if any	WC	W	Yes
ii)	Clearance for hot work	WC	HP	---
iii)	Marking of studs/anchors	WC	S	Yes
iv)	Welding of studs/anchors with approved WPS & PQR	WC	S	Yes
v)	Surface cleaning	WC	S	Yes
vi)	Check for undulations on stack shell	WC	S	Yes
vii)	Check for castable mixing	WC	W	Yes
viii)	Check for proper compaction	WC	S	Yes
ix)	Check for thickness of castable	WC	S	Yes
x)	Curing	WC	S	Yes
xi)	Cleaning after laying of castable	WC	S	Yes
xii)	Check for cracks and repair	WC	W	Yes
xii)	Cleaning and final inspection	WC	HP	Yes

D. HOT AIR DUCT

i)	Material inspection			
-	Manufacturing test certificates	WC	Rw	Format M2
-	Testing, if any	WC	W	Yes
ii)	Clearance for insulation	WC	HP	---
iii)	External Surface cleaning	WC	S	Format M24
iv)	Provide spacer rings/anchors	WC	S	Format M24
v)	Check for thickness of the mineral wool insulation	WC	S	Format M24

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1140 REV 1
REFRACTORY & INSULATION WORKS (FIRED HEATERS)

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
vi)	Check for staggering of joints in insulation	WC	S	Format M24
vii)	Check for providing expansion joints	WC	W	Format M24
viii)	Overlapping of metal sheet as per specification	WC	S	Format M24
ix)	Overlap on joints for Aluminium sheeting as per specifications	WC	W	Format M24
x)	Sealing Aluminium sheeting	WC	S	Format M24
E.	Final inspection & acceptance	WC	HP	Format M25
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1150 REV 1
EQUIPMENT ERECTION (STATIC)

Sl. No	Activity	Contractor	EIL	Records to be Submitted/ Format No.
1.	BEFORE ERECTION			
a.	Execution scheme of equipment foundation	WC	Rw	Format M27
b.	Materials supply			
	- Owner's supply	WC	Rw	Format M2
	- Contractor's supply, including check testing, if any	WC	HP	Format M2
c.	Readiness for erection			
	i) Centre line marking on equipment and foundation	WC	W	Format M27
	ii) Level of foundation (shims/ packing with marking to be prepared & kept ready)	WC	W	Format M27
	iii) Correctness of no. & size of Foundation bolts	WC	W	Format M27
	iv) Hole dia and no. of holes in base/ structure of equipment columns	WC	W	Format M27
	v) Matching equipment base bolt holes with actual foundation bolt layout	WC	W	Format M27
	vi) Marking orientation	WC	Rw	Format M27
	vii) Checking the threads of bolts & nuts	WC	S	Format M27
	viii) Chipping & roughening of foundation	WC	S	Format M27
2.	ERECTION SCHEMES FOR CRITICAL EQPTS			
a.	Approval of Rigging procedure	WC	HP	Annexure-1
3.	SAFETY TEST			
a.	Load test of cranes, lifting beams, slings and shackles, length and dia. of sling & condition of wire rope	WC	W/Rw	Yes
b.	Placement of Main & tailing crane as per approved rigging procedure	WC	Rw	---

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1150 REV 1
EQUIPMENT ERECTION (STATIC)

Sl. No	Activity	Contractor	EIL	Records to be Submitted/ Format No.
4.	DURING ERECTION			
a.	Deployment of competent Rigging crew	WC	Rw	---
b.	Orientation to be checked	WC	W	---
c.	Placement of packing as per AFC drg.	WC	S	---
d.	Outside cleaning, coating/ wrapping, painting (for underground equipment only)	WC	W	Yes
e.	Orientation of equipment as per AFC drg.	WC	Rw	---
5.	AFTER ERECTION			
a.	Tightening of Bolts and Providing washers	WC	S	Format M28, M29
b.	Leveling and Alignment of equipments.			
i)	Critical equipments/ ODCs	WC	HP	Format M28, M29
ii)	Others	WC	W	Format M28, M29
c.	Corresponding requirement elevation & distance between nozzles in special cases.	WC	W	Format M28, M29
d.	Cleaning of Sleeves before grouting	WC	S	Format M28, M29
e.	Grouting			
i)	Availability of Specified grouting materials	WC	Rw	Format M28, M29
ii)	Placement of grouting	WC	W	Format M28, M29
iii)	Curing of grout.	WC	S	Format M28, M29
f.	Final tightening of bolts	WC	S	Format M28, M29

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1150 REV 1
EQUIPMENT ERECTION (STATIC)

Sl. No	Activity	Contractor	EIL	Records to be Submitted/ Format No.
6. PACKED EQUIPMENTS				
1. Before Installation				
a.	Identify the material, check thickness, dimensions, no. and angle of fingers of packing rings	WC	S	Yes
2. During Installation				
a.	Degreasing and cleaning of packing material	WC	S	Yes
b.	Check packing support plate	WC	S	Yes
c.	Check for stacked or dumped packing as per specifications	WC	S	Yes
d.	Check for nesting	WC	S	Yes
e.	Check that packings are touching bed limiter	WC	S	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1150 REV 1
EQUIPMENT ERECTION (STATIC)

ANNEXURE - I

Sl. No	Activity	Contractor	EIL	Records to be Submitted/ Format No.
ERECTION SCHEME FOR CRITICAL EQUIPMENT (Rigging Procedure)				Yes
1.	Before Erection			
	a. Checking proper sequence for lifting of the equipment	WC	Rw	
	b. To check weight of equipment	WC	Rw	
	c. To check the centre of gravity	WC	Rw	
	d. To check suspension points	WC	Rw	
	e. To check maximum/minimum radius at which the lifting tackle will operate	WC	Rw	
	f. To check the max. Load to be lifted including wt. of slings, hook-block, lifting beams and equipment etc.	WC	Rw	
	g. To identify the safe crane with requisite capacity	WC	Rw	
2.	During Erection			
	a. To check counterweight of crane and Boom length	WC	Rw	
	b. To check slew limitations of crane	WC	Rw	
	c. To check ground conditions are adequate for supporting fully rigged crane and load	WC	Rw	
	d. To check the crane can be traveled in loaded condition	WC	Rw	
	e. To check clearances from overhead electric power cables	WC	Rw	
	f. To check maintenance certificates	WC	Rw	
	g. To check whether operators, riggers have received proper instructions	WC	Rw	
	h. To verify that safe load indicator on the crane is in working condition	WC	W	
	i. To check the provisions of bracing of equipment as per Engg /Manufacturer's Requirement/ Approved drgs.	WC	Rw	
	j. To check the guys, shoring, bracing, interference with other works	WC	S	

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1160 REV 1
EQUIPMENT ERECTION (ROTARY)

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
1.	PRE – ERECTION ACTIVITIES			
	a. Execution Scheme of equipment foundation	WC	Rw	Yes
	b. Material Supply			
	- Owner's supply including templates, if any	WC	Rw	Format M2
	- Contractor's supply & check testing, if any	WC	HP	Format M2
	c. Readiness for erection			
	i) Level of foundation (shims/packing with markings to be prepared & kept ready)	WC	S	Format M27
	ii) Marking/Centre line of foundation & equipment	WC	W	Format M27
	iii) No./dia./length of anchor bolts, depth of pockets, verticality of pockets	WC	S	Format M27
	iv) Chipping, roughing & cleaning of pockets/top of foundation			
	A. Normal equipments	WC	HP	Format M27
	B. Critical equipments	WC	S	Format M27
	v) Availability of grouting materials as per specifications/Manufacturer's recommendations	WC	S	Format M27
2.	LIFTING TACKLES			
	Load test of Cranes/Lifting beams/slings/shackles/ Wire ropes, etc. for weight of equipments to be handled	WC	W/Rw	Yes
3.	VISUAL INSPECTION OF EQPT. TAG/IDENTIFICATION NO.			
	a. For any damage	WC	S	---
	b. Free shaft rotation	WC	S	---
4.	Drilling & Tapping, holes in the base plate of eqpt. (if reqd.)	WC	W	---
5.	Approval of Rigging procedure (for critical equipments only)	WC	HP	Yes

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1160 REV 1
EQUIPMENT ERECTION (ROTATING EQUIPMENT)

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
6.	DURING ERECTION			
a.	Level/elevation of base frame	WC	S	---
b.	Checking of foundation bolts (for location, threading, greasing, etc.)	WC	S	---
c.	Checking orientation of equipment	WC	W	---
d.	Placement of Crane(s), if applicable	WC	S	---
e.	Elevation/level of equipment and placement of shims/packings as per AFC drawings	WC	HP	Format M30
f.	Distance between couplings	WC	W	Format M30
g.	Rough alignment of equipment	WC	S	Format M30
h.	Availability of Vendor's engineer at site (For critical equipments)	WC	HP	---
i.	Cleaning of pockets/ grouting of foundation bolts' pockets/base frame	WC	W	---
j.	Erection of auxiliary equipment/ Accessories	WC	S	---
k.	Final alignment of equipment			
-	Without piping	WC	HP	Format M30
-	With piping (After tightening the flange bolts)	WC	HP	Format M30
l.	All protection & safety guards installation	WC	W	Yes

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1160 REV 1
EQUIPMENT ERECTION (ROTARY)

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
7. POST ERECTION ACTIVITIES				
a.	Curing of grout	WC	S	---
b.	Auxiliary connections to be mounted on eqpts as per drawing.	WC	S	---
c.	Final tightening of bolts	WC	S	---
d.	Chemical cleaning of equipment parts/ connected piping	WC	S	---
e.	Boxing up of equipment & connected piping	WC	S	---
f.	Log book maintenance (For rotating of shaft and any other activity to be performed as per vendor's recommendations)	WC	S	Yes
g.	No load run of motors	WC	W	Yes
h.	Installation of mechanical seals (whenever mechanical seals are supplied separately)	WC	HP	---
i.	Re-coupling of motor & reconfirmation of alignment.	WC	HP	Format M30
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

ITP NO. : 1170 REV 1
CRANE (EOT/ HOT)

SL. NO.	ACTIVITY	CONTRACT OR	EIL	Records to be Submitted/ Format No.
1.	BEFORE ERECTION			
	a. Execution scheme of equipment foundation	WC	Rw	Yes
	b. Materials supply			
	- Owner's supply	WC	Rw	Format M2
	- Contractor's supply including testing, if any	WC	HP	Format M2
	c. Readiness for erection			
	i) Structural steel girder span centre to centre & elevation difference	WC	W	Format M31 (For Ref.)
	ii) Check centre to centre distance of rails, gaps, elevations, crab wheels distances	WC	W	Format M31 (For Ref.)
	iii) Check buffer stops	WC	W	Format M31 (For Ref.)
2.	a. Erection and assembly of components like LT, Crane Girders, Crab, Platforms, etc.	WC	S	Yes
	b. Check of hoist ropes and assembly of hook blocks	WC	S	---
3.	a. Electrical installation, testing & no load test of motors	WC	S	Yes
	b. Coupling of motors to drivers	WC	S	---
4.	NO LOAD TEST			
	a. Winding & unwinding test	WC	HP	Format M32
	b. Traversing test	WC	HP	Format M32
	c. Traveling test	WC	HP	Format M32
5.	LOAD TEST			
	a. Winding & unwinding test	WC	HP	Format M32
	b. Traversing test	WC	HP	Format M32
	c. Traveling test	WC	HP	Format M32
	d. Load & over load testing	WC	HP	Format M32
	e. Deflection of girder	WC	HP	Format M32
	INSPECTION & TEST DOCUMENTS			
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1180 REV 1
STORAGE TANKS

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
A. PRIOR TO FABRICATION				
1.	Acceptance of the tanks foundation	WC	HP	Yes
2.	Incoming Material			
	- Owner's supply	WC	Rw	Format M2
	- Contractor's supply, including check testing	WC	HP	Format M2
3.	Welding Filler Material Approval/Qualification			
	a) Manufacturing Test Certificate/Documents	WC*	Rw*	Yes
	b) Testing, if any			
	i) Carbon Steel	WC	W	Format M3, M4
	ii) Alloy Steel/Stainless Steel	WC	W	Format M3, M4
4.	WPS/PQR			
	a) Procedure	WC	HP	Format M5
	b) Testing			
	i) Carbon Steel	WC	HP	Format M6
	ii) Alloy Steel/Stainless Steel	WC	HP	Format M6
	c) Approval of Final WPS/PQR	WC	HP	Format M5, M6
5.	a) Welder performance Qualification Test	WC	W	Format M7
	b) Certification & approval of welder	WC	HP	Format M8
6.	NDT Procedure Qualification			
	a) Review of Proposed Procedure	WC	HP	Yes
	b) Witnessing of the proposed procedure testing	WC	HP	---
	c) Approval of Qualified Procedure	WC	HP	Yes
7.	Review of Joint numbering in drawings	WC	HP	Yes
8.	Suitability of plate bending machine	WC	Rw	---
9.	Job procedures for Fabrication, erection, testing	WC	HP	Yes
B. FABRICATION/ERECTION BOTTOM				
1.	Plate size, marking and cutting	WC	W	---
2.	Blast cleaning & painting of underside of bottom plates	WC	HP	Format M17

* Notwithstanding any other tests/documentation required for qualification/approval of filler metals :

- For Alloy Steel & Stainless Steel welding filler metals, chemical analysis to be carried out for very batch.
- For LTCS welding filler metals, Impact test to be carried out for every batch
- For NACE filler metals, corrosion tests like HIC, SSCC, etc. to be carried out for every batch

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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STORAGE TANKS

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
3.	Plate lay out, overlap and fit up	WC	S	Format M33, M34
4.	Sequence of welding	WC	S	Format M33
5.	Size and positioning of backing plate for annular plates	WC	W	Format M33
6.	Baking of electrodes	WC	S	---
7.	Inter-pass cleaning	WC	S	---
8.	Visual check of welding	WC	W	Format M34
9.	PT/MT/NDT of annular plate butt welds and bottom plate butt welds (As applicable)	WC	HP	Format M13, M14, M41, M42
10.	Vacuum box test for bottom plate welding	WC	HP	Yes
SHELL				
1.	Plate size, marking and cutting	WC	Rw	Format M35
2.	Plate bending, curvature check, stacking	WC	W	---
3.	Shell course alignments and fit-up of vertical and circumferential joints before welding	WC	W	Format M37, M38
4.	a. Check Shell diameter, circularity, perpendicularity, straight edge before welding.	WC	W	Format M38, M39
	b. Check Shell diameter, circularity, perpendicularity, straight edge after welding.	WC	HP	Format M38, M39
5.	Visual check of welding and Back chipping	WC	W	Format M36, M37
6.	Inner side welding visual check	WC	W	Format M36, M37
7.	Location, size and alignment of nozzles & other openings	WC	HP	Format M40
8.	R.F. Pads fit-up/welding	WC	W	Format M40
9.	PWHT of shell, RF pads, Nozzles, manholes, etc. (As applicable)	WC	W	Format M40
10.	Radiography marking (for Random radiography only)	WC	HP	Format M35, M41
11.	Curb angle and Wind girders fit-up/welding	WC	W	Format M40

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1180 REV 1
STORAGE TANKS

Sl. No.	Activity	Contractor	EIL	Records to be Submitted/ Format No.
12.	PT/MT of nozzles, wind girders and other attachments (as applicable)	WC	W	Format M13, M14
13.	RF pads pneumatic test	WC	HP	Yes
14.	Shell to bottom fit up	WC	HP	Format M37
15.	Shell to bottom I/S welding root run visual/Oil chalk test	WC	HP	Format M44
16.	Shell to bottom O/S welding visual and PT	WC	W	Format M37
17.	Fabrication and erection of stair ways	WC	S	Yes
18.	Cleats welding for insulation	WC	S	Yes
19.	Radiography			
	a. Radiography interpretation	WC	HP	Format M42
	b. Check shot for Radiography	WC	HP	Format M42
FIXED ROOF				
1.	Identification of Roof Structure members in AFC drgs.	WC	Rw	---
2.	Blast cleaning and painting Roof Structure, underside of Roof plates	WC	W	Format M17
3.	Location and Welding of Roof supports	WC	S	Yes
4.	Alignment and welding of Roof structures	WC	W	Yes
5.	Plate layout, overlap and fit-up	WC	S	Format M43
6.	Visual check of roof welds	WC	W	Format M43
7.	Location, size and alignment of roof nozzles, man-holes vents, etc.	WC	HP	Format M40

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1180 REV 1
STORAGE TANKS

Sl. No	Activity	Contractor	EIL	Records to be Submitted/ Format No.
8.	PWHT (as applicable)	WC		
	i) Procedure review	WC	HP	Yes
	ii) PWHT cycle monitoring	WC	W	Format M12, M40
9.	RF pads fit-up & Welding	WC	W	Format M40
10.	RF pad pneumatic testing	WC	HP	Yes
11.	PT/MT of Nozzles, vents & other attachments	WC	W	Format M13, M14
12.	Welding of Roof plate with shell/ curb angle	WC	HP	Format M43
FLOATING ROOF				
1.	Temporary staging spacing and levels	WC	Rw	---
2.	Plate size, straightening and cutting	WC	Rw	---
3.	Plate layout, overlap, fit-up/welding	WC	S	Format M34
4.	Availability of approved calculations for design of buoys	WC	HP	Yes
5.	Buoys fabrications	WC	S	Format M44
6.	Vacuum testing of roof-plate welds	WC	HP	Format M45
7.	Location of sleeve supports	WC	S	---
8.	Pad plate welding with roof and sleeve support	WC	S	Format M40
9.	Fixing and welding of Buoys	WC	W	Format M44
10.	Initial – lift	WC	W	---
11.	Supports fixing through sleeves	WC	S	---
12.	Seal welding of support sleeves from beneath after dewatering	WC	S	Yes
13.	Air test of Buoys	WC	HP	Format M44
14.	Pantoon welding	WC	S	Format M44

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

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ITP NO. : 1180 REV 1
STORAGE TANKS

Sl. No	Activity	Contractor	EIL	Records to be Submitted/ Format No.
15.	Location, fixing and welding of man holes, drains etc	WC	W	Format M40
16.	Shell to pantoon clearance	WC	HP	Format M46
17.	Seal fixing	WC	HP	Yes
18.	Floating Roof Testing, as required e.g. flooding etc.	WC	HP	Format M45
C. TESTING				
1.	Correctness of testing arrangements especially size of blind flanges/vents/drains/ temporary piping.	WC	HP	---
2.	Mechanical / Inspection clearances	WC	HP	Yes
3.	Earthing of ladder & shell	WC	W	Yes
4.	Settlement readings during water filling	WC	HP	Format M47
5.	Hammer test	WC	HP	Format M45
6.	Air pressure test	WC	HP	Format M45
7.	Vacuum test	WC	HP	Format M45
8.	Roof collapsibility test in case of floating roof tanks	WC	HP	Format M45
9.	Calibration of tanks from Statutory authorities	WC	Rw	Format M48
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

NOTE :

- 1) For cleaning & painting, refer ITP No. 6 - 82 - 1501
- 2) For Insulation, refer ITP No. 6 - 82 - 1505

Pl. refer page 5 of 107 for definition of WC, Rw, HP, W, S and Section-B (page 43 of 107) for formats

SECTION - B

FORMATS

FOR

MECHANICAL WORKS

CONTENTS

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FORMAT NO. : M-1 REV 1
RECORD OF CALIBRATION OF MEASURING/TESTING EQUIPMENTS

Report No. : _____
 Date : _____

Name of work : _____
 Job No. : _____

Project : _____
 Client : _____
 Consultant : _____
 Contractor : _____
 Work order No. : _____

Sl. No.	Test Equipment Description	Range	Make/Model No./Sr. No.	Calibrated by	Calibration Certificate No./Date	Calibration Validity Period & Date	Next Calibration Due Date	Accepted		Remarks
								Contr.	EIL	

Note : Ensure measuring/test equipment is sent to laboratory prior to expiry of present certificate

CONTRACTOR

EIL

**FORMAT NO. : M-2 REV 1
INCOMING MATERIAL INSPECTION REPORT**

Project : _____ Unit : _____ Report No. : _____
Contractor : _____ Consultant : _____ Date : _____
Work order No. : _____ P.O. No. & Date : _____ Name of Work : _____
Client : _____ Job No. : _____

Sl. No.	SOR Item No.	Material description	Tag No./ Heat No.	Date of Receipt	Qty. Received	Qty. Accepted	Manufacturer/ Vendor	MTC No./ IRN No. with Date	Invoice/ Challan/ LR No.	Observation/Remarks/ Storage Instruction

Note :

INSPECTION ACTIVITY AT SITE :

- Quantity verified and found in order
- Material condition appears to be good
- Heat/Batch/Tag No. mentioned on the material
- Color coding done as applicable
- Site identification mark on material
- Correlation w.r.t. IRN/MTC/Lab Tests report
- TC verification w.r.t. IRN/Spec/QAP, etc.

Review/Verification of documents :		Remarks, if any
1. Inspection Release Note	Reviewed/Verified/Not Applicable	
2. Manufacturer Test Certificate	Reviewed/Verified/Not Applicable	

Based on above, materials are accepted.

Contractor

EIL

OWNER

FORMAT NO. : M-3 REV 1
ELECTORDE QUALIFICATION TEST REPORT

(Sheet 1 of 3)

Report No. : _____
Date : _____

Project : _____
Name of Work : _____
Job No. : _____

Unit : _____

Work order No. : _____

Site _____

Test started on _____

Sponsoring Contractor _____

Test completed on _____

Manufacturer _____

H.O. Reference _____

Brand Name _____

Date of approval _____

Ref. Code _____

Batch No./Size _____

Colour code _____

IS/AWS Classification _____

All Weld Test

Base material used _____

Buttering used Yes/No

Preheat temp. _____

Interpass temp. _____

Postheat temp/time _____

Visual Inspection _____

Radiographic result : Gr.I/Gr.II/Not required (As per ASME Sec II Part C)

Mechanical Test Results

Identification	Size of Electrode	Current AC/DC	UTS Kgs/mm ²		YS Kgs/mm ²		% Elongation Gauge length	
			Code	Actual	Code	Actual	Code	Actual

UTS = Ultimate tensile strength

YS = Yield strength

(Sheet 2 of 3)

IMPACT TEST RESULTS : °C

Identi- fication	Size of Elect- rode	Current AC/DC	Cooling Medium	I ₁ Kgf-m	I ₂ Kgf-m	I ₃ Kgf-m	I ₄ Kgf-m	I ₅ Kgf-m	I Average Kgf-m	Code Kgf-m

CHEMICAL ANALYSIS RESULTS

WELD PAD/FILLER WIRE

Iden- tifi- cation	Size of Elec- trode	Curr- ent. AC/DC	C	Mn	P	S	Si	Ni	Cr	Mo	V	Cu	Co/Nb	% As per Code
														% As per Actual
														Code/Act

FILLET WELD TEST RESULT

Identification	Size of Electrode	Current AC/DC	F Flat	H Horizontal	V Vertical	OH Over Head

Macro Examinations Result _____

Procedure Test Result

Material _____

Pipe/Plate Size _____

In combination if any (ELECTRODE) _____

Preheat temp. _____

Post heat temp/time _____

Visual Examination Result _____

Dye Penetrant/Magnetic Particle Testing

Result _____

Position _____

Current : _____ AC/DC

Radiographic Examination

Result _____

(Sheet 3 of 3)

TENSILE AND BEND TEST RESULT

Position	Identification	Tensile Tests Kg/mm ²			Bend Tests			
		Code	Actual		F1/S1	F2/S2	R1/S3	R2/S4
			T1	T2				

Impact Test Results _____ °C

Identification : _____

Location	I1 Kgf-m	I2 Kgf-m	I3 Kgf-m	I4 Kgf-m	I5 Kgf-m	I average Kgf-m	Code requirements Kgf-m
WELD							
HAZ							

POSITION TEST AS PER IS-814 (M.S. ELECTRODES ONLY)

Material _____

Plate size _____

Visual _____

Identification _____

Radiography Result _____

		Tensile Test		Bend Tests				Impact Tests				
Position	Identification	T-kg/mm ²		F1	F2	R1	R2	I1 Kgf-m -oC	I2 Kgf-m -oC	I3 Kgf-m -oC	I ave- rage	Code Kgf-m
		Code	Actual									
1G												
2G												
3G												
4G												

Special Remarks for approval _____

Encl 1)

2)

Strike whichever is not applicable

Suffix indicates specimen number.

Index

T = Tensile Test
S = Side Bend
F = Face Bend
R = Root Bend
I = Impact Test

Witnessed by

Approved by

FORMAT NO. : M-4 REV 1
INSPECTION REPORT - FILLER MATERIAL
MANUFACTURER'S WORKS

Report No. : _____

Date : _____

Project : _____

Unit : _____

Name of Work : _____

Job No. : _____

Work order No. : _____

1. Date of visit _____

2. By _____

3. Manufacturer _____

4. Ref. _____

5. Location _____

6. Person contacted _____

7. Brand name of electrode/Filler wire/Bare electrode _____

8. Specification _____

9. Classification _____

10. Current I.S. approval available: (Yes/No) Valid upto _____

11. Testing laboratory: Available/Not available

12. Testing facilities: A) Mechanical i) Tensile _____

Including Machining ii) Bend _____

iii) Impact _____

B) Chemical elements _____

13. Qualified chemists: Available/No available

If yes Name _____

14. Quality control procedure: Suitable/Unsuitable
(copy enclosed for ready reference)

15. Qualified quality control personal: Available/No available

16. Raw material supplier _____

17. List of approvals _____

18. List of users _____

19. Remarks _____

To

Manager of Construction

Through RCM/Site In-charge

Signature

FORMAT NO. : M-5 REV 1
FORMAT FOR WELDING PROCEDURE SPECIFICATIONS(WPS)
(Section IX, ASME Boiler and Pressure Vessel Code)

(Sheet 1 of 2)

Report No. : _____
Date : _____

Project : _____ Unit : _____
Name of Work : _____ Contractor : _____
Job No. : _____ Work order No. : _____

Company Name _____ By _____
Welding Procedure Specification No. _____ Date _____ Supporting PQR No.(s) _____
Revision No. _____ Date _____
Welding Process(es) _____ Type(s) _____
(Automatic, Manual, Machine or Semi-Auto)

JOINTS (QW-402)	Details :
Joint Design _____	
Backing (Yes) _____ (No.) _____	
Backing Material (Type) _____	
Sketches, Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified. (At the option of the Mfgr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures. etc.)	
*BASE METALS (QW-403)	
P.No. _____ Group No. _____ to P.No. _____ Group No. _____	
OR	
Specification type and grade _____ to	
Specification type and grade _____	
OR	
Chem. Analysis and Mech. Prop. _____	
Thickness Range : _____	
Base Metal : Groove _____ Fillet _____	
Deposited Weld Metal _____	
Pipe Dia. Range : Groove _____ Fillet _____	
Other _____	
*FILLER METALS (QW-404)	
F.No. _____ Other _____	
A.No. _____ Other _____	
Spec. No. (SFA) _____	
AWS No. (Class) _____	
Size of filler metals _____	
(Electrode, Cold Wire, Hot wire etc.)	
Electrode-Flux (Class) _____	
Flux Trade Name _____	
Consumable Insert _____	

* Each base metal-filler metal combination should be recorded individually.

(Sheet 2 of 2)

POSITIONS (QW-405) Position(s) of Groove _____ Welding Progression : Up _____ Down _____ Position(s) of Fillet _____	POSTWELD HEAT TREATMENT (QW-407) Temperature Range _____ Time Range _____																						
PRHEAT (QW-406) Preheat Temp. Min. _____ Interpass Temp. Max. _____ Preheat Maintenance _____ (Continuous or special heating where applicable should be recorded)	GAS (QW-408) Shielding Gas(es) _____ Percent Composition (mixtures) _____ Flow Rate _____ Gas Backing _____ Trailing Shielding Gas Composition _____																						
ELECTRICAL CHARACTERISTICS (QW-409) Current AC or DC _____ Polarity _____ Amps (Range) _____ Volts (Range) _____ (Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown below.) Tungsten Electrode Size and Type _____ (Pure Tungsten, 2% Thoriated, etc.) Mode of Metal Transfer for GMAW _____ (Spray arc, short circuiting arc, etc.) Electrode wire feed speed range _____																							
TECHNIQUE (QW-410) String or Weave Bead _____ Orifice or Gas Cup size _____ Initial and Interpass Cleaning (Brushing, Grinding etc.) _____ Method of Back Gouging _____ Oscillation _____ Contact Tube to Work Distance _____ Multiple or Single Pass (per side) _____ Multiple or Single Electrodes _____ Travel Speed (Range) _____ Peening _____ Other _____																							
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">Weld Layer(s)</th> <th rowspan="2">Process</th> <th colspan="2">Filler Metal</th> <th colspan="2">Current</th> <th rowspan="2">Volt Range</th> <th rowspan="2">Travel Speed Range</th> <th rowspan="2">Other</th> </tr> <tr> <th>Class</th> <th>Dia.</th> <th>Type Polar.</th> <th>Amp Range</th> </tr> </thead> <tbody> <tr> <td style="height: 100px;"></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>e.g. Remarks, Comments Hot Wire Addition Technique Torch Angle Etc.</td> </tr> </tbody> </table>		Weld Layer(s)	Process	Filler Metal		Current		Volt Range	Travel Speed Range	Other	Class	Dia.	Type Polar.	Amp Range									e.g. Remarks, Comments Hot Wire Addition Technique Torch Angle Etc.
Weld Layer(s)	Process			Filler Metal		Current					Volt Range	Travel Speed Range	Other										
		Class	Dia.	Type Polar.	Amp Range																		
								e.g. Remarks, Comments Hot Wire Addition Technique Torch Angle Etc.															

FORMAT NO. : M-6 REV 1
SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION
RECORD (PQR)
(Section IX, ASME Boiler and Pressure Vessel Code)

(Sheet 1 of 2)

Report No. : _____
Date : _____

Project : _____ Unit : _____
Name of Work : _____
Job No. : _____ Work order No. : _____
Company Name _____
Procedure Qualification Record No. _____ Date _____
WPS No. _____
Welding Process(es) _____
Type (Manual, Automatic, Semi-Auto) _____

JOINTS (QW-402)

Groove Design Used

BASE METALS (QW-403)

Materials Spec. _____
Type or Grade _____
P. No. _____ to P.No. _____
Thickness _____
Diameter _____
Other _____

POSTWELD HEAT TREATMENT (QW-407)

Temperature _____
Time _____
Other _____

GAS (QW-408)

Type of Gas or Gases _____
Composition of Gas Mixture _____
Other _____

FILLER METALS (QW-404)

Weld Metal Analysis A No. _____
Size of Electrode _____
Filler Metal F No. _____
SFA Specification _____
AWS Classification _____
Other _____

**ELECTRICAL CHARACTERISTICS
(QW-409)**

Current _____
Polarity _____
Amps. _____ Volts _____
Other _____

POSITION (QW-405)

Position of Groove _____
Weld Progression (Uphill, Downhill) _____
Other _____

TECHNIQUE (QW-410)

Travel Speed _____
String or Weave Bead _____
Oscillation _____
Multipass or Single Pass (per side) _____
Single or Multiple Electrodes _____
Other _____

PREHEAT (QW-406)

Preheat Temp. _____
Interpass Temp. _____
Other _____

(Sheet 2 of 2)

Specimen No.	Width	Thickness	Area	Ultimate Total Load lb.	Ultimate Unit Stress psi	Character of Failure & Location

Guided Bend Tests (QW-160)

Type and Figure No.	Results

Toughness Test (QW-170)

Specimen No.	Notch Location	Notch Type	Test Temp.	Impact Values	Lateral Exp.		Drop Weight	
					% shear	M/s	Break	No. Break

Fillet Weld Test (QW-180)

Results-Satisfactory : Yes _____ No _____ Penetration into Parent Metal : Yes _____ No _____
Type and Character of Flt: Micro _____ Macro-Results _____

Other Tests

Type of Test _____
Deposit Analysis _____
Other _____

Welder's Name _____ Clock No. _____ Stamp No. _____
Tests conducted by: _____ Laboratory Test No _____

We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Date _____ Manufacturer _____
By _____

(Details of record of tests are illustrative only and may be modified to conform to the type and number of test required by the Code.)

FORMAT NO. : M-7 REV 1
**SUGGESTED FORMAT FOR MANUFACTURER'S
RECORD OF WELDER OR WELDING OPERATOR
QUALIFICATION TESTS**
(Section IX, ASME Boiler and Pressure Vessel Code)

Report No. : _____
Date : _____

Project : _____ Unit : _____
Name of Work : _____ Contractor : _____
Job No. : _____ Work order No. : _____
Welder Name _____ Check No. _____ Stamp No. _____
Welding Process _____ Type _____
In accordance with Welding Procedure Specification (WPS) _____
Backing (QW-402) _____
Material (QW-403) Spec. _____ to _____ of P No. _____ to P No. _____
Thickness _____ Dia _____
Filler Metal (QW-404) Spec.No. _____ Class No. _____ F. No. _____
Other _____
Position (QW-405) (1G, 2G, 6G) _____
Gas (QW-408 type) _____ % Composition _____
Electrical Characteristics (QW-409) Current _____ Polarity _____
Weld Progression (QW-410) _____
Other _____

For Information Only

Filler Metal Diameter and Trade Name _____
Submerged Arc Flux Trade Name _____
Gas Metal Arc Welding Shield Gas Trade Name _____

Guided Bend Test Results QW-462.2(a), QW-462.3(a), QW-462.3(b)

Type and Fig No.	Fault

Radiographic Test Results (QW-305)
For alternative qualification of groove welds

Radiographic Results:

Fillet weld test Results (QW-462.4(a), QW-462.4(b))

Fracture Test (Describe the location nature arrange of any check ring of the specimen)

Length and per cent of defects _____ inches _____ %
Macro Test-Fusion _____
Appearance-Fillet size: deg _____ in. x _____ in. Convexity _____ in. or concavity _____ in.

Test conducted by _____ Laboratory – Test No. _____
We certify that the statements in this record are correct and that the test welds were prepared, welded and tested in accordance with the requirements of Sections IX of the ASME Code

Date : _____ Organization _____
by _____

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code)

Note : Any essential variables in addition to those above shall be recorded.

FORMAT NO. : M-8 REV 1
WELDER'S IDENTIFICATION CARD

Report No. : _____
Date : _____

Project : _____
Name of Work : _____
Job No. : _____

Unit : _____
Contractor : _____
Work order No. : _____

NAME :

Identification :

Date of Testing :

Plate/Pipe size :

Welding process :

Filler material
Classification :

Position :

Qualified to weld :

Valid until :

WELDING ENGINEER

(NAME & DATE)

EMPLOYERS SIGNATURE WITH SEAL

DETAILS OF QUALIFICATIONS :
BACKSIDE OF IDENTITY CARD

Sr. No.	WPS/PQR No.	Date of Test	Qualified On	EIL Signature	Remarks
------------	-------------	--------------	-----------------	------------------	---------

FORMAT NO. : M-9 REV 1

Contractor : _____

* As per approved Inspection & Test Plans (ITPs)

(Owner)

Work order No. : _____

EIL

**FORMAT NO. : M-12 REV 1
HARDNESS TEST RECORD**

Report No. _____

 Date _____

Project _____
 Name of Work _____
 Job No. _____

Unit : _____
 Contractor : _____
 Work order No. : _____

Line No./ Equipment No.	Weld Joint No.	Stress Relief Chart No.	Hardness Bar Factor	Diameter After Impression				B.H.N.		Observation	Remarks
				Bar	Job	0 ⁰	180 ⁰	0 ⁰	18 ⁰		
				0 ⁰	180 ⁰	0 ⁰	180 ⁰	0 ⁰	18 ⁰		

CONTRACTOR

THE

FORMAT NO. : M-13 REV 1
LIQUID PENETRANT EXAMINATION REPORT

Report No. : _____
Date : _____

Project : _____ Unit : _____
Name of Work : _____ Contractor : _____
Job No. : _____ Work order No. : _____

Item Name/No. Drg. No.

Part Name	Method of Examination	Colour Contrast Solvent Removal	Application No.	Material
-----------	-----------------------	---------------------------------	-----------------	----------

EXAMINATION DETAIL

Surface Temperature & Penetrant Time _____ °C _____ Minute

Penetrant

Remover

Developer

Sketch	Line No.	Joint No.	Type	Size
--------	----------	-----------	------	------

CONTRACTOR

EIL

FORMAT NO. : M-14 REV 1
MAGNETIC PARTICLE EXAMINATION REPORT

Report No. : _____

Date : _____

Project : _____

Name of Work : _____

Job No. : _____

Unit : _____

Contractor : _____

Work order No. : _____

Name of Item

Drg. No.

Item No.

Joint No.

1. Test Condition

Tester Type : _____

Magnetizing Type : Not Remained

Method : Prod.

Remained

Coil

Exami. Medium

Dry

White

Wet

Brown

Fluorescent

Magnetizing Current _____ A

Standard JIS A type

Magnetizing Time _____ Sec.

Surface Condition

Surface Temp.

2. Acceptance Observations

3. Sketch

4. Result

Remarks

CONTRACTOR

EIL

Report No. : _____
Date : _____
Project : _____
Contractor : _____

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**FORMAT NO. : M-17 REV 1
DAILY PAINTING REPORT**

Name of Work :										Report No.	
Contractor :										Date	
Drawing No.										Location	
Specification No.										Procedure	
Job Description :											
Daily weather record :											
Time		Relative Humidity		Ambient temperature		Surface temperature		Dew point temperature		Weather condition	
Surface preparation											
a) Method											
Blasting		Power tool		Hand clean		Solvent		Emery cloth		Other	
b) Blasting details											
Abrasive		Sand		Grit		Shot		Certificate No.			
c) Surface standard											
SIS 05 5900 SA-2 ½				Others		Profile		Micron		Result : Accepted / Rejected	
Painting material and application method : Painting System -											
Material brand				Manufacturer		Certificate No.		Batch No.		Shelf life upto	
Primer (Base/Hardener)										Shade/ Colour	
Intermediate-1 st coat											
Intermediate-2 nd coat											
Finish -1 st coat											
Finish -2 nd coat											
Painting Inspection Record :											
Item	Area/Join		Coating Layer	Wet Film Thickness		Dry Film Thickness		Holiday Testing	Visual Inspection	Acceptance	
	From	To		Measurements 1,2,3...	Avg.	Measurements 1,2,3...	Avg.				
			Primer								
			Intermediate-1 st coat								
			Intermediate-2 nd coat								
			Finish -1 st coat								
			Finish -2 nd coat								
Identification colour band & direction marker : Accepted/ Not Accepted											
NOTE: All blasting and coating materials shall be approved by the Owner. All measuring and testing equipments shall have valid calibration certificate and shall adhere to relevant specifications.											

(Contractor)

(EIL)

FORMAT NO. : M-19 REV 1
PICKLING ABOVE GROUND PIPING CERTIFICATE

Report No. : _____
Date : _____

Project : _____
Name of Work : _____
Job No. : _____

Unit/Plant : _____
Contractor : _____
Work order No. : _____

SYSTEM : _____
LOOP/LINE NOS : _____
PICKLING DONE DURING : _____

LOOP SKETCH - ATTACHED
TEST RESULTS - ATTACHED

CERTIFICATE

Certified that the pickling of the above system has been carried out successfully as per specification and the system is preserved with gas at kg/cm² pressure

CONTRACTOR

EIL

CLIENT

FORMAT NO. : M-20 REV 1
SYSTEM COMPLETION REPORT ABOVE
GROUND PIPING

Report No. : _____
Date : _____

Project : _____
Name of Work : _____
Job No. : _____

Unit/Plant : _____
Contractor : _____
Work order No. : _____

System : _____
Loop Nos. : _____
Ref. P&ID No. : _____

Area : _____
Unit : _____
Test Reports – Enclosed

The above system has been cleaned/flushed/tested as per the requirement of drawings and specifications and cleared for operation.

CONTRACTOR

EIL

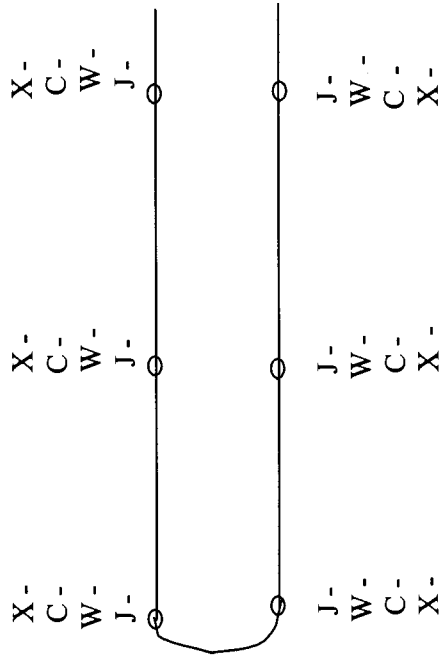
CLIENT

FORMAT NO. : M-22 REV 1

SHOP HYDRO TEST REPORT FOR COIL (HEATER)

Name of Work : _____
 Project : _____
 Plant : _____

Report No : _____
 Date : _____
 Contractor : _____

Sketch	Coil No. _____ Test Medium : _____ Test Pressure : _____	
		
Item		Acceptance By
		Contractor
Cleared for Hydro/Pneumatic Testing		EIL
Air Blowing and Flushing		
Pneumatic/Hydrostatic Testing		
Dewatering and Drying		
Cleared for Erection		

Legend : J – Joint No, W – Welder No., C – Stress Relief Chart No., X – X-Ray No.

CONTRACTOR

EIL

FORMAT NO. : M-23 REV 1
MECHANICAL COMPLETION RECORD (HEATER)

Name of work : _____
Project : _____
Plant : _____
Contractor : _____

Report No. : _____
Date : _____
Area : _____
Ref P&ID No. : _____

Loop No. : _____

Inch Mtr. _____

From _____ To _____

Line Nos. : _____

Sl. No.	Activity	Check	Clearance by			
			Contractor		EIL	
			Sign	Date	Sign	Date
1.	Clearance for flushing and testing.					
1.1	Mechanical clearance - Conformity to drawings - Provision of Inst. Tappings - Provision of Vent & Drains - Correctness of gaskets and fastners - Correctness of type of support anchors, guides, etc. - Correctness of valves - Provision of cold pull - Isolation of equipment, CV, Insts, Bellows, etc.					
1.2	Welding and NDT clearance - Material as per piping class - Fit up checks - Visual check of completed welds - LPT/ MPT checks - Radiography clearance - PWHT & Hardness clearance - Preparatory arrangements for flushing/testing					
2.0	Flushing and testing Medium _____ Pressure _____ KG/CM ²					
3.0	Draining and drying					
4.0	Pickling					
5.0	Box up					

Remarks : ISO/Loop sketches duly filled in data (Jt. No. W. No. XR No. Sr. chart No.) shall be enclosed for item (1)

CONTRACTOR

EIL

FORMAT NO. : M-24 REV 1
INSPECTION CHECK SHEET –
DAILY INSPECTION RECORD OF INSULATION
(HOT & COLD)

Report No. : _____
Date : _____

Project : _____
Name of Work : _____
Job No. : _____

Unit : _____
Contractor : _____
Work order No. : _____

Item No. / Equip. No. / Line No. _____

Surface Preparation : Visual Acc./Not Acc.
Fixing of Support Ring/ Lugs & Spacing : Acc./Not Acc.

Sl. No.	Activity & Item No.	Thickness of Insulation	Visual Inspection	Surface Area Length Insulated			Remarks
				From	To	SA(m ²)	
1.	Lagging of Insulation materials						
2.	Sheeting/Cladding work						
3.	Miscellaneous						
	a) Inspection Window						
	b) Valve boxes						
	c) Flange covers						
	d) Expansion joint						
	e) SS Foil for SS Piping						
	f) Wooden Support						
	g) Vapour Barrier						
	h) Vapour Sealant						
	i) Others						

CONTRACTOR

EIL

FORMAT NO. : M-25 REV 1
INSPECTION CHECK SHEET –
INSTALLATION ACCEPTANCE CERTIFICATE FOR
INSULATION

Report No. : _____
Date : _____

Project : _____
Name of Work : _____
Job No. : _____

Unit : _____
Contractor : _____
Work order No. : _____

SHEET _____ OF _____

Insulation Items	Result		Remarks
	Contractor	EIL	
<u>Quality control after installation</u> ☐ <u>Hot Insulation</u> (Visual & position of seam to prevent water penetration)			
☐ <u>Cold Insulation</u> (Visual & Sealing)			

CONTRACTOR

EIL

FORMAT NO. : M-26 REV 1
ERECTION CHECK LIST

Name of work : _____
Project : _____
Plant : _____
Contractor : _____
Loop No: _____
Line Nos.: _____

Report No: _____
Date : _____
Page : _____ of _____
P & ID Ref. No. : _____
Test Pack No: _____

SL. NO.	REMARKS DESCRIPTION OF ERROR FOUND AND ACTION TO BE TAKEN	ACTION TAKEN CONTRACTOR'S SIGN & DATE	RECHECK AND ACCEPTED, DATE

CHECKED BY

REMARKS:

CONTRACTOR

EIL

FORMAT NO. : M-27 REV 1
EXECUTION SCHEME

NAME OF WORK :

PROJECT :

PLANT :

CONTRACTOR :

**EXECUTION SCHEME
FOR FOUNDATIONS**

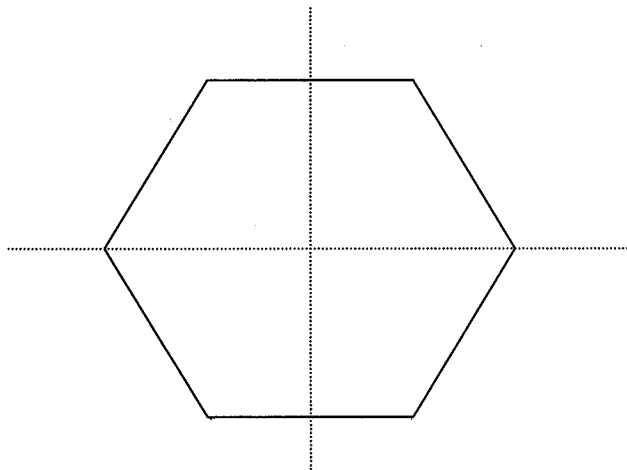
REPORT NO :

DATE :

DATE OF CHECKING :

FDN NO:

DRG NO:



PCD / BCD _____

GROUT THK _____

() TOP OF BOLT

() TOP OF CONCRETE

PITCH													
CIRCLE													
DIA (PCD)													
BOLT HT.													

DESCRIPTION	AS PER DRG	ACTUAL	DEVIATION	REMARKS
C/L CO-ORDINATES N				
E				
EL. TOP OF CONCRETE				
NO. OF BOLTS & SIZE				
HEIGHT OF BOLTS				
PCD OF BOLTS				
POCKET CLEARING				
FDN. ROUGHENING				
EL. TOP OF GROUT				

Remarks :

CONTRACTOR

EIL

FORMAT NO. : M-28 REV 1
HEAT EXCHANGERS/HORIZONTAL VESSELS
RECORD

Report No. :

Date :

Name of Work : _____

Service : _____

Eqpt. Type & No: _____

Location : _____

Client : _____

Unit/Area : _____

Project : _____

Manufacturer : _____

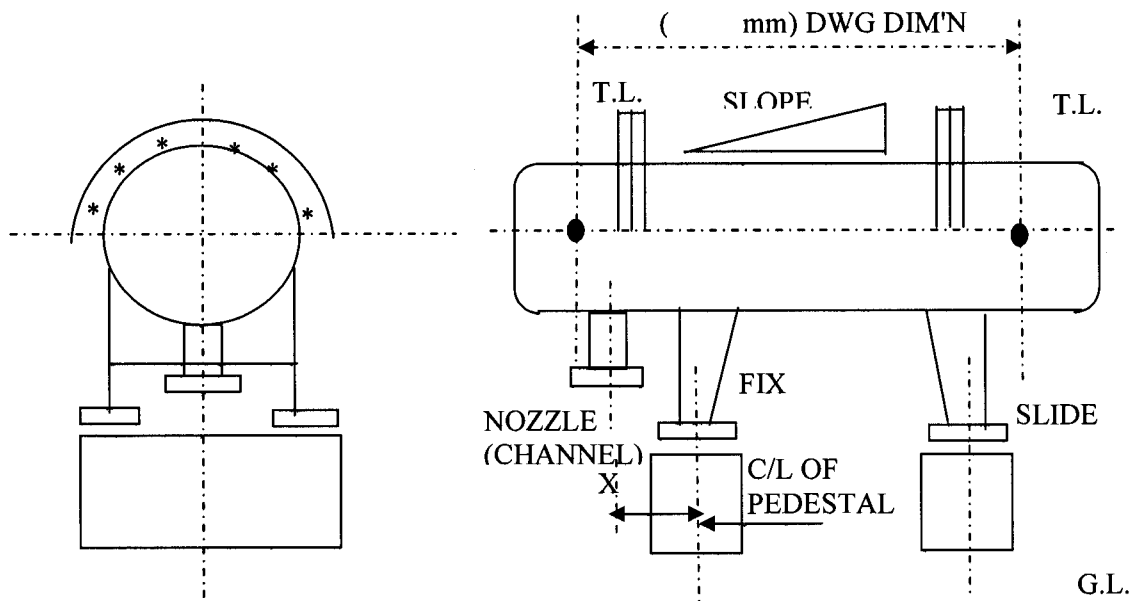
Contractor : _____

Length/Height : _____

Diameter : _____ Weight : _____

Vender Drg. No: _____

Check Items	Result	Date With Signature	Check Items	Result	Date With Signature
1. Foundations/ Co-ordinates			6. Alignment		
2. Anchor Bolts & Nuts			7. Grouting		
3. Name Plate			8. Sliding Plate Arrangement		
4. Setting of Centre Line			9. Greasing of Bolts/Nuts		
5. Erected on					



NOZZLE NO.	SIZE	DRG. ELV.	ACTUAL ELV	DRG. DIM 'X'	ACTUAL DIM 'X'

NOTES : Deviations on the above dimensions shall be intimated all concerned

REMARKS :

Approvals	Signatures	Designation	Date
Contractor			
EIL			
Client			

FORMAT NO. : M-29 REV 1
COLUMNS/REACTORS/VESSELS RECORD

Report No. :

Date :

Name of Work : _____

Services : _____

Eqpt. No: _____

Location : _____

Client : _____

Area/Unit : _____

Project : _____

Manufacturers : _____

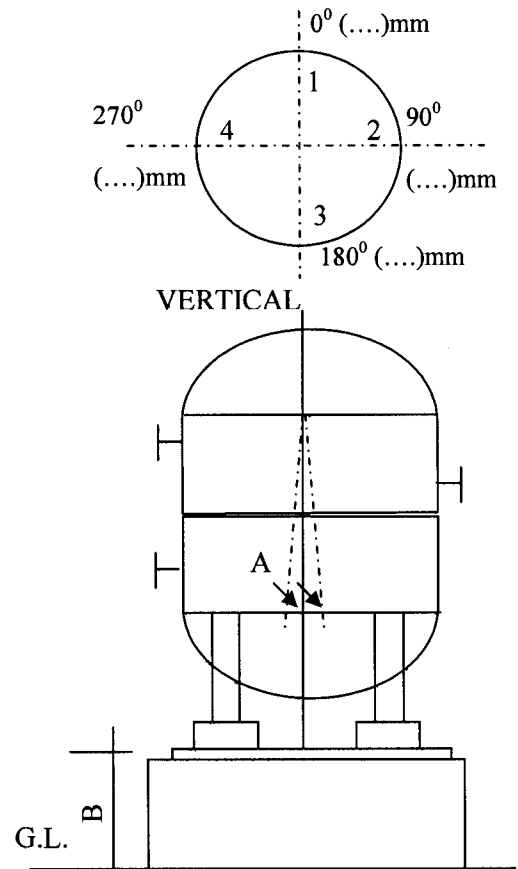
Contractor : _____

Length/Height : _____ Dia Meter : _____ Weight : _____

Vendor Drg No.: _____

CHECK ITEMS	REMARKS	DATE WITH SIGNATURE	CHECK ITEMS	REMARKS	DATE WITH SIGNATURE
1. FOUNDATION/ CO-ORDINATES			5. VERTICAL ALIGNMENT		
2. ANCHOR BOLTS & NUTS			6. BASE ALIGNMENT		
3. SETTING OF CENTRE LINES WITH TEMPLATE IF REQUIRED.			7. GROUTING		
4. ERECTED ON			8.		
			9.		

NOZZLE NO.	SIZE	DRG. ELV.	ACTUAL ELV.



Approvals	Signatures	Designation	Date
Contractor			
EIL			
Client			

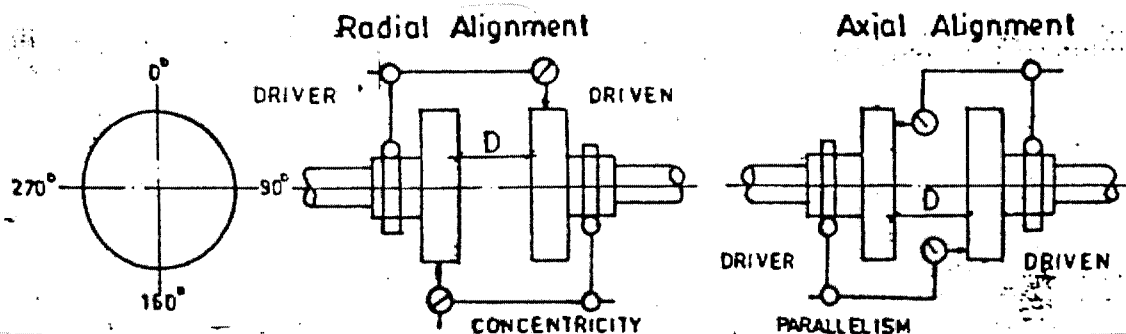
FORMAT NO. : M-30 REV 1
MACHINERY ALIGNMENT RECORD

Report No. : _____
Date : _____

Project : _____
Name of Work : _____
Job No. : _____

Unit : _____
Contractor : _____
Work order No. : _____

- 1) Equipment No. : _____
2) Manufacturer : _____
3) Drive : HP/RPM : _____
4) Weight in M.T. : _____
5) Erected on : _____
6) Aligned & Grouted on : _____
- 7) Type of Coupling : _____
8) Distance Between Coupling Halves (D) : _____
- As/Drg. : _____
Actual : _____



Angular Position	Without Piping				With Piping			
	Concentricity		Parallelism		Concentricity		Parallelism	
	A	B	A	B	A	B	A	B
0°								
90°								
180°								
270°								

Tolerances As per Data Sheet/Manual : -

Recoupling of motor and reconfirmation of alignment

☐ Checked

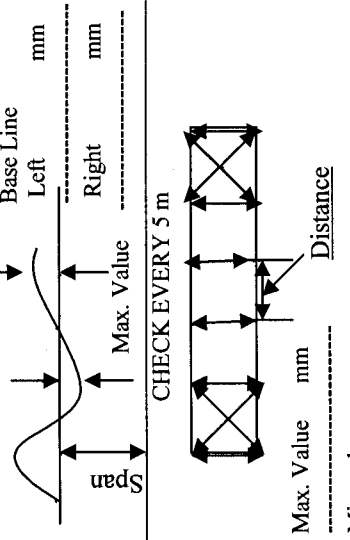
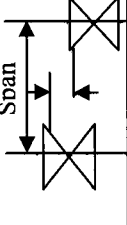
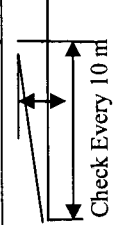
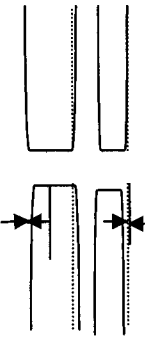
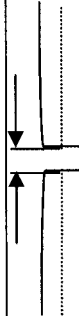
Result :-

Approvals	Signature	Designation	Date
Contractor			
EIL			
Client			

FORMAT NO.: M-31 REV 1

PERMISSIBLE TOLERANCE FOR TRAVELLING RAIL

Report No. : _____
 Date : _____
 Name of work : _____

CHECK ITEM	TOLERANCE AT INSTALLATION	CHECK METHOD	TRUTH DATUM
Straight Degree	For Total Length $\leq \pm 5$ mm		By Transit or Piano Wire
SPAN	$\leq \pm 5$ mm	(At two ends of the girders diagonal distance should also be checked) By Steel Tape Scale (JIS Fat Class)	
Elevation difference between rails	For wheel base length $\leq \text{SPAN} \times \frac{1}{1000}$		By Transit
Inclination	$\leq \frac{1}{1000}$		By Transit
Joint Difference	≤ 0.5 mm		By steel tape scale
Joint gap	≤ 2 mm		By steel tape scale

REMARKS : The Span should be measured by steel tape scale stretching with

(CONTRACTOR)

Crane Span
 < 20 mm ----- 7 kg
 ≥ 20 mm ----- 10 kg

(EIL)

FORMAT NO.: M-32 REV 1
TEST AND INSPECTION RECORD – CRANE

Report No. : _____
Date : _____

Project : _____
Name of Work : _____
Job No. : _____

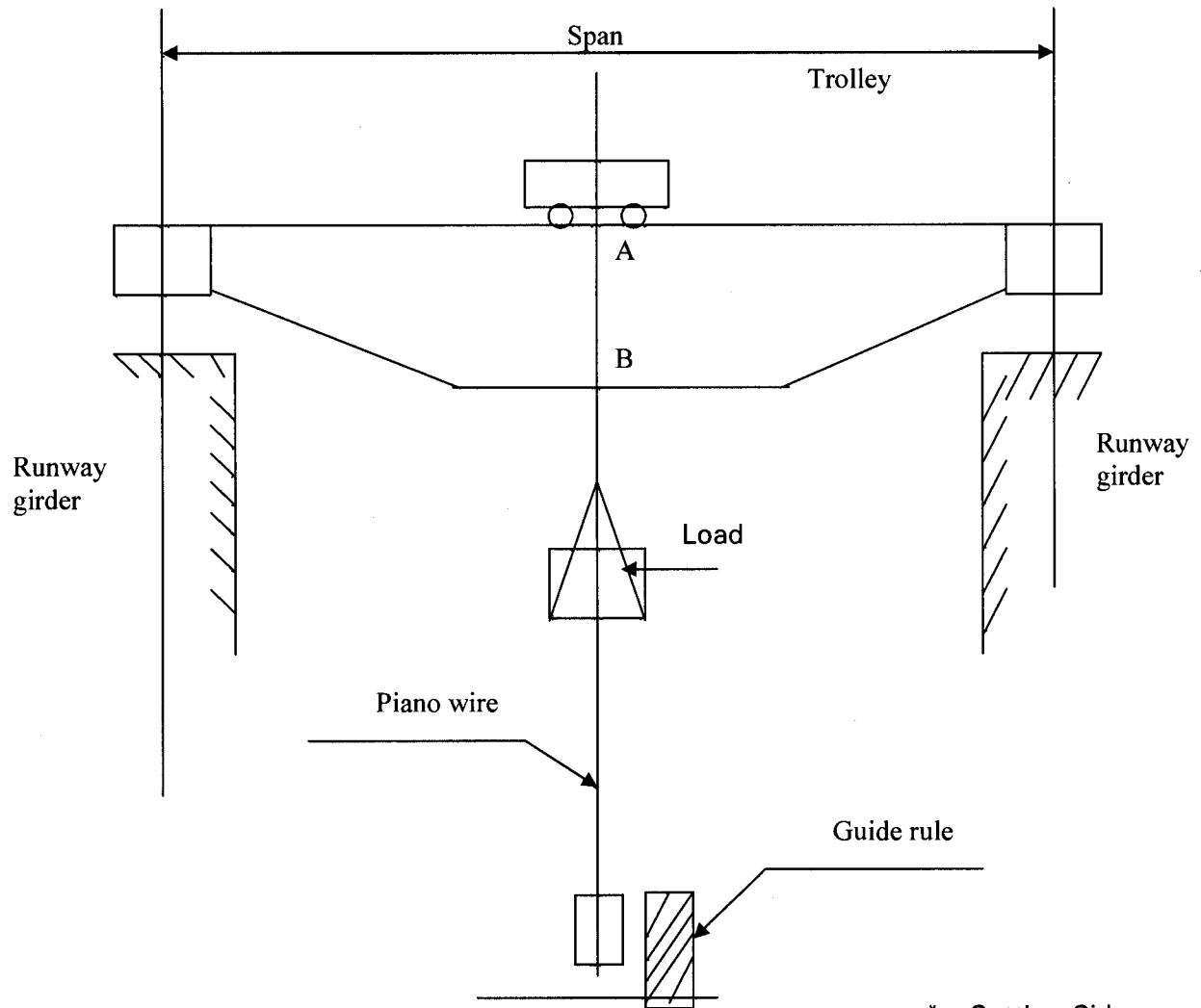
Contractor : _____
Work order No. : _____

(Sheet 1 of 2)

		No Load			0Ton			Rated Load			Ton			125% Load			Ton		
		Speed (m/mm)	Volt (V)	Ampere (A)	Speed (m/mm)	Volt (V)	Ampere (A)	Speed (m/mm)	Volt (V)	Ampere (A)	Speed (m/mm)	Volt (V)	Ampere (A)	Speed (m/mm)	Volt (V)	Ampere (A)	Speed (m/mm)	Volt (V)	Ampere (A)
Hoisting	Upper																		
	Lowering																		
Traversing	Right																		
	Left																		
Travelling	Front																		
	Back																		

Item Name	Hoisting		Traversing	Travelling
	Lowering (m/min.)	Upper (m/min)	(m/min.)	(m/min.)
1. Maintenance Shop Crane				
2. Warehouse Crane				
3. Emergency Generator Crane				
4. Propane Compressor Crane				
5. B.O.G. Compressor Crane				
6. Return Gas Blower Crane				
7. Sea Water Pump Crane				
8. Air Compressor Crane				

(Sheet 2 of 2)



* Setting Side
of wirght

Item Name	Rated Load (Ton)	Allowable Deflection of Girder (m/m) (Drive or Non drive)*	Test Result (m/m)
1. Maintenance Shop Crane			
2. Warehouse Crane			
3. Emergency-Generator Crane			
4. Propane Compressor Crane			
5. B.O.G. Compressor Crane			
6. Return Gas Blower Crane			
7. Sea Water Pump Crane			
8. Air Compressor Crane			

CONTRACTOR

EIL

TANK BOTTOM/FLOATING ROOF INSPECTION RECORD

Project : _____
Name of Work : _____
Job No. : _____

Unit : _____
 Contractor : _____
 Work order No. : _____

CONTRACTOR

EIL

Name of work :

NOTE :-

Contractor

100

- 1) Fit Up
- 2) Welding (Inside)
 - a) Visual
 - b) Oil chalk
- 3) Welding (Outside)
 - a) Visual
 - b) D.P.
- 4) Curb Angle/Wind
Girders (as per det
given in Const./QA
- 5) Openings (as per d
given in Const./QA

FORMAT NO. : M-36 REV 1
INSPECTION RECORD FOR TANK FABIRCATION
(VERTICAL JOINTS)

Report No. : _____
Date : _____

Project : _____
Name of Work : _____
Job No. : _____

Unit : _____
Contractor : _____
Work order No. : _____

Course No.	Vertical Joint No.	Fit-up Check		Welder No.	First Side Welding Check		Back Chip Check		Second Side Welding Check		Remarks
		Cont.	EIL		Cont.	EIL	Cont.	EIL	Cont.	EIL	
1	V 1										
	V 2										
	V 3										
	V 4										
	V 5										
	V 6										
2	V 7										
	V 8										
	V 9										
	V 10										
	V 11										
	V 12										
3	V 13										
	V 14										
	V 15										
	V 16										
	V 17										
	V 18										

V - Vertical Joint

CONTRACTOR

EIL

FORMAT NO. : M-37 REV 1

INSPECTION RECORD FOR TANK FABRICATION (HORIZONTAL JOINTS)

Report No. : _____
 Date : _____

Project : _____
 Name of Work : _____
 Job No. : _____
 Unit : _____
 Contractor : _____
 Work order No. : _____

Joint NO.	Fit-up Check		First Side Welding				Check		Back Chip Check		Second Side Welding Check		Remarks
			Welder Detail										
			0 – 90	90 – 180	180 – 270	270 - 0							
	Cont.	EIL					Cont.	EIL	Cont.	EIL			
H 1													
H 2													
H 3													
H 4													
H 5													
H 6													
H 7													
H 8													

H - Horizontal Joint

(CONTRACTOR)

(EIL)

FORMAT NO.:

M-39 REV 1

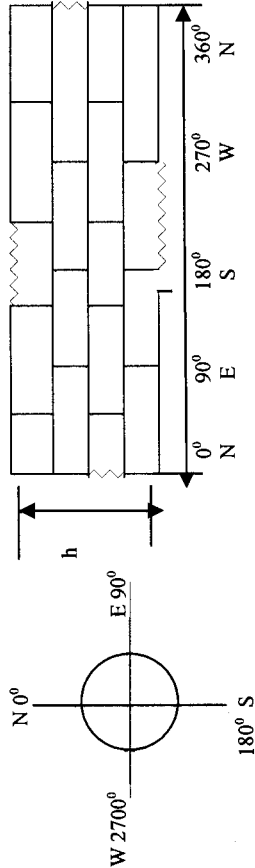
INSPECTION RECORD FOR CHECKING PERPENDICULARITY OF TANK

Report No. : _____
 Date : _____
 Name of work: _____

Tank No. : _____
 Dia : _____
 Height : _____
 No of courses : _____
 Contractor : _____

CONTRACT CLAUSE

Difference in perpendicularity between top & bottom shall not be more than mm per metre of height. When one metre straight edge or template is applied at right angles to a horizontal joint, maximum gap shall not be more than



Course No.	N-E								0°-90°								E-S								90°-180°								S-W								180°-270°								W-N								270°-360°								REMARKS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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NOTE : The straight edge shall be moved on the horizontal weld joint and any variation in respect to the specified tolerance shall be highlighted. Minimum three readings shall be taken for each full length plate

CONTRACTOR

EIL

Unit : _____
Contractor : _____
Work order No. : _____

EIL

FORMAT NO. : **M-44 REV 1**
BUOY/PANTOON INSPECTION RECORD

Report No. _____
Date _____

Project : _____

Name of Work : _____

Job No. : _____

Unit : _____

Contractor : _____

Work order No.: _____

[illegible]

CONTRACTOR

EIL

FORMAT NO. : M-45 REV 1
CERTIFICATE OF PRESSURE TESTS FOR TANKS

Report No. : _____
Date : _____

Project : _____
Name of Work : _____
Job No. : _____

Unit : _____
Contractor : _____
Work order No. : _____

Write N.A. when not applicable

TYPE OF TEST	SIGNATURE OF CONTRACTOR WITH DATE	SIGNATURE OF EIL WITH DATE
Hammer Test Water Height _____		
Fixed Roof Test Air Pressure _____		
Vacuum Test Vacuum _____		
Floating Roof Test As Per _____		
Additional Test if Any		

This is to certify that the subject tank was tested at the above pressures in the presence and to the satisfaction of EIL/Client

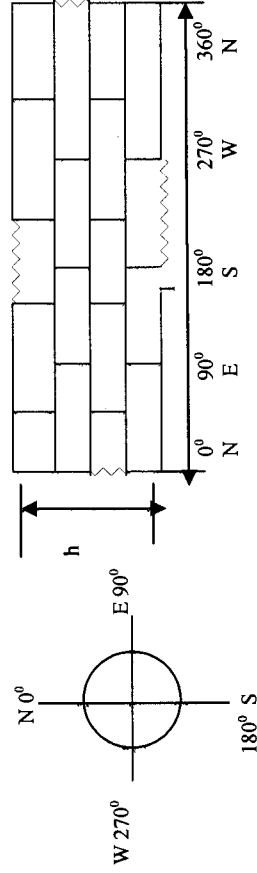
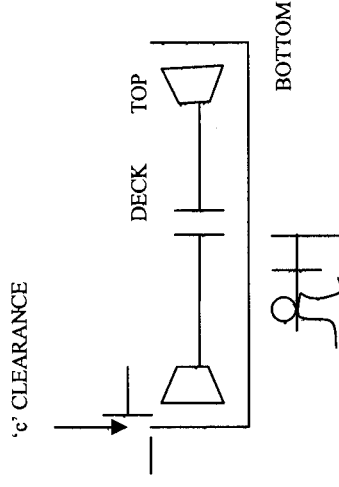
CONTRACTOR

EIL

FORMAT NO. :

Tank No.	_____
Dia	_____
Height	_____
No of courses	_____
Dia of pontoon	_____

C = A tolerance of 40 mm will be allowed on the clearance originally provided for the tank shells

[illegible]

TANK NO.

Unit : _____
Contractor : _____
Work order No. : _____

[illegible]

EIL

FORMAT NO. : M-48 REV 1
MANUFACTURER'S CERTIFICATION FOR
TANK BUILT TO API STANDARD 650

Report No. : _____

Date : _____

Project : _____

Name of Work : _____

Job No. : _____

Unit : _____

Contractor : _____

Work order No. : _____

To _____
(Name & address of purchaser)

We hereby certify that the tank constructed for you at

(Location)

and described as follows: _____
(Serial or contract number, size (diameter x height), capacity,

description of tank, i.e., floating roof or fixed roof)

meets all applicable requirements of API Standard 650 _____

Edition, _____ Revision and Appendix _____

dated _____ including the design, materials,
fabrication, and erection.

The tank is further described on the attached as built data sheet dated _____

Manufacturer

Authority Representative

Date

(Sheet 1 of 6)

FORMAT NO. : M-49 REV 1
INSTALLATION REPORTING FORMAT FOR
COLUMN INTERNALS (BEFORE INSTALLATION)

Contractor : _____ Name of work : _____
Column No. : _____ EIL/Vendor's Drg. No. : _____
Service : _____ Job No. : _____
Plant : _____ Client : _____

Report No. : _____
Date : _____

1. DISTANCE BETWEEN TRAY SUPPORT RING (BETWEEN CONSECUTIVE TRAYS)

Tray No.									
Drg. Dimension									
As Built Dimension at Point	A								
	B								
	C								
	D								
	E								
	F								

Dimension to be taken from top to top of TSR with points marked on the same orientation for all Trays minimum at four points upto 2000Ø & minimum six points above 2000 Ø

2. LOCATION OF BOLTING BAR

Tray No.									
G1	Drg. Dimension								
	Actual								
G2	Drg. Dimension								
	Actual								
G3	Drg. Dimension								
	Actual								
G4	Drg. Dimension								
	Actual								
G5	Drg. Dimension								
	Actual								
G6	Drg. Dimension								
	Actual								
G7	Drg. Dimension								
	Actual								
G8	Drg. Dimension								
	Actual								

Installation Contractor : _____
(Signature)

Name : _____
Date : _____

Engineer-In-Charge : _____
(Signature)

Name : _____
Date : _____

Notes :

- (1) This format shall be filled for all Trays by Installation Contractor and counter checked by Engineer-in-charge.
- (2) Tolerance on various drawing dimensions shall be as per applicable drawing/standard.
- (3) Refer Standard 7-14-0202 for abbreviations & typical detail of trays.

(Sheet 2 of 6)

- (1) This format shall be filled for all **Trays/Internals** by Installation Contractor and counter checked by Engineer-in-charge.
- (2) Tolerance on various drawing dimensions shall be as per applicable drawing/standard.
- (3) Refer Standard 7-14-0202 for abbreviations & typical detail of trays.

FORMAT NO. : M-49 REV 1
INSTALLATION REPORTING FORMAT FOR
COLUMN INTERNALS (AFTER INSTALLATION)

(Sheet 3 of 6)

Tray No.										
A	Drg. Dimension	A1, A3, A4, A5, A7, A8								
		A2, A6								
Height of Exit weir in mm (From top of tray deck to top of weir)			A1							
			A2							
			A3							
			A4							
			A5							
			A6							
			A7							
			A8							
B	Drg. Dimension	B1, B3, B4, B5, B7, B8								
		B2, B6								
Under downflow clearance in mm (distance between downcomer bottom & tray deck/recessed seal pan plate)			B1							
			B2							
			B3							
			B4							
			B5							
			B6							
			B7							
			B8							
C	Drg. Dimension	C1, C3, C4, C5, C7, C8								
		C2, C6								
Horizontal distance between downcomer plate & recessed seal pan (mm)			C1							
			C2							
			C3							
			C4							
			C5							
			C6							
			C7							
			C8							
Installation Contractor : _____ (Signature)			Engineer-In-Charge : _____ (Signature)							
Name : _____			Name : _____							
Date : _____			Date : _____							

Note :

- (1) This format shall be filled for all **Trays** by Installation Contractor and counter checked by Engineer-in-charge.
- (2) Tolerance on various drawing dimensions shall be as per applicable drawing/standard.
- (3) Refer Standard 7-14-0202 for abbreviations & typical detail of trays.

FORMAT NO. : M-49 REV 1
INSTALLATION REPORTING FORMAT FOR
COLUMN INTERNALS (AFTER INSTALLATION)

(Sheet 4 of 6)

Tray No.										
D	Drg. Dimension	D1, D3, D4, D5, D7, D8								
		D2, D6								
Under downflow clearance in mm (distance between downcomer plate & seal Pan)			D1							
			D2							
			D3							
			D4							
			D5							
			D6							
			D7							
			D8							
E	Drg. Dimension	E1, E3, E4, E5, E7, E8								
		E2, E6								
Clear distance between downcomer plate & seal pan (mm)			E1							
			E2							
			E3							
			E4							
			E5							
			E6							
			E7							
			E8							
Installation Contractor : _____ (Signature) Name : _____ Date : _____			Engineer-In-Charge : _____ (Signature) Name : _____ Date : _____							

Note :

- (1) This format shall be filled for all **Trays** by Installation Contractor and counter checked by Engineer-in-charge.
- (2) Tolerance on various drawing dimensions shall be as per applicable drawing/standard.
- (3) Refer Standard 7-14-0202 for abbreviations & typical detail of trays.

FORMAT NO. : M-49 REV 1
INSTALLATION REPORTING FORMAT FOR
COLUMN INTERNALS (AFTER INSTALLATION)

(Sheet 5 of 6)

Check the following	Tray No.						
Check each bolt for tightness							
Check orientation, proper mark (type) and tightness of each clamp							
Check provision of lock Nuts and Seal plates wherever specified							
Check each top downcomer piece for correct installation of shimming including tack Welding/Bolting							
Check seal welding/gasketing wherever applicable							
Check leak testing of seal pans, recessed seal pan, chimney trays, distributor, drawoff boxes etc. as per drawing							
Check overlapping of decks							
Check for damaged missing valves and valve movement for all valves for vale trays							
Check for fitting of proper valve combination (MR2, MR6 etc.)							
Check for noticeable damage to deck components							
Check levelness and alignment of inlet weir and exit weir and adjust if necessary							
Check beam & clips are properly fitted							
Check that tray manway can be opened from top as well as from bottom							
Check that all slots on tray components are fully covered							
Check that gaps at downcomer ends and other places are within specified limits							
Check orientation in case of ripple trays							
For lattice girders, check the levelness of primary members and completeness of welding of all the bracings and secondary members							
Check temporary plugs wherever provided for testing have been removed							
Check that trays have been cleared of all foreign materials							
Installation Contractor : _____ (Signature) Name : _____ Date : _____		Engineer-In-Charge : _____ (Signature) Name : _____ Date : _____					

Note :

- (1) This format shall be filled for all **Trays** by Installation Contractor and counter checked by Engineer-in-charge.
- (2) Tolerance on various drawing dimensions shall be as per applicable drawing/standard.
- (3) Refer Standard 7-14-0202 for abbreviations & typical detail of trays.

FORMAT NO. : M-49 REV 1
**INSTALLATION REPORTING FORMAT FOR
COLUMN INTERNALS (AFTER INSTALLATION)**

(Sheet 6 of 6)

Check the following	Tray No.						
Check that multibeam support plate sits properly on the TSR with no undesired gaps. All spacings and gaps are evenly distributed across the vessel diameter.							
Check for proper levelling of top of bed and gap between top of bed and bed limiter (No gaps preferred; Maximum gap at few locations not to exceed one packing size).							
Check that bed limiter is properly bolted and the gap on the periphery is uniform and not more than that specified in the drawing. Also check that packing is not free to come out from any opening. Also check that bed limiter mesh is intact.							
Check levelness for distributor/redistributors/flash galleries/spray header. Same to be within tolerance specified in the drawings/standards and to be recorded in sht.1							
Check that the distributors/redistributorire/flash galleries/spray headers are properly clamped/bolted.							
Check that the distributor/redistributors/flash galleries (if required) are properly gasketted as specified in the drawing.							
Check leak tightness of the distributor/redistributor/flash gallery (if required), to be ensured by filling water and checking leakages from gasketted joints.							
For chimney/collector tray, draw-off boxes, wherever applicable, check completeness of seal welding, gasketting, proper fitment of vapour riser covers and review record for leak testing.							
For spray nozzle distributor, check for i) Hydrotest for spray header. ii) Colgging of spray nozzles, by running pump, if feasible. iii) Check tip distance from top of the bed (to be within 25mm) iv) Check gasket at flange joint, thread sealant at threaded joints. v) Any obstruction in the uniform spray pattern							
Review of proper orientation of various tower internals like bed limiter w.r.t. distributor/redistributors, as per detail shown in respective drawings.							
Check Temporary plugs wherever provided have been removed after testing.							
Installation Contractor : _____ (Signature) Name : _____ Date : _____		Engineer-In-Charge : _____ (Signature) Name : _____ Date : _____					

Note :

- (1) This format shall be filled for all Trays by Installation Contractor and counter checked by Engineer-in-charge.

FORMAT NO. : M-50 REV 1
INSTALLATION REVIEW CHECK LIST

Report No. : _____
Date : _____

(Sheet 1 of 2)

TRAY INSTALLATION REVIEW CHECK LIST

(To be filled by Specialist)

1. Review of filed formats for Tray levelness and other tray installation data Formats (M49, sht. 1 of 6 to 6 of 6) to be completed by Contractor and duly certified for 100% checking by EIL site. If any dimension is out of permissible tolerances as per 7-14-0001. Specialist to review and suggest remedial action, in construction with HO (if required)
2. Provide clarification to site on any matter w.r.t. installation of trays and tower internals.
3. Random check minimum 25% of trays (subject to minimum two trays per set) (Trays selected shall be true representative.)
 - EWH & Adjustability (permissible deviation ± 1 mm)
 - UDFC (permissible deviation ± 3 D/C bottom piece to rest on D/C bracket.
 - Gap at deck joints (max. gap-3 mm at deck joint, 5 mm at EW location).
 - Overlapping of tray decks (no overlapping allowed)
 - Valve movement, missing & damaged valves (check approx 5% of valves)
 - For bubble cap trays, check skirt height & locknuts on caps (check approx 5% caps)
 - Check plugging of holes in case of sieve trays.
 - Noticeable damage in internal components, wooden hammers to be used in case flattening is required.
 - Chord heights (acceptable limit $\pm$ (Col. ID/200 + 4))
 - Check inlet weir/inlet weir seal plate at respective location.
 - Check for proper fitting of gaskets for gasketed deck components.
 - Also check whether same has been leak tested or not. Also check that drain holes are open unless specified otherwise in the drawings.
 - Light & heavy valve combination adopted at right place.
 - Check provision of lock-nuts wherever specified.
 - For Ripple trays, check relative orientation of trays.
 - For cartridge trays, check the top tray of each bundle orientation and removal of lifting box.
 - Check the provision of antijump baffle wherever specified.
 - Check for seal plates on recessed seal pans.
 - Check temporary plugs wherever provided has been removed after testing
4. For Chimney/Collector Tray, Draw-off boxes, wherever applicable, check Completeness of seal welding, gasketing, proper fitment of vapour riser covers and review record for leak testing.
5. Check arrangement for proper feeding & liquid withdrawal
 - Reflux at top tray
 - Transition arrangement from one tray to other
 - Intermediate feed including direction/angle of vapour & liquid slots
 - Feed from bottom most seal pan to partitioned column bottom
 - Vapour/reboiler return, if flush, should be parallel to down comer of bottom most tray.
 - Location/Orientation of withdrawal nozzle. Also check provision of vortex breaker
 - Drain & vent holes wherever provided in the feed system shall be clear & open
6. List out all discrepancies in a punch list for individual column

Signature _____

Date : _____

Name : _____

Report No. : _____
Date : _____

(Sheet 2 of 2)

TOWER INTERNALS INSTALLATION REVIEW CHECK LIST

(To be filled by Specialist)

1. Review site record for levelness for distributor/redistributors/flash galleries/spray header. Same to be within tolerance specified in the drawing/standards ☐
2. Check that the distributor/redistributors/flash galleries/spray headers are properly clamped/bolted ☐
3. Check that the distributor/redistributors/flash galleries (if required) are properly gasketed as specified in the drawing. ☐
4. Review site record of leak tightness of the distributor/redistributors/flash gallery (if required), to be ensured by filling water and checking leakages from gasketed joints. ☐
5. For Chinney/Collector Tray, wherever applicable, check, if possible, completeness of seal welding, gasketing, proper fitment of vapour riser covers and review record for leak testing. ☐
6. For spray nozzle distributor, check for
 - i) Hydrotest record for spray header ☐
 - ii) Clogging of spray nozzles, by running pump, if feasible ☐
 - iii) Sample check tip distance from top of the bed (to be within $\pm 25\text{mm}$) ☐
 - iv) Check proper gasket fitment at flange joint, thread sealant at threaded joints. ☐
 - v) Any obstruction in uniform spray pattern ☐
7. Review of proper orientation of various tower internals like bed limiter w.r.t. Distributor/redistributors, as per detail shown in respective drawings is mandatory. ☐

Signature _____

Date : _____

Name : _____

INSPECTION & TEST PLANS (ITPs) FOR CIVIL, STRUCTURAL & ARCHITECTURAL WORKS (ITEM RATE CONTRACTS)

1	06.10.2006	REVISED & UPDATED	AS	MPJ	VNP	VC
0	04.08.2006	ISSUED AS STANDARD SPECIFICATION	AS	MPJ	VNP	VJN
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	

Abbreviations:

AFC	:	Approved For Construction
BM	:	Bench Mark
CT	:	Cast Iron
CPT	:	Cone Penetration Test
GI	:	Galvanized Iron
IBR	:	Indian Boiler Regulation
Id	:	Identification
IQI	:	Image Quality Indicator
IRC	:	Indian Road Congress
JB	:	Junction Box
MS	:	Mild Steel
MT	:	Magnetic Particle Testing
NDT	:	Non Destructive Testing
OMC	:	Optimum Moisture Content
PCC	:	Plain Cement Concrete
P&ID	:	Piping & Instrumentation Diagram
PQR	:	Procedure Qualification Record
PT	:	Penetrant Testing
PVC	:	Poly Vinyl Chloride
PWHT	:	Post Weld Heat Treatment
RCC	:	Reinforced Cement Concrete
RF	:	Reinforcement
RMC	:	Ready Mixed Concrete from batching plant/ external agency
SPT	:	Standard Penetration Test
U/G	:	Under Ground
WBM	:	Water Bound Macadam
WPS	:	Welding Procedure Specification

Construction Standards Committee

Convenor : Sh. V.N. Prasad, GM (Construction)

Members : Sh. A.K. Mittal, DGM (Projects)
Sh. M.P. Jain, AGM (Construction)
Sh. Neeraj Agarwal, Sr. Manager (Construction)
Sh. Rakesh Nanda, Sr. Manager (Piping)



SECTION - A

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3.	Site Grading	6 – 82 - 1703 Rev.1	06.10.2006	8
4.	Excavation	6 – 82 - 1704 Rev.1	06.10.2006	9
5.	Back Filling	6 – 82 - 1705 Rev.1	06.10.2006	10
6.	Underground Piping Works (RCC/CI)	6 – 82 - 1706 Rev.1	06.10.2006	11
7.	WBM Roads	6 – 82 - 1707 Rev.1	06.10.2006	12
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	FORMATS FOR UNDERGROUND PIPING WORKS			56

GENERAL NOTE

The enclosed ITP's shall be followed for the works to be performed by the contractor. The provisions indicated for stagewise inspection by EIL/Owner are the minimum and the Engineer-In-Charge may decide to increase Hold Points/ Witness Points. Activities for which ITP's are not given, contractor to develop and get the same approved by EIL/Owner well before start of the work.

Contractor to submit required reporting formats and job procedures for each activity listed in ITP's and submit to EIL/Owner for approval, well before commencement of the activity. If the contractor has to deviate from the given ITP for a valid reason, he shall obtain prior written approval of EIL/Owner. Contractor to carry out 100% examination of all activities.

LEGEND

HP : Hold Point ;

A point which requires inspection/verification and acceptance by Owner/EIL before any further processing is permitted.

The Contractor shall not process the activity/item beyond a Hold Point without written approval by Owner/EIL except where prior written permission for further processing is available.

W : Witness Point ;

An activity which requires witnessing by Owner/EIL when the activity is performed.

After proper notification has been provided (notification modalities and period shall be finalized before hand), the Contractor is not obliged to hold further processing if Owner/EIL is not available to witness the activity or does not provide comments before the date notified. Basis of acceptance shall be as per relevant technical specification.

Rw : Review of Contractor's documentation.

S : Surveillance Inspection by Owner/ EIL.

Monitoring or making observations to verify whether or not material/items or services conform to specified requirements. Surveillance activities may include audit, inspections, witness of testing, review of quality documentation & records, personnel qualifications, etc.

WC : 100% Examination by Contractor.

Responsibility for execution of the inspection/testing is with the Contractor; Owner/EIL only verifies examination or testing done by the Contractor at important stages

ITP NO. : 1701 REV 1
LAND & TOPOGRAPHICAL SURVEY

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1	Check boundary markings and submission of drgs./sketches	WC	W	Yes
2	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
3	Block levels, contour plans, establishing permanent bench marks with ref. to Survey of India B.Ms. by check levels and submission of relevant drgs. & records	WC	S	Format C2
4	Protection of control points, permanent bench marks and regular rechecking	WC	S	-
5	Submission of Master plan showing monuments, structures exposed rocks, weirs, water works, ponds, underground services if crossing that area, etc.	WC	Rw	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP No. : 1702 REV 1
SOIL INVESTIGATION

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Positioning of test location	WC	S	-
2.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
3.	Check for boring & sampling	WC	S	-
4.	In-situ testing (SPT, CPT, Pile load test, etc.)	WC	W	Yes
5.	Lab testing (as applicable)	WC	W/Rw	Yes
6.	Monitoring of water level	WC	S	-
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1703 REV 1
SITE GRADING

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Clearing and stripping of soil including disposal of unsuitable material	WC	S	-
2	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
3.	Taking and plotting of initial joint levels at specified intervals for cutting as well as filling areas	WC	HP	Yes
4.	Check for classification (Levels of strata) and testing of filling soil for suitability including preparation of Lead Charts to filling/disposal areas.	WC	W	Yes
5.	Proper warning of explosions, misfires and storage of explosive materials (As applicable).	WC	S	-
6.	Breaking up of clods, lumps, etc. at the time of filling and compaction.	WC	S	-
7.	Ensure identification and suitability of borrow areas for filling soil/murum including verification of payments for royalty, etc.	WC	W	Yes
8.	Compaction test for earth filling in specified layers including finished areas.	WC	W	Format C3
9.	Verification of final finished grade levels.	WC	HP	Yes
10.	Computation of Earth works.	WC	Rw	Yes
11.	Record of tree cuttings, stacking of blasted rocks and other quarry materials including handing over to Owner	WC	W	Yes
12.	Preparation of "As built drawings" indicating culverts, other open drainage facilities etc.	WC	Rw	Yes
13.	Removal of Surplus earth/excavated material and leveling in disposal areas.	WC	S	-
14.	Resolution of obstacles/hindrances	WC	W	-
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1704 REV 1
EXCAVATION

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
2.	Layout checking	WC	S	Format C2
3.	Taking initial levels	WC	W	Yes
4.	Slopes of excavation, benching, overburden, shoring & strutting (in case of deep excavation)	WC	S	-
5.	Check for sub-soil water, dewatering requirements as per specifications.	WC	S	-
6.	Check for bottom level of excavation and compaction	WC	W	-
7.	Stacking of different type of soils separately	WC	S	-
8.	List of obstacles encountered (cables, pipes, conduits, etc)	WC	S	Yes
9.	Barricading of excavated pits for safety and protection from rain	WC	S	-
FOR HARD ROCK				
1	Obtaining license from district authorities for undertaking blasting operations	WC	Rw	Yes
2	Storing of explosive materials as per explosive rules	WC	S	-
3	Prominent display of red flags around the area to be blasted	WC	S	-
4	Check the dimensions of bore holes	WC	S	-
5	Stacking of hard rock for useable/non useable including handing over to owner	WC	W	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1705 REV 1
BACK FILLING

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Checking of materials/earth for backfilling	WC	W	Format C4, C5
2.	Check for treatment of soil, if any	WC	S	Yes
3.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
4.	Filling in specified layers, consolidating, watering	WC	S	-
5.	Compaction tests for layers	WC	W	Format C3
6.	Filling to required levels	WC	S	-
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1706 REV 1
UNDERGROUND PIPING (RCC/CI)

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Checking of materials	WC	W	Yes
2.	Adequate slope, benching in excavation for safety purposes (if required)	WC	S	-
3.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
4.	Layout, line & level	WC	S	Format C2
5.	Ensure proper laying & jointing, grouting at manholes/chambers	WC	W	-
6.	Check for supports/ firm bed/ sub soil water level	WC	S	-
7.	Testing for leakages by blocking pipe ends	WC	HP	-
8.	Hydrostatic-testing and other tests, Removal of blockages, Cleaning & flushing of system	WC	HP	Format C6
9.	Backfilling in layers	WC	S	Format C3
10.	Check for MS rungs in proper position, inlet/outlet pipe levels in manholes	WC	S	-
11.	Preparation of "As-built drawings"	WC	Rw	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1707 REV 1
WBM ROADS

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
2.	Layout checking including Road crossings and taking initial levels	WC	W	Yes
3.	Approval of source of materials	WC	Rw	Format C4
4.	Checking/testing of materials (wherever required)	WC	W	Format C5
5.	Filling (if any), compaction, providing cambers in sub-grade including levels	WC	S	Format C3
6.	Spreading metal to required thickness, line & levels, dry rolling including spreading of screening material	WC	S	Yes
7.	Check for camber and levels over metalling	WC	S	-
8.	Spreading murrum/ sand, watering and rolling	WC	S	-
9.	Checking thickness after each layer and rectification thereof (if any)	WC	W	Yes
10.	Checking quantity of aggregate by excavation of trial pits as per IRC Code	WC	HP	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1708 REV 1
BLACK TOPPING (PREMIX CARPETING)

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Approval of source of materials	WC	Rw	Format C4
2.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
3.	Surface preparation & check for camber/level	WC	S	-
4.	Checking/ testing of material wherever required	WC	W	Format C5, Yes
5.	Tack coat application	WC	S	-
6.	Check for premix carpeting (including thickness of carpeting) and rolling	WC	S	Yes
7.	Seal coat (including thickness of seal coat)	WC	S	Yes
8.	Check for camber and levels	WC	S	-
9.	Check for bitumen temperature and consumption	WC	S	-
10.	Premix sample check test (as applicable)	WC	W	Yes
11.	Removal of surplus earth	WC	S	-
12.	Berm preparation	WC	S	-
13.	Final Inspection	WC	HP	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1709 REV 1
TANK PADS

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Approval of source of materials	WC	Rw	Format C4
2.	Stripping the area	WC	S	-
3.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
4.	Check for layout and marking of ground level	WC	W	Format C2
5.	Check for excavation to required level, compaction of sub-grade	WC	W	-
6.	Checking/ testing of materials	WC	W	Format C5
7.	Filling selected materials in specified layers, rolling, watering	WC	S	-
8.	Compaction tests	WC	W	Format C3
9.	Check for gravel filling under annular ring with compaction and addition of graded filler material (as applicable)	WC	W	Yes
10.	Anti-corrosive layer, consolidation	WC	S	-
11.	Premix carpeting on side slopes	WC	S	-
12.	Preparation of "As-built drawings"	WC	Rw	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1710 REV 1
MICRO GRADING

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
2.	Taking initial levels	WC	S	Yes
3.	Clearing/ Removal of extra soil, debris, etc. from site by transportation	WC	S	Yes
4.	Taking final levels	WC	W	Yes
5.	Verification of gradient of ground	WC	S	-
6.	Finishing of ground surface by hand compactor/ Roller (As applicable)	WC	S	-
7.	Final inspection	WC	HP	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1740 REV 1
UNDERGROUND PIPING (STEEL)

(Sheet 1 of 6)

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
A. PRIOR TO FABRICATION				
1.	Incoming Material			
	i) Owner's supply	WC	Rw	Yes
	ii) Contractor's supply including check testing	WC	HP	Yes
2.	Welding Filler Material Approval/Qualification			
	i) Review of Manufacturer's Test Certificates/ other documents	WC	Rw	Yes
	ii) Testing, if any	WC	HP	Yes
3.	WPS/PQR			
	i) Review of proposed Procedure	WC	HP	Yes
	ii) Testing	WC	HP	Yes
	iii) Approval of Final WPS	WC	HP	Yes
4.	Welder Performance Qualification Test	WC	W	Yes
4a.	Certification & approval of welders	WC	HP	Yes
5.	NDT Procedure Qualification			
	i) Review of proposed Procedure	WC	HP	Yes
	ii) Testing	WC	HP	Yes
	iii) Approval of Qualified procedure	WC	HP	Yes
6.	Preparation of sketches from General Arrangement drawings	WC	Rw	Yes
7.	Joint numbering	WC	Rw	Yes
8.	Approval of colour coding scheme	WC	HP	Std Spec
9.	Monitoring of colour coding on pipes & fittings	WC	S	Yes
B. FABRICATION (SHOP & FIELD)				
1.	Material as per piping class (check w.r.t. approved colour coding procedure)	WC	W	Format P1
	i) Fit-up check – butt welds	WC	S	
	ii) Fit-up check – branch welds	WC	W	
	iii) Dimensional check	WC	S	

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) & Section-C (page 55 of 65) for formats

(Sheet 2 of 6)

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
2.	Pre-heat (if any)	WC	S	Yes
3.	Check for purity of purging/shielding Gas (if any)	WC	S	-
4.	Purging (if any)	WC	S	-
5.	Shielding rate (if any)	WC	S	-
6.	Baking of Electrodes	WC	S	Yes
7.	Inter-pass cleaning & Temperature check.	WC	S	-
8.	Visual check of completed welds	WC	W	Format P2
	- For welds with Random Radiography	WC	S	Format P2
	- For welds with 100% Radiography			
9.	PT/MT	WC	S	Yes
10.	Radiography marking (for Random Radiography)	WC	HP	Format P3
11.	Radiography Interpretation	WC	HP	Format P4
C. HYDROSTATIC/ PNEUMATIC TESTING				
1.	Procedure Review	WC	HP	Yes
2.	Correctness of Testing arrangements	WC	W	-
3.	Calibration of Pressure Gauges	WC	W	Format C1
4.	R.F. Pad testing, if any	WC	HP	-
5.	Scrutiny of test packs for Mechanical & NDT Clearance	WC	HP	Annex-1, Format P5, UG1
6.	Air/Water Flushing (preliminary)	WC	W	-
6a.	Addition of corrosion inhibitors, if required – Approval of make & quality	WC	HP	Yes

Pl. refer page 5 of 65 for definition of WC, RW, HP, W, S and Section-B (page 40 of 65) & Section-C (page 55 of 65) for formats

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S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
7.	Pneumatic/ Hydrostatic testing	WC	HP	Format P6
8.	Draining of water & Air drying	WC	W	Format P6
D. LAYING				
1.	Trench excavation and levels	WC	S	Yes
2.	Cleaning of pipe surface	WC	W	-
3.	Approval of wrapping/coating material manufacturers	WC	HP	Yes
4.	Approval of agency for wrapping & coating	WC	HP	Yes
5.	Sample test of coating materials in approved laboratory	WC	W/Rw	Yes
6.	Procedure qualification for wrapping & coating	WC	HP	Yes
7.	Application of primer	WC	S	-
8.	Coal tar temperature	WC	S	-
9.	Coating & wrapping	WC	S	-
10.	Check Thickness of coating (if applicable)	WC	W	-
11.	Calibration of Holiday tester	WC	HP	Format C1
12.	Holiday testing	WC	HP	Yes
13.	Peel test	WC	HP	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) & Section-C (page 55 of 65) for formats

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S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
14.	Lifting arrangement	WC	S	Yes
15.	Lowering (levels & orientation of branches)	WC	HP	-
16.	Checking of wrapping & coating for damages during lowering, their repair, Holiday Testing, etc.	WC	HP	-
17.	Back filling	WC	HP	Yes
18.	Location, Brickwork, plaster of valve pit	WC	S	Yes
19.	Top cover & Finish of valve pit	WC	S	-
E. SYSTEM COMPLETION				
1.	Tie in joints	WC	Annex-2	Annex-2
2.	Scrutiny of test packs for system testing	WC	Rw	Annex-1
3.	System testing	WC	HP	Format UG2
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) & Section-C (page 55 of 65) for formats

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ANNEXURE - 1

Sl. No.	Activity	Contractor	EIL
A. MECHANICAL COMPLETION RECORD (U/G Piping)			
1.	Clearance for flushing & testing	WC	Rw
1a	Mechanical clearance		
	- Conformity with drawing	WC	HP
	- Material as per Specification	WC	Rw
1b	Welding & NDT clearance		
	- Material as per Specification	WC	Rw
	- Fit-up check record	WC	Rw
	- Visual check of completed welds	WC	Rw
	- PT/MT	WC	Rw
	- Radiography	WC	Rw
	- PWHT & hardness	WC	Rw
	- RF pad testing	WC	Rw
2.	Flushing & Pressure testing	WC	HP
3.	Coating & wrapping		
	- Surface preparation	WC	Rw
	- Primer application	WC	Rw
	- Coating, wrapping & peel test	WC	Rw
	- Holiday check	WC	Rw
4.	Laying		
	- Trench leveling	WC	Rw
	- Lowering & checking for damages in wrapping & coating, their repair, Holiday testing, etc.	WC	Rw
	- Backfilling	WC	Rw

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W and S

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ANNEXURE - 2

TIE-IN JOINTS

	CONTRACTOR	EIL
1. FIT UP	WC	W
2. ROOT RUN DP	WC	W
3. FINAL RUN DP	WC	S
4. RADIOGRAPH REVIEW	WC	HP
5. PWHT HARDNESS	WC	Rw
6. RF PAD TESTING	WC	W
7. CLEANING & PRIMING	WC	S
8. COATING, WRAPPING	WC	S
9. PEEL TEST	WC	HP
10. HOLIDAY TESTING	WC	HP
11. CHECKING FOR ANY DAMAGE IN WRAPPING & COATING AFTER LOWERING, THEIR REPAIR, HOLIDAY TESTING, ETC.	WC	W
12. BACK FILLING	WC	S

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W and S

ITP NO. : 1741 REV 1
PLAIN CEMENT CONCRETE

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
2.	Checking of layout and materials, compaction of sub -grade	WC	W	Format C2, C3, C5, C7
3.	Mix proportion	WC	S	-
4.	Check for shuttering, dewatering (as applicable)	WC	S	Yes
5.	Concreting with proper compaction	WC	S	-
6.	Checking of top level of PCC	WC	W	Yes
7.	Curing	WC	S	-
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1742 REV 1
RCC(SUB-STRUCTURE)

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Approval of source of materials	WC	Rw	Format C4
2.	Approval of agency for providing Ready Mixed Concrete (RMC), as applicable	WC	Rw	Yes
3.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
4.	Checking of layout & condition of PCC/ leveling course	WC	S	Yes
5.	Checking/ testing of materials	WC	W	Format C5, C7
6.	Design of mix	WC	HP	Yes
7.	Check for line & level of shuttering including its condition, quality and rigidity.	WC	S	-
8.	Check for sub-soil water & dewatering arrangement, if any	WC	W	Yes
9.	Placing of reinforcement & covers to reinforcement	WC	S	-
10.	Check for Inserts, Anchor bolts and pipe sleeves, pockets, dowels, etc.	WC	W	Yes
11.	Pour Card	WC	HP	Format C8, C9
12.	Quality records of RMC like Delivery Ticket Information	WC	Rw	Yes
13.	Check for obstacles encountered (Electrical conduits, pipe lines, etc.)	WC	S	Yes
14.	Concreting, testing, compaction & finishing	WC	W	Yes
15.	Casting of cubes	WC	W	-
16.	Curing	WC	S	-
17.	Testing of cubes	WC	W	Format C10
18.	Removal of shuttering	WC	S	-
19.	Check for water tightness, rendering, if any	WC	S	-
20.	Preparation of As-built drawings	WC	Rw	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1743 REV 1
RCC (SUPER-STRUCTURE)

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Approval of source of materials	WC	Rw	Format C4
2.	Approval of agency for providing Ready Mixed Concrete (RMC), as applicable	WC	Rw	Yes
3.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
4.	Checking of layout	WC	S	Yes
5.	Checking/ testing of materials	WC	W	Format C5, C7
6.	Design of mix	WC	HP	Yes
7.	Check for line & level of shuttering and scaffolding/ vertical bracing including hoisting arrangements.	WC	S	-
8.	Placing of reinforcement & covers to reinforcement	WC	S	-
9.	Check for inserts, bolts, pipe sleeves, MS rungs, concealed electrical conduits, fan hooks, dowels, etc. including welding if any	WC	S	Yes
10.	Check for pockets/ openings	WC	W	-
11.	Check for expansion joints, if any	WC	S	-
12.	Check for water stops, slopes, stoppers, if any	WC	S	-
13.	Pour Card	WC	HP	Format C8, C9
14.	Quality Records of RMC like Delivery Ticket Information	WC	Rw	Yes
15.	Concreting, testing, compaction & finishing	WC	W	Yes
16.	Casting of cubes	WC	W	-
17.	Curing	WC	S	-
18.	Testing of cubes	WC	W	Format C10
19.	Removal of formwork/ stayings	WC	S	-
20.	Verification of dimensions viz AFC drawings and tolerances	WC	S	Yes
21.	Check for water tightness, rendering, if any	WC	S	-
22.	Preparation of As built drawings	WC	Rw	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1744 REV 1
RCC (CRITICAL STRUCTURES)
Like Technological structures, Water retaining structures,
Rotating eqpt. Foundations, Cooling towers, Chimney

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Approval of source of materials	WC	Rw	Format C4
2.	Approval of agency for providing Ready Mixed Concrete (RMC), as applicable	WC	Rw	Yes
3.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
4.	Checking of layout	WC	W	Yes
5.	Checking/ testing of materials	WC	W	Format C5, C7
6.	Soil strata below PCC	WC	S	-
7.	Design of mix	WC	HP	Yes
8.	Check for line & level of shuttering and scaffolding/ vertical bracing including hoisting arrangements, shoring & strutting	WC	S	-
9.	Placing of reinforcement & covers to reinforcement	WC	S	-
10.	Check for inserts, anchor bolts, pipe sleeves, MS rungs, concealed electrical conduits, fan hooks, dowels, etc. including welding if any	WC	W	Yes
11.	Check for pockets/ openings	WC	W	-
12.	Separation & construction joints, if any	WC	S	-
13.	Check for water stops, slopes, stoppers, if any	WC	S	-
14.	Detailed work plan including equipment, manpower & other resources	WC	Rw	Yes
15.	Pour Card	WC	HP	Format C8, C9
16.	Quality records of RMC like Delivery Ticket Information	WC	Rw	Yes
17.	Concreting, testing, compaction & finishing	WC	W	Yes
18.	Casting of cubes	WC	W	-
19.	Curing	WC	S	-
20.	Testing of cubes	WC	W	Format C10
21.	Removal of formwork/ stayings	WC	S	-
22.	Verification of dimensions viz. AFC drawing & tolerances	WC	S	Yes
23.	Check for water tightness, rendering, if any	WC	W	-
24.	Preparation of As built drawings	WC	Rw	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1745 REV 1
RCC FLOORING/PAVEMENT

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Approval of source of materials	WC	Rw	Format C4
2.	Approval of agency for providing Ready Mixed Concrete (RMC), as applicable	WC	Rw	Yes
3.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
4.	Layout checking/ excavation of all new foundations	WC	S	Yes
5.	Checking/ testing of materials	WC	S	Format C5, C7
6.	Mix proportion/Design Mix	WC	W	Yes
7.	Check for proper back filling/compaction/ completion of sub - Structure works	WC	S	Format C3, Yes
8.	Check for proper arrangements for vacuum dewatering flooring including all accessories as per specification (as applicable)	WC	W	-
9.	Check for edges of shuttering, alternate panels	WC	S	-
10.	Check for slopes, thickness of flooring	WC	S	-
11.	Check for Shuttering, placing of reinforcement (if any)	WC	S	-
12.	Check for expansion joints/ Construction joints	WC	S	-
13.	Check for concealed pipe embedment, earthing, if any	WC	S	-
14.	Check for dividing strips, if any	WC	S	-
15.	Pour Card	WC	HP	Format C8, C9
16.	Quality records of RMC like Delivery Ticket Information, as applicable	WC	Rw	Yes
17.	Concreting, testing, finishing, test cubes	WC	W	Yes
18.	Checking for line, levels, slopes, joints, thickness of flooring viz. AFC drawings	WC	S	-
19.	Curing	WC	S	-
20.	Grinding & polishing, if applicable	WC	S	-
21.	Testing of concrete cubes (as applicable)	WC	W	Format C10
22.	Testing of vacuum dewatering flooring (as applicable)	WC	W/Rw	Yes
23.	Preparation of "As Built Drawings" including underground facilities if any	WC	Rw	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1746 REV 1
BRICK MASONRY

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
2.	Checking/ testing of bricks	WC	W	Format C11
3.	Cleaning of surface	WC	S	-
4.	Wetting of bricks	WC	S	-
5.	Cement mortar proportion	WC	S	-
6.	Staging & scaffolding	WC	S	-
7.	Hacking of concrete surface	WC	S	-
8.	Check for bond/closers, thickness of joints	WC	S	-
9.	Check for Line, level & plumb	WC	W	-
10.	Raking out joints, keys in brick work, if any	WC	S	-
11.	Check for RCC bonds/Reinforcement/PCC flooring, in case of partition brick work	WC	W	-
12.	Embedment of fixtures	WC	S	-
13.	Curing	WC	S	-
14.	Preparation of 'As Built' Drawings	WC	Rw	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1747 REV 1
STRUCTURE STEEL WORKS

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
A	PRE – FABRICATION ACTIVITIES			
1.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
2.	Checking of structural steel material supplied by the Contractor/ Manufacturers test certificates/ testing (as applicable)	WC	W/Rw	Yes
3.	Welding Filler material approval/ qualification			
	a) Manufacturing test certificates/ documents	WC	Rw	Yes
	b) Testing, if any	WC	W	Yes
4.	WPS/ PQR	WC	W	Yes
5.	Welders performance qualification	WC	W	Yes
6.	Layout checking	WC	S	Yes
7.	Welding equipment and accessories	WC	S	-
8.	Preparation and approval of Fabrication drawings	WC	Rw	Yes
B	FABRICATION ACTIVITIES			
1	Ensure materials as per design drawing	WC	W	Format C12
2	Check straightness and non-warping of members	WC	S	Format C12
3	Dimensional and fit-up checks including provision of slopes for deflection wherever required	WC	S	Format C12
4	Visual check for welding	WC	W	Format C12
5	Grinding including surface preparation for painting and application of primer	WC	S	Format C12
6	Checking paint as per specs, shelf-life, test certificates, etc.	WC	S/Rw	Yes
7	Ensure application of specified paint, painting thickness, etc.	WC	W	Format C12
C	FIELD ERECTION ACTIVITIES			
1	Lifting arrangements including test certificates of lifting tackles	WC	S/Rw	Yes
2	Correctness of location and fit - up checks	WC	S	Format C12
3	Orientation of bracing, lugs	WC	S	-
4	Alignment & levels	WC	S	Format C12
5	Check for field welding (if any)	WC	W	Format C12
6	Grouting	WC	S	Format C12
7	Check for finishing coat of paint, overall thickness of paint etc.	WC	W	Format C12
8	Preparation of As-built drawings	WC	Rw	Yes
	INSPECTION & TEST DOCUMENTS			
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1748 REV 1
CAST IN SITU/DRIVEN PILES

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1	Approval for source of materials	WC	Rw	Format C4
2	Approval of agency for providing Ready Mixed Concrete (RMC), if applicable	WC	Rw	Yes
3	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
4	Checking of layout and ground level	WC	W	Yes
5	Checking/ testing of materials	WC	W	Format C5, C7
6	Design of mix	WC	HP	Yes
7	Driving of piles & check for set point	WC	S	-
8	Check for depth of bore and lowering of cage measuring	WC	S	-
9	Check for cage reinforcement, its length, overlaps	WC	W	-
10	Pour Card	WC	HP	Format C8, C9
11	Quality records of RMC like Delivery Ticket Information, if applicable	WC	Rw	Yes
12	Concreting, testing	WC	W	Yes
13	Casting of cubes/Testing	WC	W	Format C10
14	Check for cut off level of concreting & quantity of concrete poured	WC	S	Yes
15	Lifting of casing pipe	WC	S	-
16	Pile load tests (lateral/vertical/cyclic/pull out)	WC	W	Yes
17	Submission of pile load test report	WC	Rw	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1771 REV 1
ANTITERMITE TREATMENT

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Checking/ testing of material & spraying devices including personal protective equipments like facemask, gloves, shoes, etc.	WC	HP	Yes
2.	Preparation of surface for taking dosage of emulsion by ramming of each layer of soil by roding the earth at specified intervals	WC	W	-
3.	Backfilling and compaction in specified layers along with application of emulsifier along the sides of masonry & RCC structures	WC	S	Format C3
4.	Compaction of top surface for taking dosage of emulsifier by roding the earth at specified intervals for the entire floor area before concreting	WC	S	-
5.	Check for consumption of emulsifier utilized	WC	W	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1772 REV 1
PLASTERING

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Calibration of testing equipments	WC	Rw	Format C1
2.	Checking/ testing of materials	WC	W	Format C5, C7
3.	Check for completeness of all hidden jobs like piping, conduiting, etc.	WC	S	-
4.	Check for grading of sand, Mix proportion	WC	W	-
5.	Sample preparation for finish and its approval	WC	W	-
6.	Neeru application on plaster (as applicable)	WC	S	-
7.	Hacking and cleaning the surface, removing loose particles, wetting the surface	WC	S	-
8.	Checking of plaster thickness, plumb & even surface	WC	S	Yes
9.	Check for grooves, openings, rounding off the corners, hollowness in plaster	WC	S	-
10.	Curing	WC	S	-
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1773 REV 1
DOORS, WINDOWS & VENTILATORS

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	a) Calibration certificate of measuring & testing equipments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
2.	Checking of sample, material, anodizing (as applicable)	WC	W/Rw	Yes
3.	Check for sections & dimensions	WC	W	Yes
4.	Check for line, level & plumb	WC	S	-
5.	Check for section joinery details	WC	S	-
6.	Grouting with lugs/ dash fasteners	WC	S	-
7.	Check for fixtures & fittings including their approval as applicable	WC	S	Yes
8.	Check for thickness & type of glazing	WC	S	Yes
9.	Check for rubber gasket	WC	S	-
10.	Brand/ shade of paints, no. of coats including surface preparation	WC	S	-
11.	Final inspection	WC	HP	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1774 REV 1
PAINTING (BUILDING WORKS)

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Completion of surface preparation	WC	S	-
2.	Checking of material/ Manufacturers test certificates (wherever required)	WC	W/Rw	Yes
3.	Confirmation of colour, shade & brand	WC	Rw	-
4.	Check for number of coats and thickness	WC	W	Yes
5.	Curing, if any	WC	S	-
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W and S

ITP NO. : 1775 REV 1
SANITARY FITTINGS

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Checking of material (approved vendor)	WC	HP	Yes
2.	Checking/Testing of sample (as applicable)	WC	W/Rw	Yes
3.	Check completeness of finishing works w.r.t. line, level & position	WC	W	-
4.	Check proper fixing of the sanitary fittings to give aesthetic appeal	WC	S	-
5.	Check for leakage	WC	W	-
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W and S

ITP NO. : 1776 REV 1
WATER PROOFING (ROOF)

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Approval of source of materials	WC	Rw	Format C4
2.	a) Calibration certificate of measuring & testing equipments/ instruments	WC	Rw	Yes
	b) Field calibration, if any	WC	W	Format C1
3.	Checking/ testing of construction materials (as applicable)	WC	W	Format C5, C7
4.	Surface preparation for screeding/ water proof plastering	WC	S	-
5.	Mix proportion, thickness of screeding/ plastering & slope towards rain water pipes	WC	S	Yes
6.	Formation of groove at specified height on parapet wall	WC	S	-
7.	Checking of water proofing material, no. of coats, application procedure and consumption.	WC	HP	Yes
8.	Termination of material in groove on vertical plane	WC	S	-
9.	Check for hollowness, bubbles in water proofing, if any	WC	S	-
10.	Conducting a sample of water proofing test by flooding the area for specified interval (as applicable)	WC	W	Yes
11.	Cleaning of surface	WC	S	-
12.	Submission of Guarantee in the requisite Performa	WC	Rw	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W, S and Section-B (page 40 of 65) for formats

ITP NO. : 1777 REV 1
FALSE FLOORING AND FALSE CEILING

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
FALSE FLOORING				
1.	Manufacturers' Test Certificates	WC	Rw	Yes
2.	Checking/ Testing of material	WC	W/Rw	Yes
3.	Cleaning base floor	WC	S	-
4.	Ensure painting of base floor with Polyurethane based paint (as specified)	WC	W	Yes
5.	Check for installation of grid framework and flooring material as per specification	WC	S	-
6.	Check for proper line, level & layout	WC	W	-
FALSE CEILING				
1.	Manufacturers' Test Certificates	WC	Rw	Yes
2.	Checking/ Testing of material	WC	W/Rw	Yes
3.	Check for fixing of grid framework and ceiling material as per specification	WC	S	-
4.	Check for proper line, level & cut-outs	WC	W	-
5.	Surface preparation and painting of ceiling material	WC	S	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W and S

ITP NO. : 1778 REV 1
UNDER-DECK INSULATION

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Checking/ Testing of materials including density	WC	HP	Yes
2.	Checking/Testing of adhesive, fasteners for anchorage	WC	W/Rw	Yes
3.	Fixing of scaffolding, ladders, platforms	WC	S	-
4.	Fixing of under-deck insulation with adhesive	WC	S	-
5.	Fixing of dash fasteners at defined spacing	WC	S	-
6.	Check for proper finishing	WC	W	-
7.	Final inspection	WC	HP	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W and S

ITP NO. : 1779 REV 1
ROOFING ACCESSORIES

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Checking/ Testing of material including Manufacturers test certificates, anodizing (as applicable)	WC	W	Yes
2.	Ensure proper sequence of sheeting	WC	W	-
3.	Check for mitring, overhang, laps, etc.	WC	S	-
4.	Slopes line, level of sheets, barge boards, ridges & gutters, over hang of sheets	WC	S	-
5.	Bolting by drilling only, length of bolts, nos., and type of washers	WC	S	-
6.	Check for slopes of rain gutters, down take pipes, north lighting curves/ supports for gutters	WC	S	-
7.	Check for leakage/ passing of light	WC	W	-
8.	Final inspection	WC	W	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W and S

ITP NO. : 1799 REV 1
LIGHTING WORKS FOR NON PLANT BUILDINGS

S. No.	Activity	Contractor	EIL	Records to be submitted/ Format No.
1.	Preparation of detailed conduit layout diagram as per the approved electrical drawing	WC	Rw	Yes
2.	Providing GI/PVC sleeves in columns/beams at identified locations to facilitate laying of conduit on later date.	WC	S	-
3.	Ensure conduit & accessory materials are inspected at site before using	WC	W	Yes
4.	Ensure that the conduit is laid in line with execution drawings & provide pull-wires as per requirement.	WC	S	-
5.	Check correctness of drop/JB locations	WC	S	-
6.	Check threaded joints are proper	WC	S	-
7.	Ensure all JB/Fan box are properly stuffed with jute	WC	S	-
8.	Ensure conduits are properly tied to reinforcement bars to prevent floating during concrete	WC	S	-
9.	Ensure proper supporting of conduit lengths wherever required	WC	S	-
10.	Ensure adequate chasing depth for conduit portion coming inside brick walls	WC	S	-
11.	Check workmanship towards joints and presence of any foreign material inside the conduits	WC	S	-
12.	Ensure wiring material is inspected at site before use	WC	S	Yes
13.	Ensure correctness of lighting wire size and no. of wires as per the drawing in each conduit portion	WC	S	-
14.	Preparation of "As Built" drgs.	WC	Rw	Yes
INSPECTION & TEST DOCUMENTS				
	Completeness of Inspection and Test Records	WC	Rw	Yes

Pl. refer page 5 of 65 for definition of WC, Rw, HP, W and S

SECTION - B

FORMATS

FOR

CIVIL, STRUCTURAL &

ARCHITECTURAL WORKS

CONTENTS

S. NO	DESCRIPTION	FORMAT NO.	ISSUE DATE	PAGE NO.
FORMATS FOR CIVIL, STRUCTURAL & ARCHITECTURAL WORKS				
1.	Record of calibration of Measuring/Testing equipments	C1 Rev.1	06.10.2006	43
2.	Surveying and Layout record	C2 Rev.1	06.10.2006	44
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4.	Record of approval of source(s) for aggregates	C4 Rev.1	06.10.2006	46
5.	Sieve analysis report	C5 Rev.1	06.10.2006	47
6.	Underground piping – test report (RCC/CI)	C6 Rev.1	06.10.2006	48
7.	Cement testing result report	C7 Rev.1	06.10.2006	49
8.	Pour card (I) – Programme of concreting	C8 Rev.1	06.10.2006	50
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11.	Water absorption, crushing strength & efflorescence testing results of bricks	C11 Rev.1	06.10.2006	53
12.	Structural fabrication & erection sheet	C12 Rev.1	06.10.2006	54
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FORMAT NO. : C1 REV 1
RECORD OF CALIBRATION OF MEASURING/TESTING EQUIPMENTS

Project :
 Client :
 Name of Work :
 Job No. :
 Contractor :

Sl. No.	Name of Equipment/Apparatus	Model No.	Certificate No.	Calibrated By	Calibration Date	Next Calibration Due on	Remarks	Accepted Contractor	EIL
	Theodolite								
	Levels								
	Steel measurement tapes								
	Cross staff								
	Distomat								
	All balances								
	Weigh Batcher								
	Cube testing Machine								
	Pressure Gauges								
	Dial gauges								
	Dead weight tester								
	Vernier caliper/ screw gauge								
	Holiday tester								
	Universal Testing Machine								
	Charpy V-notch Impact testing machine								
	Hardness Testing Machine								
	Various Digital and Analog meters								
	Variable current, voltage and resistance generators								
	Temperature/ Pressure Recorders								
	Temperature gauges including RTDs								
	Thermocouples								
	Vibration probes								
	Decibel-meter								
	Any other								

FORMAT NO. : C2 REV 1
SURVEYING AND LAYOUT RECORD

Project :

Job No :

Client :

Contractor :

Name of Work :

1. Reference Drawing :
2. Reference Grid Pillars :
3. Reference Bench Mark/Reduced Level :
4. Co-ordinates :
5. Reduced Level :
6. Closing error, if any :
7. Layout Sketch :

(CONTRACTOR)

(EIL)

(CLIENT)

Date :

FORMAT NO. : C3 REV 1
TEST REPORT FOR DETERMINATION OF DRY DENSITY & MOISTURE CONTENT OF SAND/SOIL

Project : _____
 Client : _____
 Name of Work : _____
 Job No : _____
 Contractor : _____
 Layer No : _____

S. No.	Description	Relation	Test Nos:						Remarks
			1	2	3	4	5	6	
1.	Wt. of mould + wt. of wet soil/sand	W_1 gm							
2.	Wt. of mould	W_2 gm							
3.	Wt. of wet soil/sand	$(W_1 - W_2)$ gm							
4.	Volume of mould	V cc							
5.	Density of wet soil/sand	$D_w = (W_1 - W_2)/V$ gm/cc							
6.	Wt. of wet sample taken	W_w gm							
7.	Wt. of sample after drying	W_d gm							
8.	Moisture Content (or directly by moisture meter)	$M_c = (W_w - W_d)/w_d \times 100\%$							
9.	Dry density	$D_d = D_w/(1 + M_c)$ gm/CC							
10.	Laboratory Max dry density	gm/cc							
11.	Degree of Compaction	%							
12.	Required degree of compaction	%							
13.	Optimum Moisture Content (OMC)	%							

(TESTED BY/LAB-IN-CHARGE)

(CONTRACTOR)

(EIL)

Date :

FORMAT NO. : C4 REV 1
RECORD OF APPROVAL OF SOURCE(S) FOR
AGGREGATES

Project : Job No :

Client : Contractor :

Name of Work :

1. Reference :
2. Material :
3. Location of Source :
4. Approx. distance from the site :
5. Physical Properties
 - a) Colour :
 - b) Shape : Rounded/Irregular
 - c) Texture : Glossy/Smooth/Granular
6. Tests conducted at :
7. Code of Conformance : IS : 383
8. Test Report Reviewed : Satisfactory/Un-satisfactory
9. Remarks : The source is approved/not approved
10. Explanation if any :
- Enclosures :
 - a) Reviewed Test Reports
 - b) Request of contractor, if available

COMMITTEE MEMBERS :

APPROVED :

- i) EIL :
- ii) Client :

Signature of the contractor :

Date :

Place :

**FORMAT NO. : C5 REV 1
SIEVE ANALYSIS REPORT**

Project : _____
 Client : _____
 Wt. of Sample taken : _____
 Name of Work : _____
 Contractor : _____
 Date on which sample taken : _____

FINE AGGREGATE

S. No.	Sieve Size	Weight Retained (gm)	Percentage Retained	Cumulative % Retained	% Passing	Fineness Modulus	Zone (As per IS:383)	Remarks
1.	4.75mm							
2.	2.36mm							
3.	1.18mm							
4.	600 u							
5.	300 u							
6.	150 u							
7.	Pan							

COARSE AGGREGATE/ROAD METAL

Wt. of Sample taken :				Passed/ Failed (As per IS:383/EIL Spec 6-65-0018)	Remarks
1.	125mm				90-45 (Gr-I), 63-45 (Gr-II), 13.2mm (screening) for road work 40mm down for PCC 20mm down for RCC
2.	90mm				
3.	80mm				
4.	63mm				
5.	53mm				
6.	45mm				
7.	40mm				
8.	22.4mm				
9.	20mm				
10.	16mm				
11.	13.2mm				
12.	12.5mm				
13.	11.2mm				
14.	10mm				
15.	5.6mm				
16.	4.75mm				
17.	2.36mm				
18.	180 u				

(TEST BY/LAB-IN-CHARGE)

(CONTRACTOR)

(EIL)

Date :

FORMAT NO. : C6 REV 1
UNDERGROUND PIPING-TEST REPORT (RCC/CI)

Project :
Client :
Name of Work :
Job No :
Contractor :

1. Reference Drawing :
2. Location :
3. Line Designation :
4. Type of Pipe & System :
5. Specification :
6. Dia of Pipe :
7. Gradient :
8. Type of Manhole :
9. Test (s) Conducted :
10. Date of Testing :
11. Remarks, if any :

Date :

CONTRACTOR

EIL

CLIENT

FORMAT NO. : C7 REV 1
CEMENT TESTING RESULT REPORT

Project : Job No :
Client : Contractor :
Name of Work :
Brand of Cement : Consignment No. :
Wt. of sample taken : Sample Collected on :
Room Temperature :

A. CONSISTENCY

Trial No.	Wt. of Cement (gm)	Wt. of Water Added (gm)	% of Water	Reading on Indicator (mm)	Consistency	Remarks

B. SETTING TIME

Trial No.	Wt. of Cement (gm)	Wt. of Water Added (gm)	W/C Ratio	Time Recorded When Water Added	Time Recorded At set	Initial Set	Final Set	Setting Time	Remarks

C. FINENESS

Trial No.	Wt. of Cement Sample Used	Retained on 90 μ IS sieve in gm	% Retained	Remarks

D. COMPRESSIVE STRENGTH

Cube Size : 7.06X7.06X7.06 cm

Trial No.	Mix Proportion	Date of		Age of Specimen	Crushing Surface Area (Cm ²)	Crushing Load (Kg)	Crushing Strength (Kg/Cm ²)	Remarks
		Casting	Testing					

(TESTED BY)/LAB-IN-CHARGE

(CONTRACTOR)

(EIL)

Date :

FORMAT NO. : C8 REV 1
POUR CARD-I (PROGRAMME OF CONCRETING)

Contractor :		Client :	
Name of work :			
1.	Reference document :		
2.	Type of structure :	Location :	
3.	Levels	From :	To :
4.	Grade of concrete/ Approved Design Mix		
5.	Brand name, Grade and Consignment no. of cement		
6.	Estimated volume of concrete :		
7.	Quantity of cement required :		
8.	Reinforcement checking details :		
		No.	Dia.
	a) Laps		Length
	b) Separators		
	c) Chairs		
	d) Any other		
Remarks			
9.	Pre pour inspection details	Checked	NA
	a) Survey/ Layout		
	b) Sub soil compaction		
	c) Completion of underground works		
	d) Cleanliness		
	e) Cover to reinforcement		
	f) Anchor bolts		
	g) Sleeves/ pockets		
	h) Water stops		
	i) Formwork		
	j) Slopes		
	k) Construction/ Expansion joints		
	l) Admixtures		
	m) Any other		
Remarks			
10.	Clearance for Electrical/ Mechanical works required/ not required :	Electrical	Mechanical
11.	The above structure is finally inspected on _____ at _____ AM/PM and found/ not found satisfactory for concreting.		
Remarks, if any			

(Contractor)

Name
Designation
Date

(EIL)

Name
Designation
Date

(Client/ Owner)

Name
Designation
Date

FORMAT NO. : C9 REV 1
POUR CARD-II (OBSERVATIONS DURING CONCRETING)

Contractor :		Client :	
Name of work :			
1.	a) Quality of coarse aggregates	Satisfactory ☐	Not satisfactory ☐
	b) Quality of fine aggregates	Satisfactory ☐	Not satisfactory ☐
	c) Bulkage of sand taken into account	Yes ☐	No ☐
2.	Quality of water	Satisfactory ☐	Not satisfactory ☐
3.	Machinery mobilization	Nos.	Stand by
	a) Mixture machine		
	b) Ready mixed concrete dumpers		
	c) Vibrators		
	d) Pumps		
	e) Hoists		
4.	Pour start time : AM/PM ;	Date :	
5.	Slump		
6.	W/C Ratio		
8.	Type of weather	Normal ☐	Abnormal ☐
	Details of abnormality : (Precautions taken for <5°C and >40°C, rainy season)		
10.	Number of cubes taken :		
11.	Quantity of concrete poured :		
12.	Pour completion time : AM/PM ;	Date :	
13.	Curing method :		
	☐ Traditional	☐ Curing compound	
	☐ Blankets/ foils/ gunny bags	☐ Others (specify)	
14.	Period for removal of form work :		
15.	Any defect(s) observed during concreting :		

(Contractor)
Name
Designation
Date

(EIL)
Name
Designation
Date

(Client/ Owner)
Name
Designation
Date

Name of Work :

NOTE : i) Water absorption shall not be more than 20% by its dry weight. Bricks should be soaked in cold water for 24 hrs.
ii) Code of conformance shall be IS:3495 (for conducting tests) and IS:5454 (for collecting samples)

Date :

FORMAT NO. :

C10 REV 1

CRUSHING STRENGTH TESTING RESULTS OF CONCRETE CUBES

Project :

Job No :

Client :

Contractor :

Name of Work :

Grade of Concrete :

Type of Cement :

W/C Ratio :

Max. size of Aggregate :

Cube No.	Id. Mark on cube	Type & Location of Structure	Date of		Age (days)	Dimensions of Cube			Vol. of Cube (m ³)	Wt. of Cube (Kg)	Unit W.T. (Kg/m ³)	Surface Area (Cm ²)	Crushing Load (Kg)	Crushing Strength (Kg/Cm ²)	Remarks
			Casting	Testing		L (Cm)	B (Cm)	H (Cm)							

(TESTED BY)/LAB-IN-CHARGE

(CONTRACTOR)

(EIL)

C12 REV 1

Job No. : :

Contractor :

Name of Work :

Location/Coordinates/Grids : :

Lavout Clearance obtained : Yes/ No

[illegible]

Abbreviations:

Con : Contractor's signature with date

SECTION - C

FORMATS FOR UNDERGROUND PIPING WORKS

CONTENTS

S.NO	DESCRIPTION	FORMAT NO.	ISSUE DATE	PAGE NO.
FORMATS FOR UNDERGROUND PIPING WORKS				
1.	Daily fit up inspection & traceability report	P1 Rev.1	06.10.2006	58
2.	Weld visual inspection report	P2 Rev.1	06.10.2006	59
3.	Radiography offering report	P3 Rev.1	06.10.2006	60
4.	Radiography interpretation report	P4 Rev.1	06.10.2006	61
5.	Piping hydrostatic test release record	P5 Rev.1	06.10.2006	62
6.	Piping hydrostatic test acceptance record	P6 Rev.1	06.10.2006	63
7.	Linewise record	UG1 Rev.1	06.10.2006	64
8.	U/G piping system testing record	UG2 Rev.1	06.10.2006	65

FORMAT NO. : P1 REV 1
DAILY FIT UP INSPECTION & TRACEABILITY REPORT

Project : Job No :
Client : Contractor :
Name of Work :
Report No. : Date :

Sl. No.	Service/Line No.	Dia.	Joint No.	Type	Inch Mtr.	Manufacturers Heat No.	Clearance	Remarks
TOTAL INCH DIA.					TOTAL INCH MTR.			

Total Inch	Previous	Till Date
Diameter		
Meter		

G – Butt Weld	S – Socket Weld	B – Branch Weld	M – Mitre Weld
---------------	-----------------	-----------------	----------------

(CONTRACTOR)

(EIL)

FORMAT NO. : P2 REV 1
WELD VISUAL INSPECTION REPROT

Project : Job No :
Client : Contractor :
Name of Work :
Report No. : Date :
WPS No. :

Sl. No.	Service/Line No.	Dia.	Joint No.	Type	Welder No.	Visual Inspection Clearance	Remarks
Total inch Dia							

WORK LOAD =
PREVIOUS =
TILL DATE =
% PROGRESS =

G - BUTT WELD
S - SOCKET WELD
B - BRANCH WELD
M - MITRE WELD

CONTRACTOR

EIL

FORMAT NO. : P4 REV 1
RADIOGRAPHY INTERPRETATION REPORT

Project : Job No :

Client : Contractor :

Name of Work :

Radiography Technique : SWSI/DWSI/DWDI

Source : Ir192 ☐ , X-Ray ☐ , Cobalt 60 ☐

Film Type & Make :

IQI : Date :

Radiography Procedure No. :

Sl. No.	Service/Line No.	Dia.	Joint No.	Welder No.	Radiography No.	Segment	Results	Joint Status A/R/H

SWSI - SINGLE WALL SINGLE IMAGE
DWSI - DOUBLE WALL SINGLE IMAGE
DWDI - DOUBLE WALL DOUBLE IMAGE

A - ACCEPTED
R - REPAIR
H - HOLD
S/C - SURFACE CHECK
RT - RETAKE

CONTRACTOR

EIL

FORMAT NO. : P5 REV 1
PIPING HYDROTESTATIC TEST RELEASE RECORD

Project :

Job No :

Client :

Contractor :

Name of Work :

Plan : _____		Date : _____	
Loop No : _____		Area : _____	
		REF P & ID No. : _____	
		INCH MTR : _____	
		From _____ To _____	
	Line No. (s)	Isometric No. (s)	P&ID No. (s)
Test Medium :		Test Duration :	Design/Test Pressure :
Test Pressure Gauge No.	Range	Calibration Certificate No.:	Gauge Calibration Date:
Items to check		Accept	Witness
		Contractor	EIL
Field Installation Checklist Prior to Hydrostatic test Signed			
Punch list Prepared		Yes ☐	No ☐
Pre – Hydrostatic test Punch items Cleared			
Accessibility to Inspection/Witness Locations			
Capacity of pressurizing pump checked			
Cordon off area for high pressure testing, as required			
Pre-hydrostatic test flushing carried out			
IBR/Others test Witnessing Required		Yes	No
System Released for Pressure Testing :			
Contractor :		EIL:	
Sign :	Name :	Sign :	Name :
Date :		Date :	
Designation :		Designation:	

FORMAT NO. : P6 REV 1
PIPING HYDROSTATIC TEST ACCEPTANCE RECORD

ACTIVITY	Date	Time
Water Filling and Venting started at		
Water Filling Completed		
Vents Closed		
Isolation of Pressurizing pump		
Test completed at :		
- Water drained		
- Air		
- Temp Blinds Removed		
- Checked for reinstallation of a. Valves b. Others		
- Cold setting of spring supports carried out		
Contractor :	EIL :	
Sign :	Sign:	
Date :	Date:	
Name : Designation	Name:	Designation:
	Reviewed by EIL Area Coordinator :	
	Sign:	
	Date:	
	Name:	Designation:

FORMAT NO. : UG1 REV 1
LINEWISE RECORD

Project : Job No :
 Client : Contractor :
 Name of Work :
 Plant : % Radiography :
 Loop No. :

Sl. No.	Dia.	Jt. No	Type	Fitup Clearance Date	Welder No.	Date of Welding	Radiography		Stress Relieve Chart No.	Hardness	Hydrostatic test Date	Clearance date for					Remarks
							No.	Result & Date				Cleaning & Priming	Coating & Wrapping	Trench Level Checking	Holiday Checking	Lowering Back-Filling	

CONTRACTOR

EIL

Date :

FORMAT NO. : UG2 REV 1
U/G PIPING SYSTEM TESTING RECORD

ACTIVITY	Date	Time
Air/Water Filling and Venting started at		
Water Filling Completed/Air pressure achieved		
Vents Closed (for water testing)		
Isolation of Pressurizing pump/compressor		
Visual Test/Soap Bubble check completed at :		
- Water drained/Air depressurized		
- Drying, if applicable		
- Temp Blinds Removed		
- Checked for reinstallation of a. Valves b. Others		
Contractor :	EIL :	
Sign :	Sign:	
Date :	Date:	
Name : Designation	Name:	Designation:
	Reviewed by EIL Area Coordinator :	
	Sign:	
	Date:	
	Name:	Designation:

ABBREVIATIONS

API	AMERICAN PETROLEUM INSTITUTE	HP	HORSE POWER
ANSI	AMERICAN NATIONAL STANDARD INSTITUTE	HS	HOSE STATION
AWWA	AMERICAN WATER WORKS ASSOCIATION	HPP	HIGH POINT OF PAVEMENT
BC	BOX CULVERT	ID	INSIDE DIAMETER
BE	BEVEL END	INST	INSTRUMENT
BF	BLIND FLANGE	INV	INVERT
BL	BED LEVEL	IRC	INSTRUMENT CABLE ROAD CROSSING
BOP	BOTTOM OF PIPE	MK	MARK
BOTT.EL	BOTTOM ELEVATION(CABLE DUCT ETC)	MR	MATERIAL REQUISITION
CBD	CLOSE BLOW DOWN	MTO	MATERIAL TAKE OFF
CI	CAST IRON	MS	MILD STEEL
C/C	CENTRE TO CENTRE	MH	MANHOLE
CL OR ϕ	CENTRE LINE	NGL	NATURAL GROUND LEVEL
CONC.RED	CONCENTRIC REDUCER	OD	OUTSIDE DIAMETER
CONC	CONCRETE	OHT	OVERHEAD TANK
CPLG	COUPLING	OWS	OILY WATER SEWER
CS	CARBON STEEL	PC	PIPE CULVERT
CONN	CONNECTION	PE	PLAIN END
CONT	CONTINUATION	PWS	PROCESS WASTE SEWER
CW	CONSTRUCTION WATER/CARRIAGE WAY	PWB	PIPE WAY BRIDGE
CWS	CAUSTIC WASTE SEWER	RCC	REINFORCED CEMENT CONCRETE
COL	COLUMN	R	RADIUS
DIA	DIAMETER	RF	RAISED FACE
DWG	DRAWING	REF	REFERENCE
DISCH.	DISCHARGE	RW	ROAD WAY
DS	SANITARY SEWER	SO	SLIP ON
ECC	ECCENTRIC	SS	STORM SEWER
EL	ELEVATION	STD	STANDARD
ERC	ELECTRIC CABLE ROAD CROSSING	STN	STATION
EW&SS	EYE WASH & SAFETY SHOWER	TEMP	TEMPERATURE
FCR	FOR CONTINUATION REFER	TOS	TOP OF SLEEPER
FF	FLAT FACE	TYP	TYPICAL
FGL	FINISHED GROUND LEVEL	TWDK	TEMPORARY DRINKING WATER
F TO F	FACE TO FACE	WCS	COOLING WATER SUPPLY
FFL	FINISHED FLOOR LEVEL	WCR	COOLING WATER RETURN
FLGD.	FLANGED	WDK	DRINKING WATER
FDN	FOUNDATION	WF	FIRE WATER
GLV	GALVANISED	WR	RAW WATER
GT	GALVANISED BLACK STEEL TUBE	WH	HORTICULTURE WATER
GR	GROUND/GRADE	WT	TREATED WATER
HC	HOSE COUPLING	WF	FILTERED WATER

3	01.10.09	REVISED & ISSUED AS STANDARD	SKP	RKS/RBB	NK	ND
2	11.11.99	REVISED & ISSUED AS STANDARD	HC	PCS	MMK	AS
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman

LEGENDS

	NATURAL GROUND LEVEL		BOX CULVERT REPRESENTATION ON AREA DRAWING		
	FINISHED GROUND LEVEL				
	ROAD TOP LEVEL/ PAVEMENT TOP LEVEL				
	FINISHED FLOOR LEVEL OF BUILDING				
	CENTRE LINE		ERC-ELELCTRIC CABLE 3x4 ROAD CROSSING NO.OF PIPE IN EACH LAYER LAYERS		
	LAND ACQUISTION LIMIT				
	COMPOUND WALL				
	BATTERY LIMIT				
	MATCHING LINE		R.C.C. CABLE TRENCH		
	ROAD-A REPRESENTATION ON LAYOUTS				
	ROAD-A REPRESENTATION IN AREA DRAWINGS		BURIED CABLE TRENCH D=DEPTH W=WIDTH		
	SIDE SLOPE				
	TRAPEZOIDAL DITCH REPRESENTATION ON AREA DRAWING		PIPEWAY BRIDGE		
	RECTANGULAR DITCH REPRESENTATION ON AREA DRAWING				
	TRAPEZOIDAL DITCH REPRESENTATION ON LAYOUT DRAWING				
	RECTANGULAR DITCH REPRESENTATION ON LAYOUT DRG.				
	PIPE CULVERT BOX CULVERT REPRESENTATION ON LAYOUT DRG.		PIPE SLEEVES		
	PIPE CULVERT REPRESENTATION ON AREA DRAWING				
					CONSTRUCTION WATER PIPE LINE
					TREATED WATER PIPE LINE
			TEMPORARY DRINKING WATER PIPE LINE		
			DRINKING WATER PIPE LINE		

3 01.10.09 REVISED & ISSUED AS STANDARD

2 11.11.99 REVISED & ISSUED AS STANDARD

Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
			SKP	RKS/RBB	NK	ND
			HC	PCS	MMK	AS

	COOLING WATER SUPPLY PIPE		45° BEND (TURNED DOWN)
	COOLING WATER RETURN PIPE		CATCH BASIN
	FIRE WATER PIPE LINE		
	HORTICULTURE WATER PIPE LINE		
	SERVICE WATER PIPE LINE		
	STORM SEWER		
	SANITARY WATER SEWER		PIPE INVERT LEVEL
	OILY WASTE SEWER/PROCESS WASTE SEWER		SANITARY SEWER MANHOLE
	COOLING TOWER BLOW DOWN		OILY/PROCESS SEWER MANHOLE
	ACIDIC SEWER		ACIDIC SEWER MANHOLE
	ALKALI SEWER		ALKALI SEWER MANHOLE
	CTBD SEWER		CTBD SEWER MANHOLE
	SANITARY PUMPING MAIN		CHEMICAL SEWER MANHOLE
	GATE VALVE		CIRCULAR MANHOLE
	GLOBE VALVE		CLEAN OUT
	BUTTERFLY VALVE		
	CHECK VALVE		
	FLOAT VALVE		
	PIPE WITH FLANGED END		FUNNEL FOR STORAGE TANK DRAIN
	BLIND FLANGED END		RECTANGULAR SEALED MANHOLE (SINGLE COMPARTMENT)
	VALVE PIT IN PIPE LINE		
	90° BEND (TURNED UP)		RECTANGULAR SEALED MANHOLE (DOUBLE COMPARTMENT)
	90° BEND (TURNED DOWN)		
	45° BEND (TURNED UP)		SAND TRAP

3 01.10.09 REVISED & ISSUED AS STANDARD

2 11.11.99 REVISED & ISSUED AS STANDARD

Rev. No. Date Purpose

Prepared by

Checked by

Stds. Committee Convenor

Stds. Bureau Chairman

Approved by

	SEALED MANHOLE (CIRCULAR)		WATER MONITOR FOR FOR FIRE WATER SYST.
	TRIPPLE VALVE PIT (VALVE PITS OUTSIDE TANKFARM AREA FOR DRAINAGE)		FOAM MONITOR FOR FOR FIRE WATER SYST.
			DOUBLE HEADED FIRE HYDRANT AWAY FROM HEADER
	SEPTIC TANK		FIRE HOSE COUPLING
	SOAK PIT		EARTHEN DYKE
	GULLY TRAP		RAILWAY TRACK REPRESENTATION ON LAYOUT
	GATE		RAILWAY TRACK REPRESENTATION ON AREA DWG.
	BARBED WIRE FENCING		PIPE RACK
	CHAIN LINK FENCING		EQPT. SYMBOLS
	R.C.C. PAVEMENT		HOSE CABINET
	FOOTPATH 1000 MM W=WIDTH OF FOOTPATH		HOSE REEL
	SLIDING SLEEPER		DELUGE VALVE ASSEMBLY
	ANCHOR SLEEPER		PUMP (HORIZONTAL)
	GUIDE SLEEPER		PUMP VERTICAL a) ELECT. DRIVE B) DEISEL DRIVE
	JUMP OVER SLEEPER		
	FIRE HYDRANT DOUBLE HEADED		

3 01.10.09 REVISED & ISSUED AS STANDARD

SKP

RKS/RBB

NK

ND

2 11.11.99 REVISED & ISSUED AS STANDARD

HC

PCS

MMK

AS

Rev. No. Date Purpose

Prepared by

Checked by

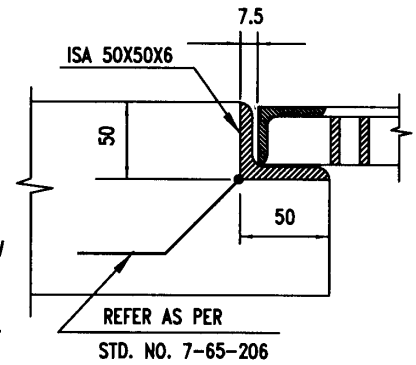
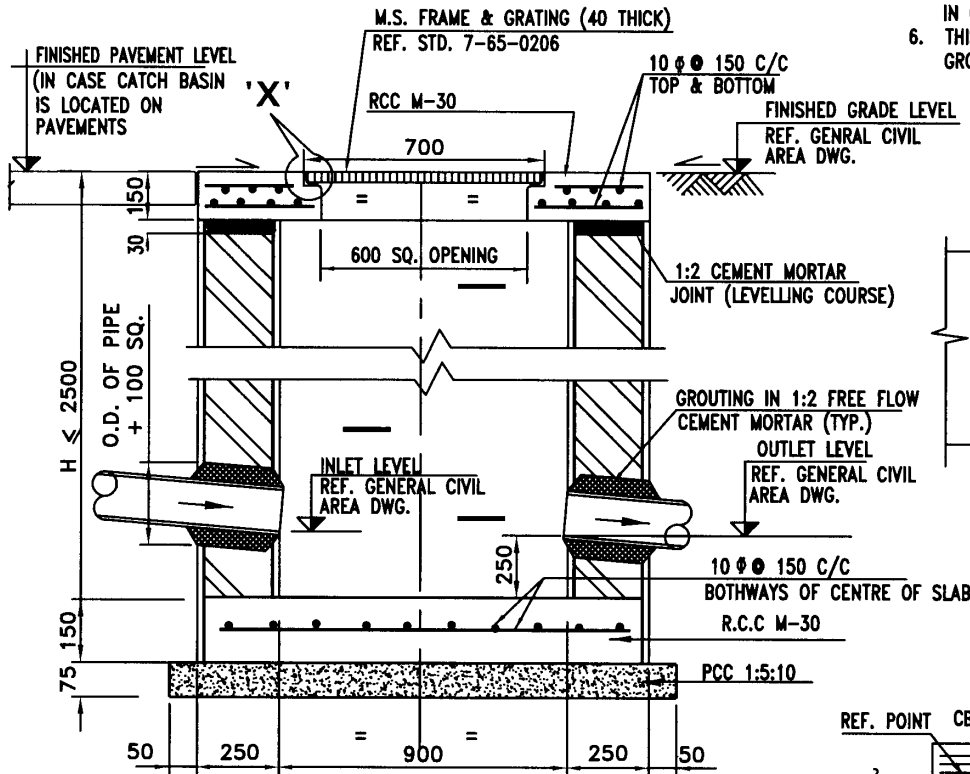
Stds. Committee
Convenor

Stds. Bureau
Chairman

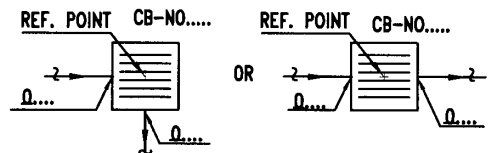
Approved by

NOTES:-

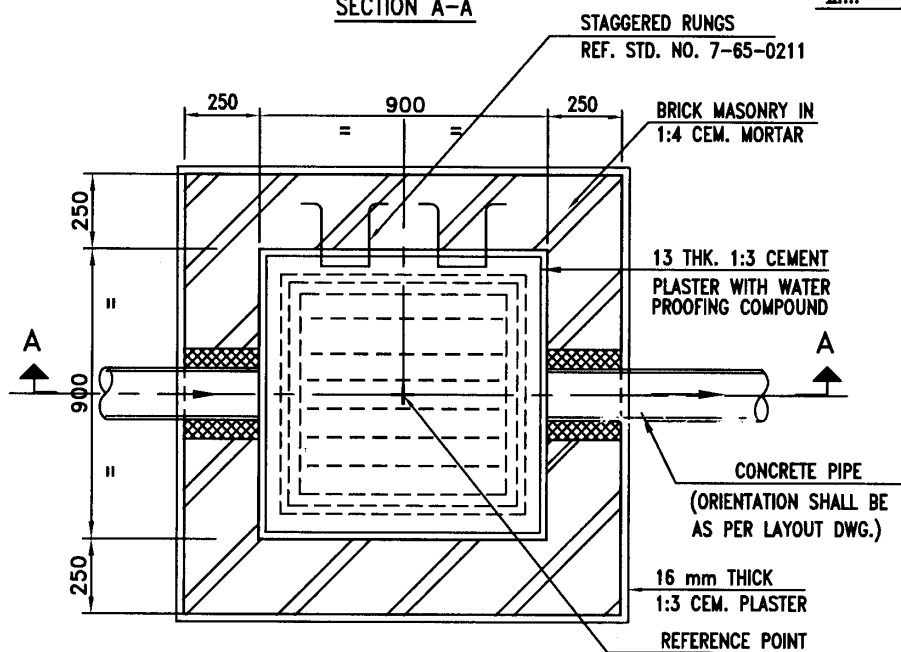
1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. EXACT THICKNESS OF BRICK MASONRY SHALL BE ACCORDING TO SIZE OF LOCALLY AVAILABLE BRICK.
3. REINFORCEMENT SHALL BE OF GRADE Fe 500 TMT BAR CONFORMING TO IS:1786.
4. REINFORCEMENT COVER SHALL BE 45 mm.
5. THIS TYPE OF CATCH BASIN IS TO BE CONSTRUCTED FOR STORM WATER SERVICE IN OFFSITE AREA.
6. THIS STD. IS VALID FOR THE AREA WHERE GROUND WATER TABLE IS UPTO FGL.



DETAIL-X

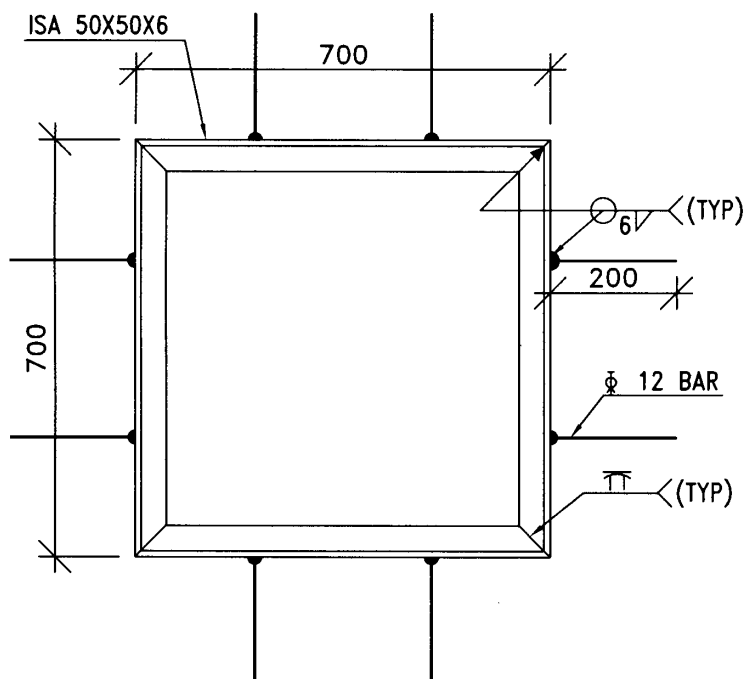


REPRESENTATION ON AREA DRG.

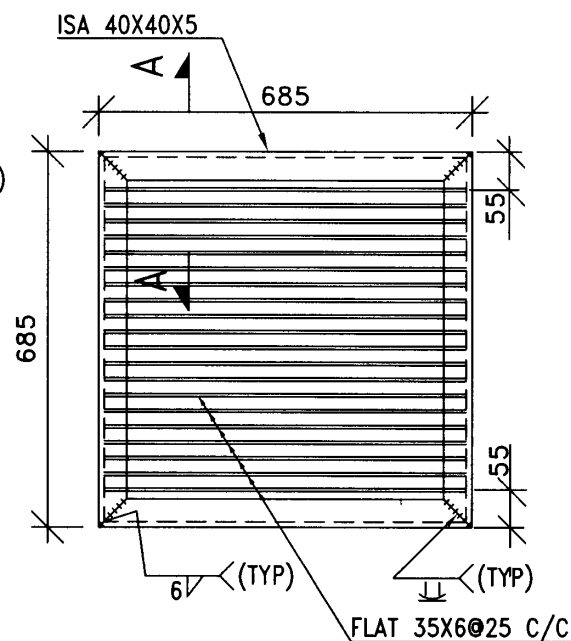


PLAN

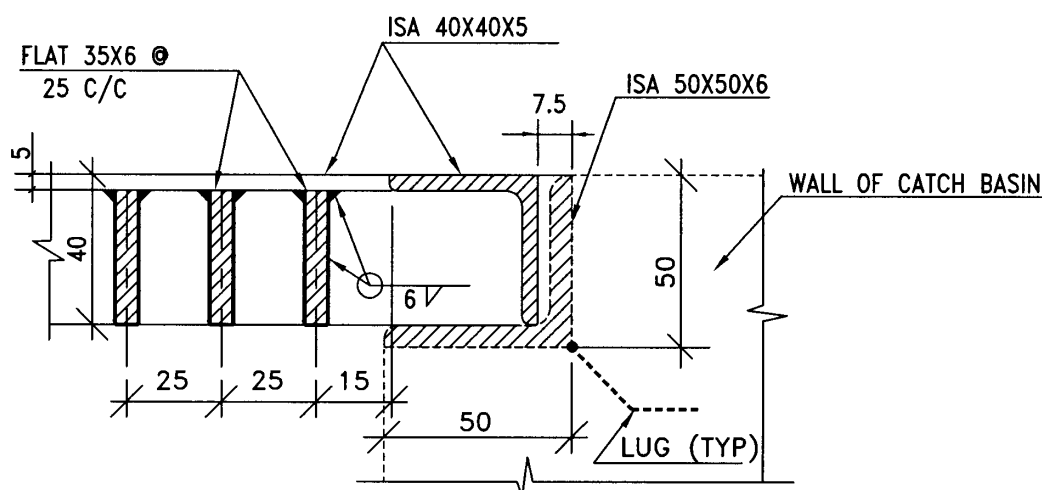
5	19.05.09	UPDATED AND ISSUED AS STANDARD	SR	APC/RKS	NK	ND
4	20.02.03	UPDATED AS PER IS:456.2000 & ISSUED AS STANDARD	SSM	G.GHOSH/SKC	AK	SKG
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman



DETAIL OF FRAME



DETAIL OF GRATING



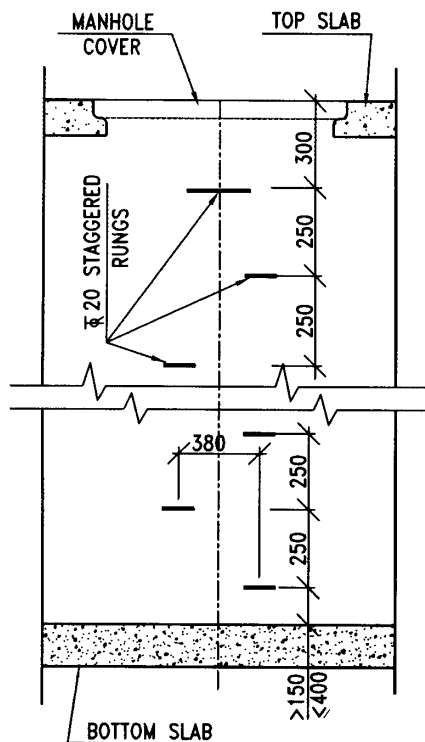
SEC. A-A

(FIXING DETAIL OF FRAME OVER THE
VERTICAL WALL OF THE CATCH BASIN)

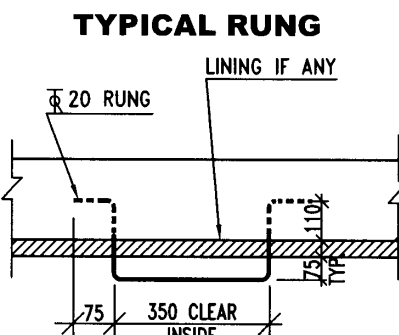
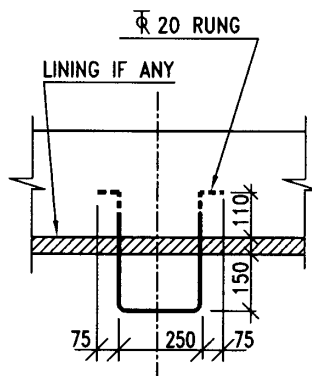
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. CATCH BASIN FRAME AND GRATING SHALL BE HOT DIP GALVANISED ACCORDING TO IS: 2629 AND THE QUANTITY OF ZINK COATING SHALL BE 900gms/sq.m OF SURFACE AREA (0.12mm UNIFORM THICKNESS).
3. STEEL SHALL CONFORM TO IS: 2062, GRADE-A.

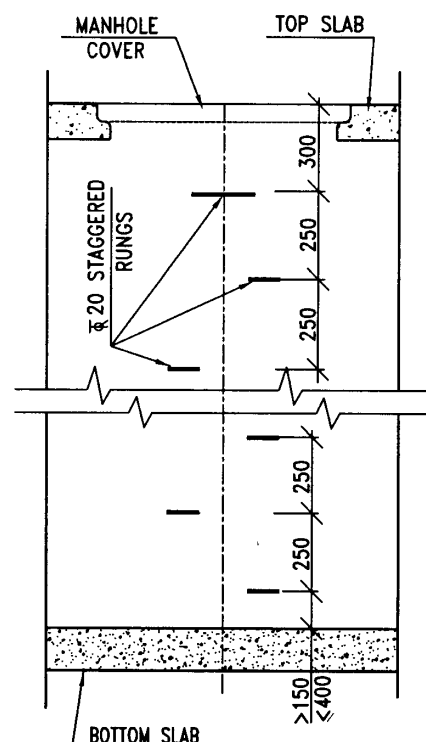
3	19.05.09	REAFFIRMED AND ISSUED AS STANDARD	SSM	DCB	NK	ND
2	13.05.03	REVISED AND ISSUED AS STANDARD	SSM	G.GHOSH/SKC	AK	SKG
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman



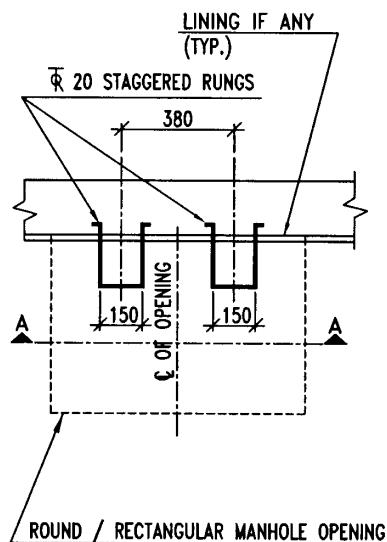
VIEW. A-A
(TYP.)



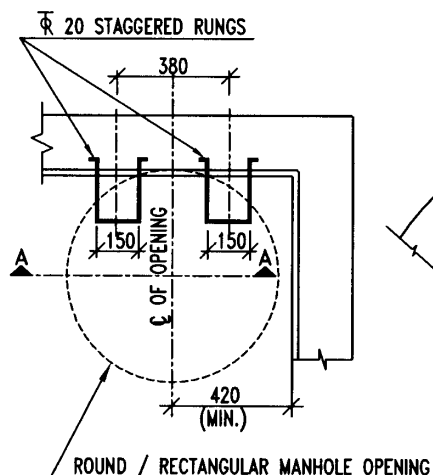
DETAIL OF TOP RUNG



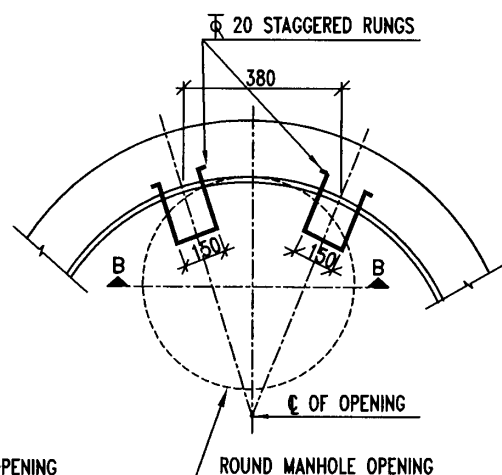
VIEW. B-B



CASE - 1



CASE - 2

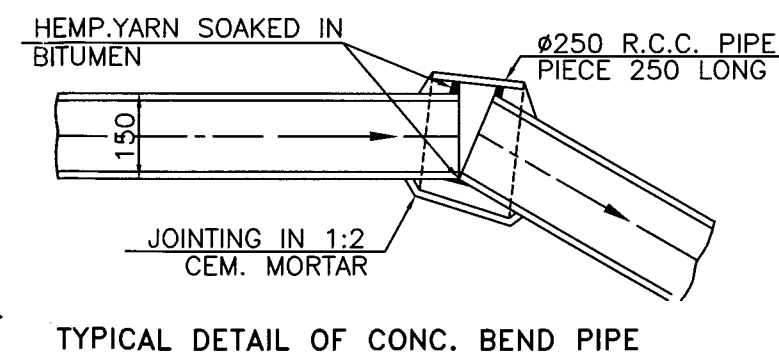
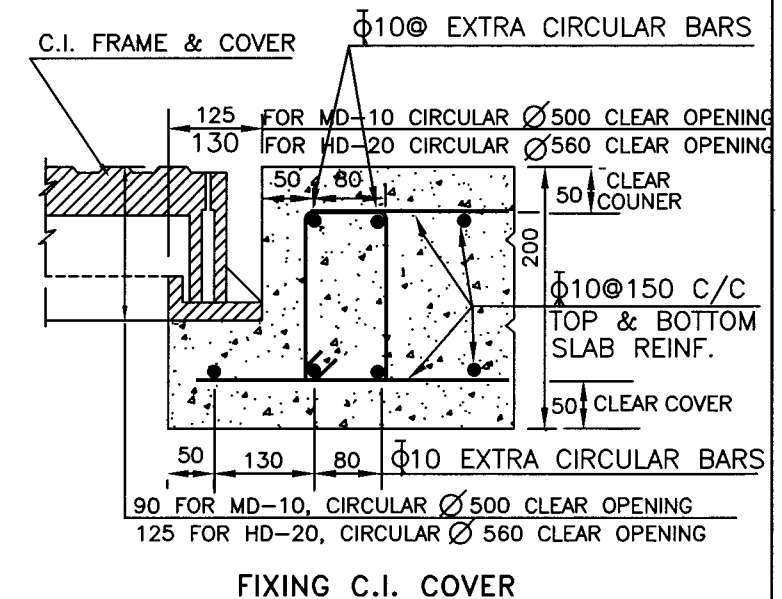
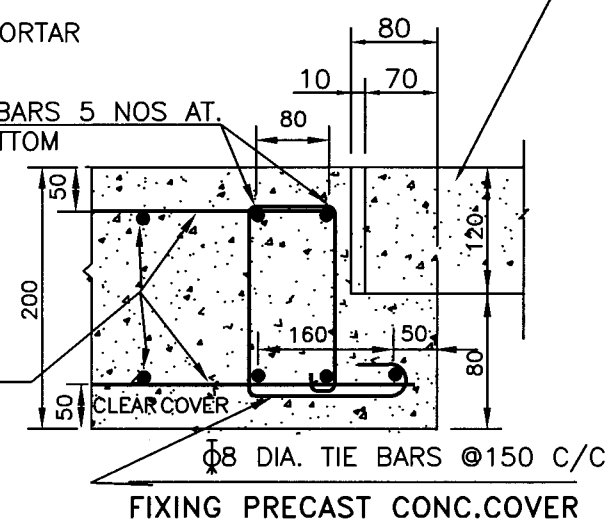
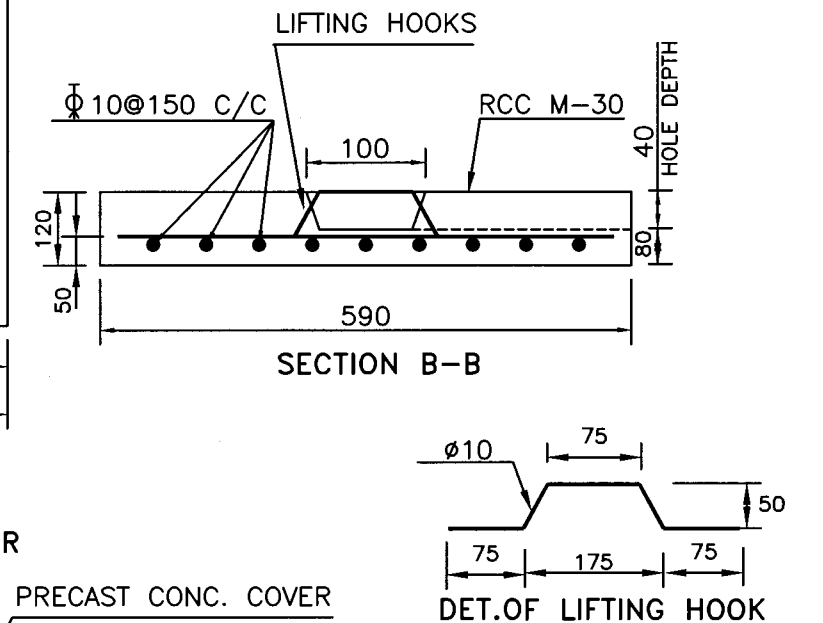
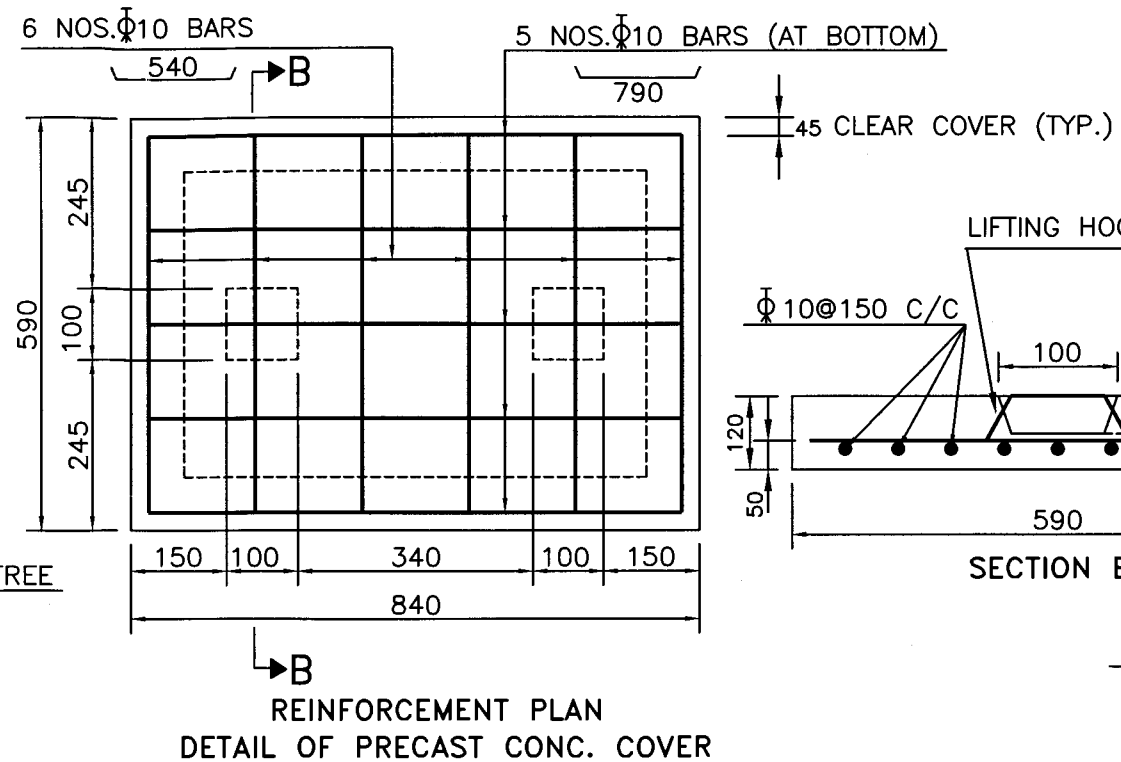
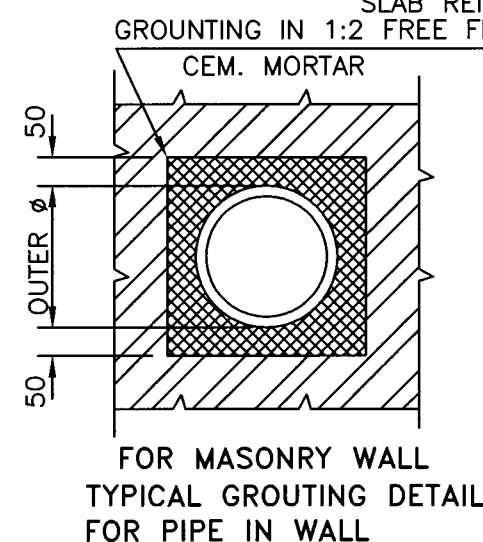
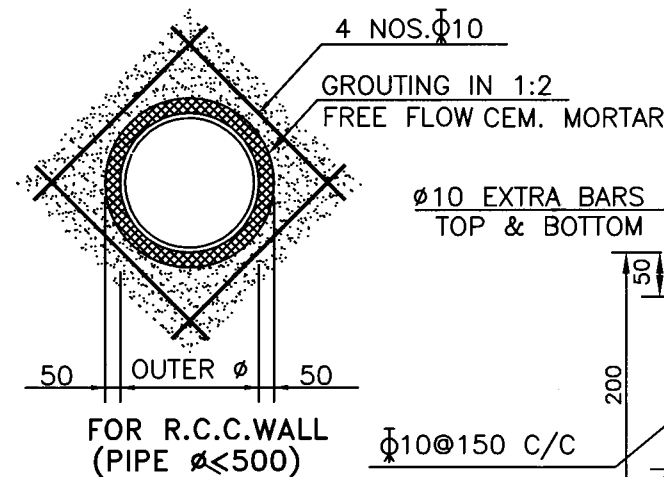
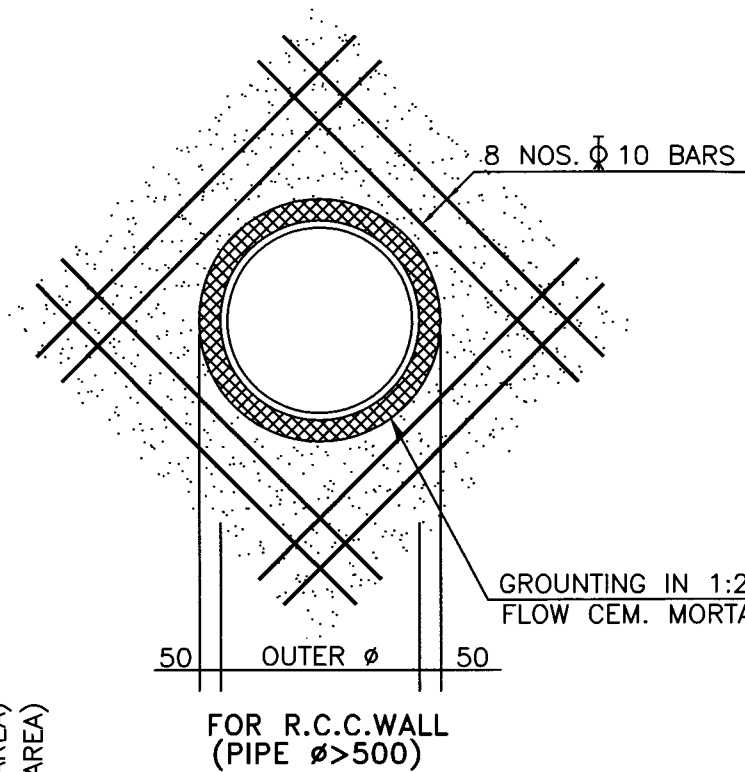
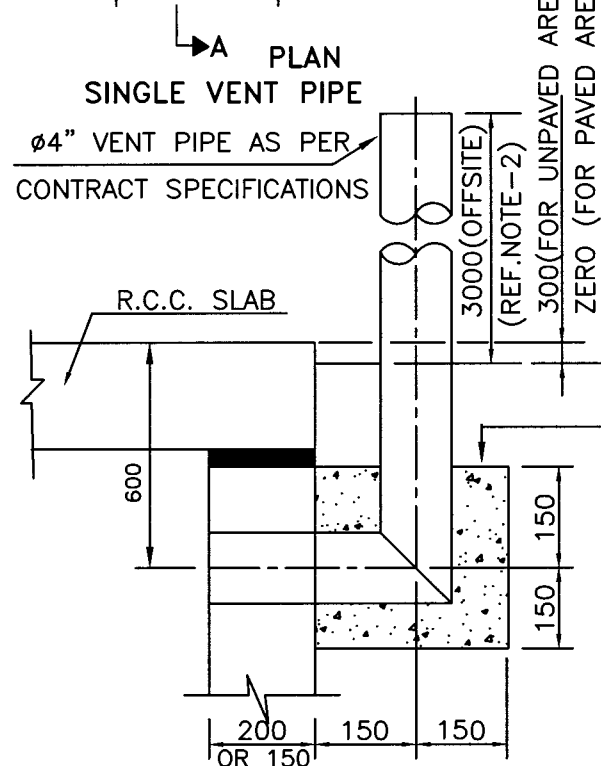
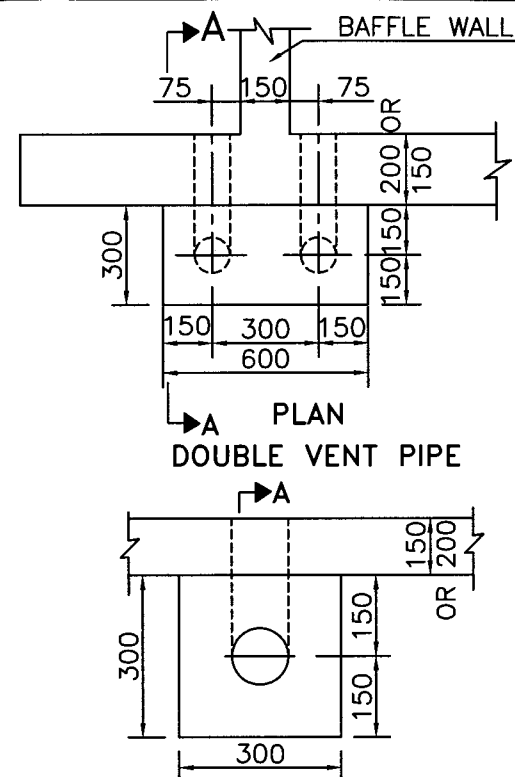


CASE - 3

NOTE:-

1. ALL DIMENSIONS ARE IN MILLIMETER UNLESS SPECIFIED.
2. RUNGS SHALL BE EPOXY COATED OR PAINTED AS PER SPEC. NO. 6-44-04.
3. REINFORCEMENT SHALL BE OF GRADE Fe 500 TMT BAR CONFORMING TO IS: 1786.

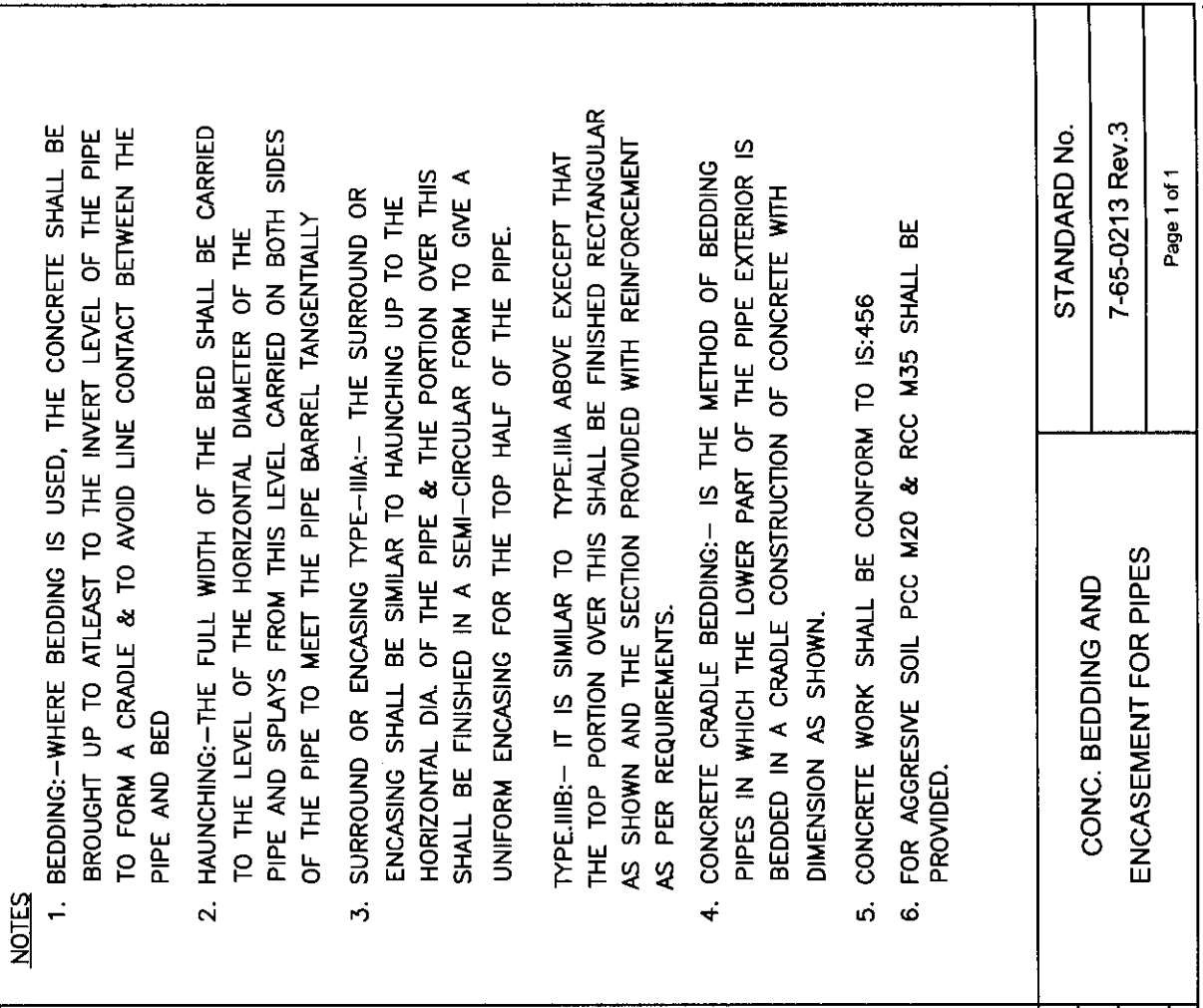
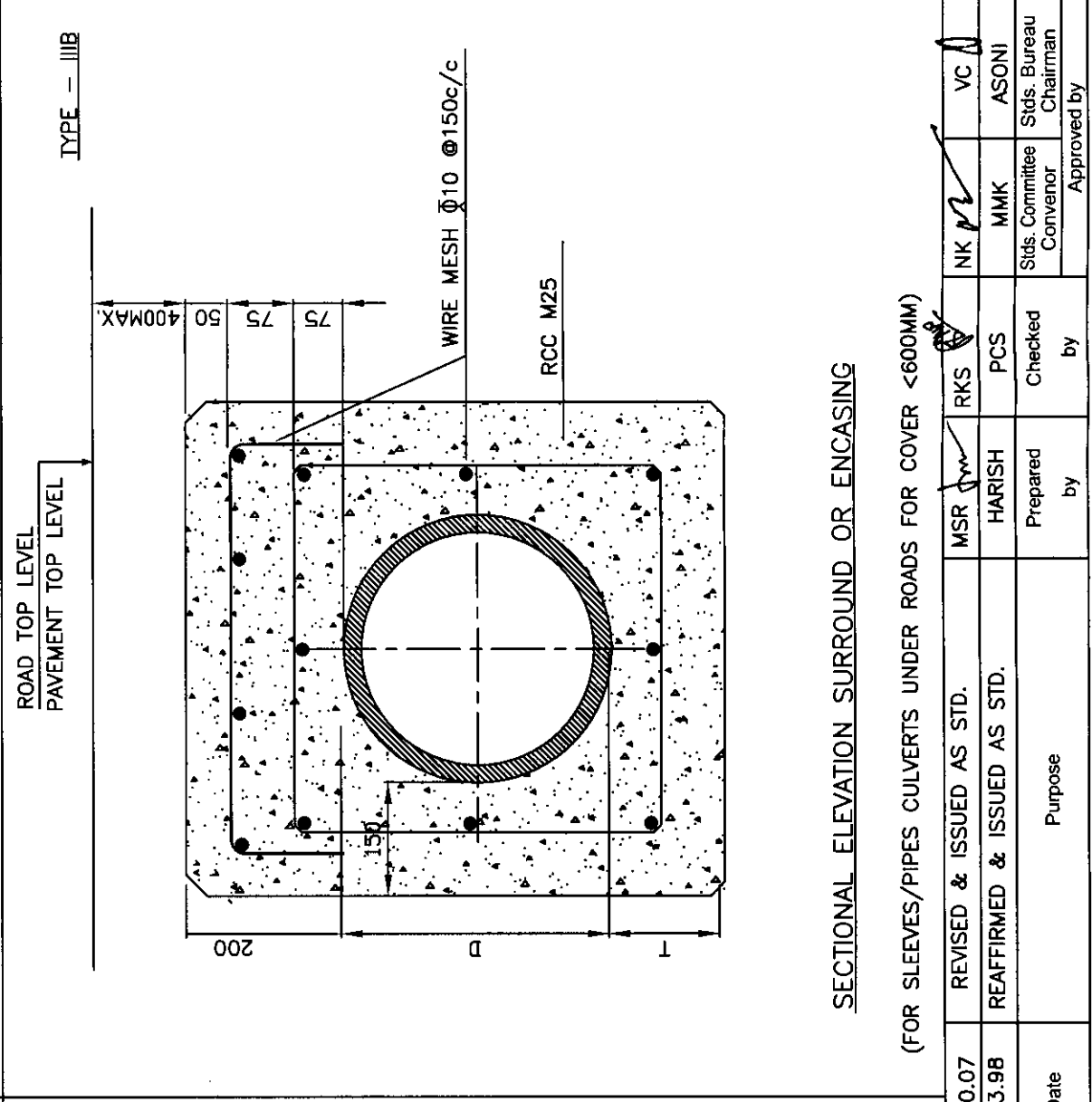
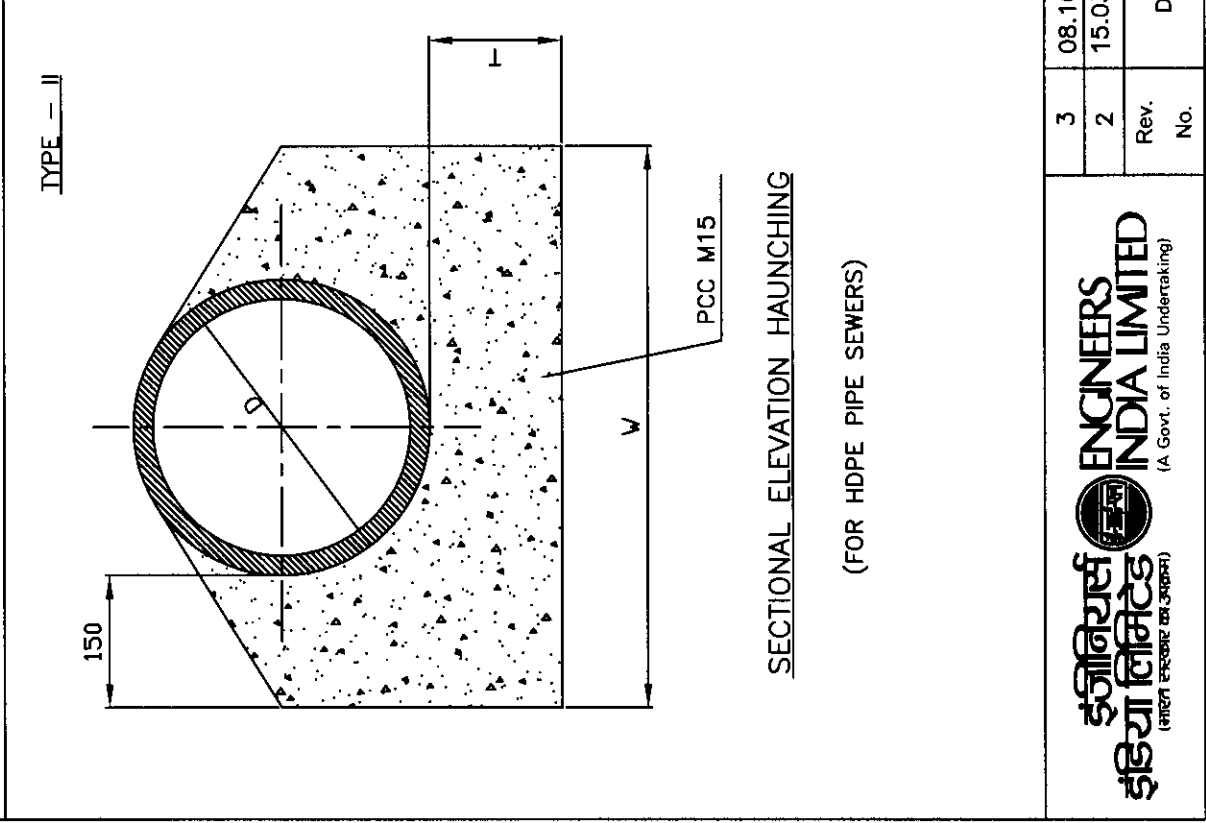
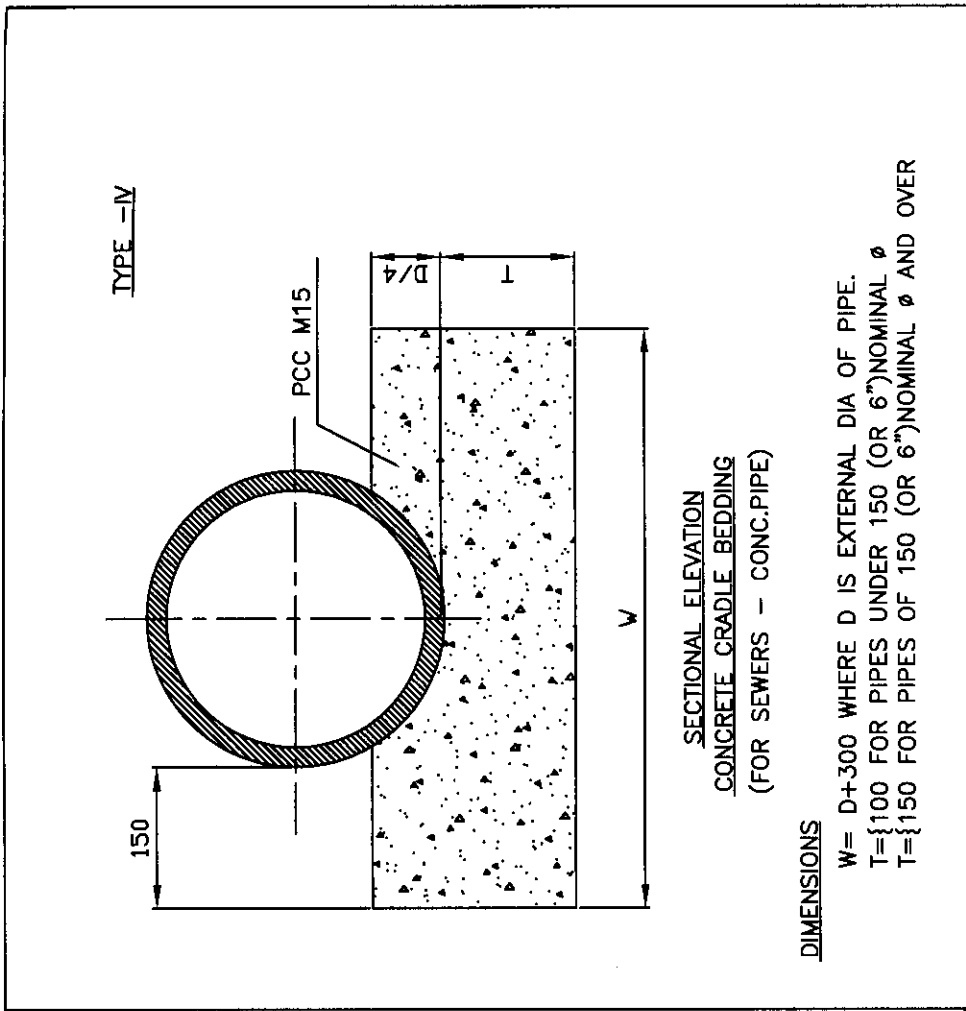
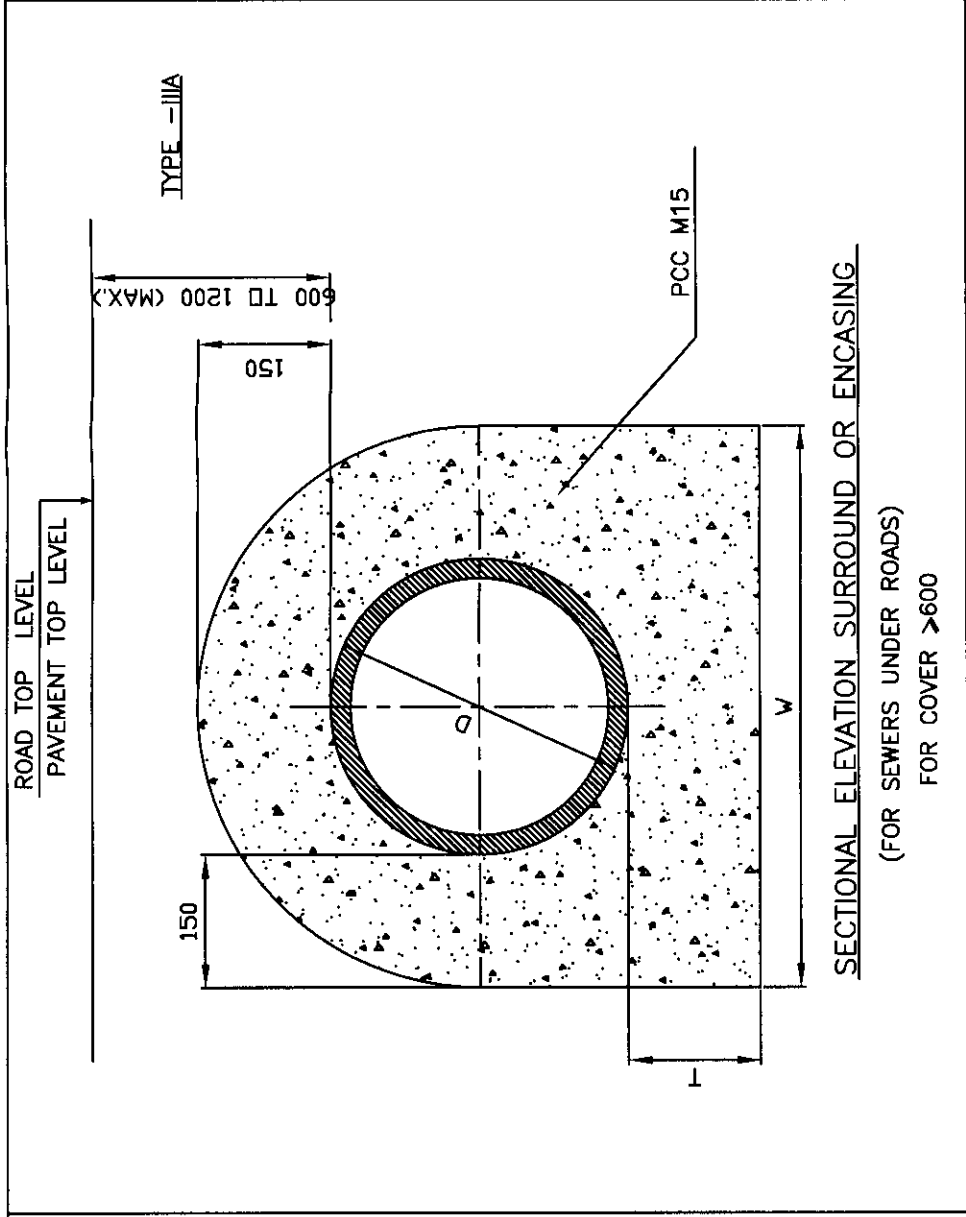
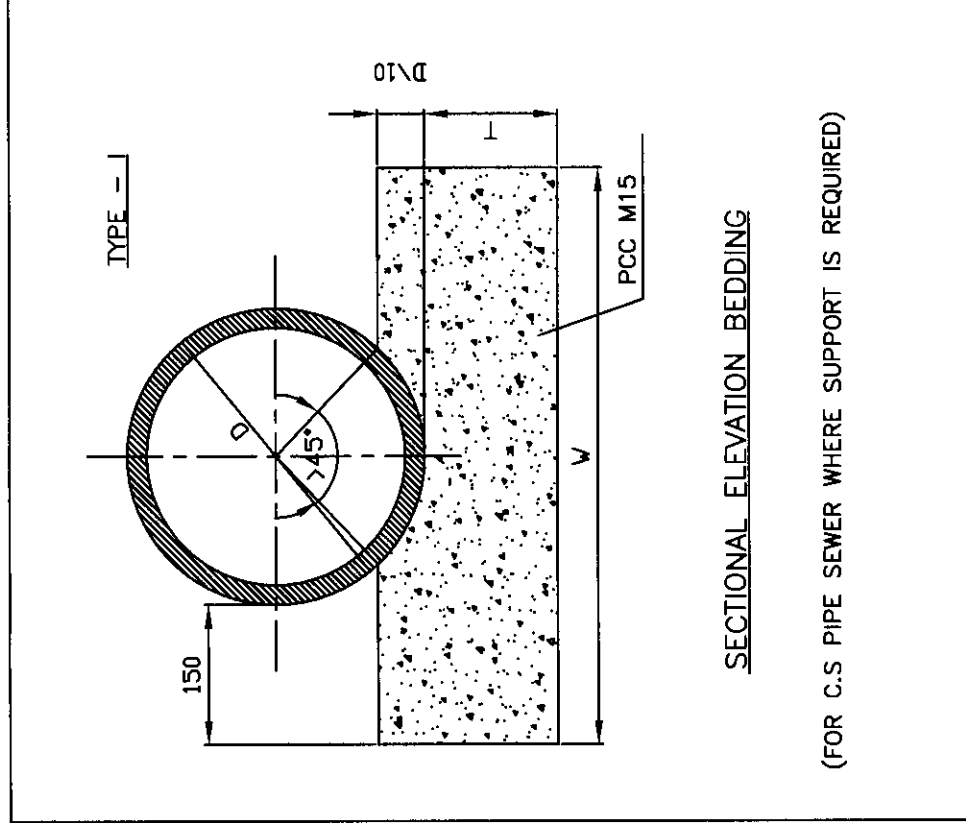
3	19.05.09	REVISED & ISSUED AS STANDARD	SSM	DDB/RKS	NK	ND
2	25.02.04	REVISED & ISSUED AS STANDARD	SSM	GG/SKC	AK	SKG
1	15.03.98	REVISED & ISSUED AS STANDARD	GPSB	RPB	HVR	A.K
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman



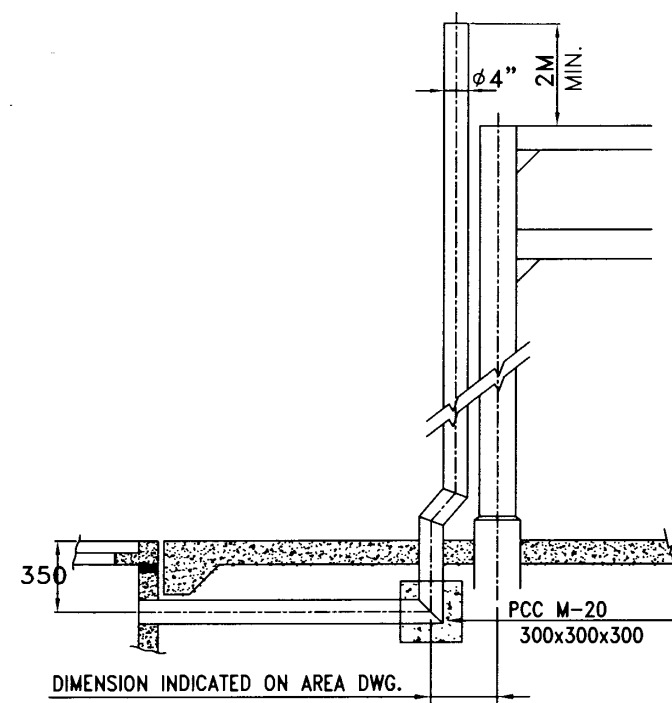
NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
2. IN UNIT AREA
VENT PIPES SHOULD BE LOCATED ALONG PIPE RACK COLUMNS OR BUILDING COLUMNS & SHOULD BE TAKEN 2M ABOVE THE BUILDING PARAPET OR LAST LAYER OF PIPES OF THE UNIT.
IN OFFSITE AREA
VENT PIPE SHALL PROJECT 3.0M ABOVE FGL. AND SHALL BE SELF SUPPORTING.

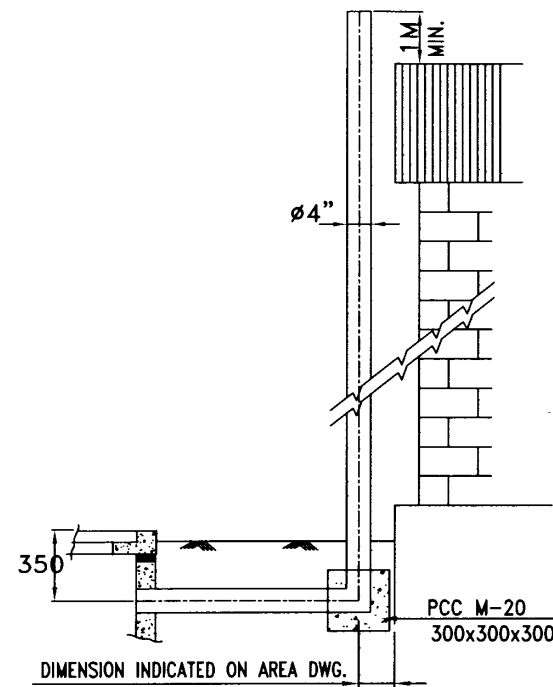
2	16.10.06	REVISED AND ISSUED AS STD.	MEENA	RKS/UCJ	VBS	VC
1	15.3.98	REAFFIRMED AND ISSUED AS STD.	HARISH	RB	MMK	AS
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	



इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)				CONC. BEDDING AND ENCASEMENT FOR PIPES						STANDARD No.	
3	08.10.07	REVISED & ISSUED AS STD.	MSR <i>gm</i>	RKS <i>AK</i>	NK <i>AK</i>	VC <i>AK</i>	7-65-0213 Rev.3				
2	15.03.98	REAFFIRMED & ISSUED AS STD.	HARISH	PCS	MMK	ASONI	Page 1 of 1				
Rev.	Date	Purpose	Prepared	Checked	Sds. Committee Convenor	Sds. Bureau Chairman					
No.			by	by	Approved by						

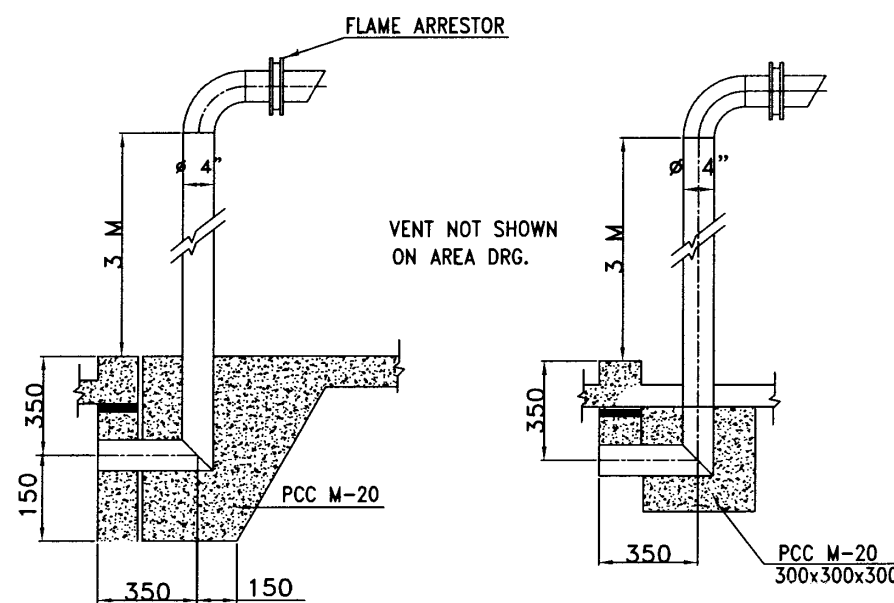


PAVED AREA



UNPAVED AREA

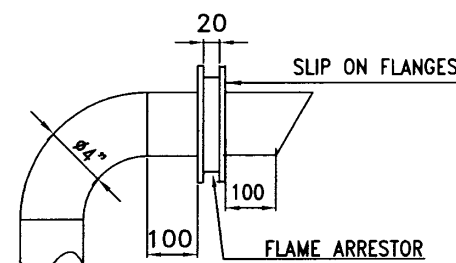
VENTS IN UNIT AREA



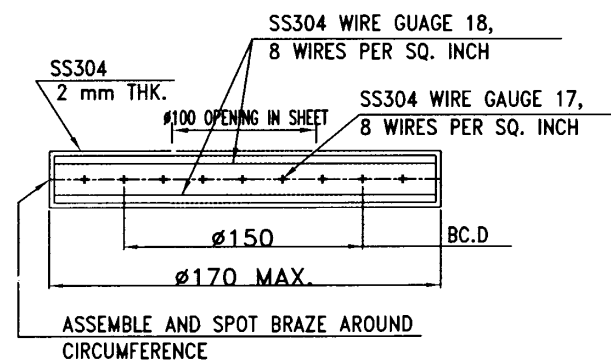
PAVED AREA

UNPAVED AREA

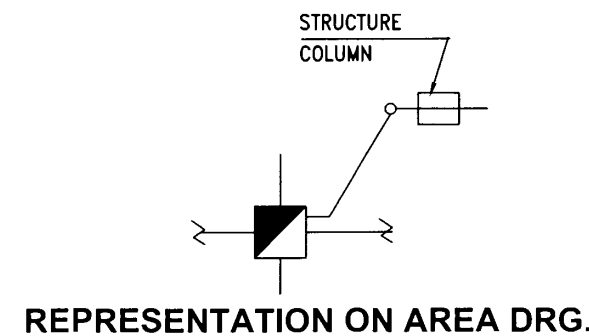
VENTS IN OFFSITE AREA (ISOLATED MAN HOLES)



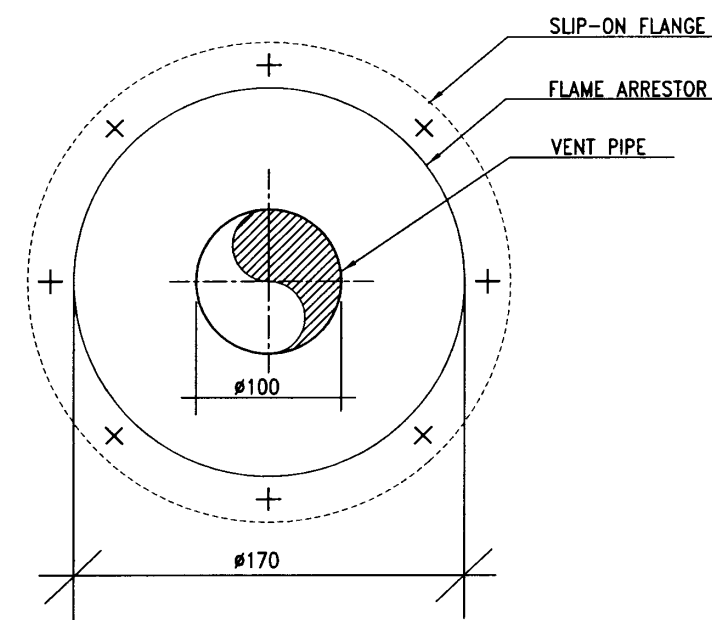
FLAME ARRESTOR INSTALLATION



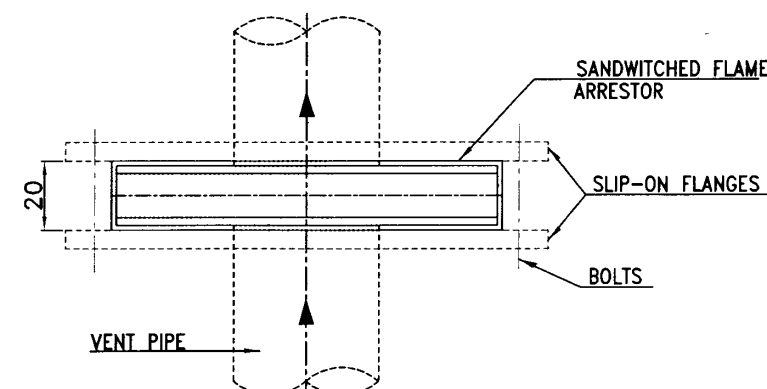
FLAME ARRESTOR DETAIL



REPRESENTATION ON AREA DRG.



ELEVATION



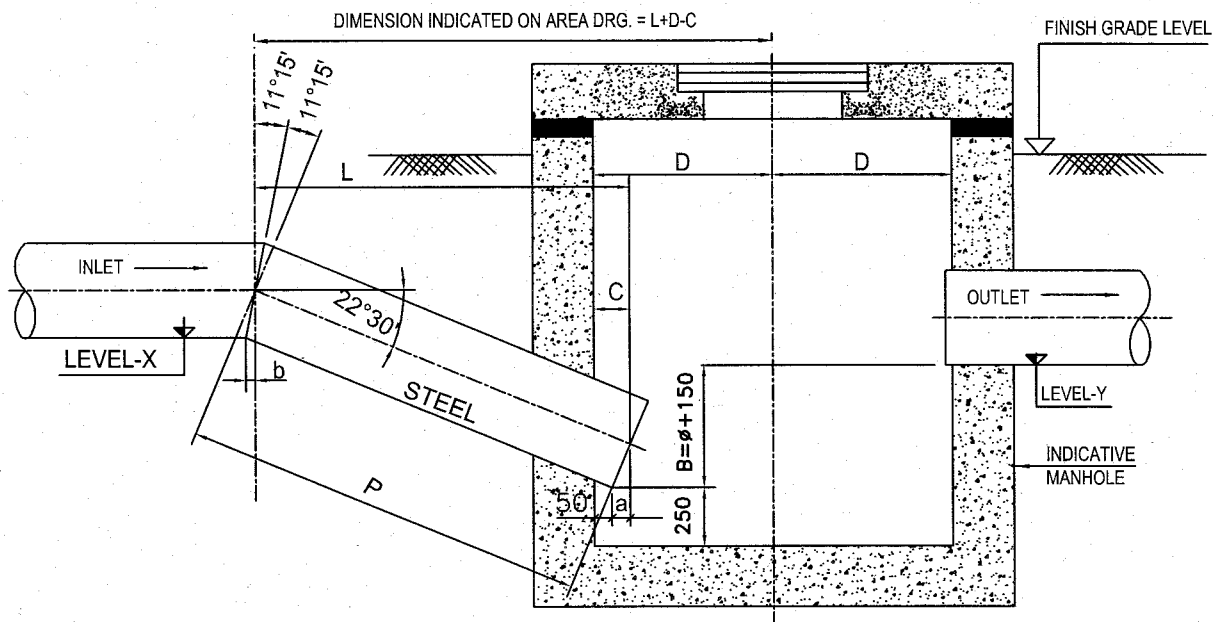
PLAN

FIXING ARRANGEMENT OF FLAME ARRESTOR

NOTES:-

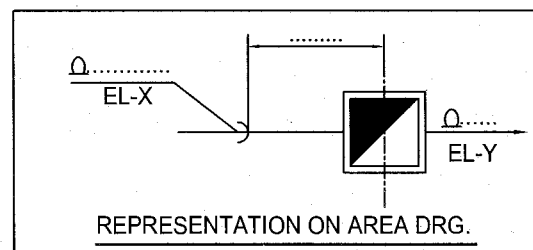
- ALL DIMENSIONS ARE IN MILLIMETERS.
- MIN. SAFETY DISTANCES SHALL BE MAINTAINED AS BELOW.
 - INSIDE BATTERY LIMIT :- ATLEAST 15 M FROM FURNACE OR NAKED FLAME
 - OFFSITES :- IF VENTS ARE LESS THAN 15 M FROM NAKED FLAME OR EDGE OF FREE CIRCULATION ROADS, THEY SHALL BE FITTED WITH FLAME ARRESTORS AND LOCATED ATLEAST 4 M FROM EDGE OF ROAD.

3	19.05.09	REVISED AND ISSUED AS STANDARD	SKP	RKS/RBB	NK	ND
2	22.01.04	REVISED AND ISSUED AS STANDARD	SSM	GG/SKC	AK	SKG
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	



VALUES OF (a-b), B AND C		ACCORDING TO PIPE Ø		
Ø DIAMETER		(a-b)	B	C
STEEL	CAST IRON			
4"	100	10	250	70
6"	150	15	310	80
8"	200	20	360	90
10"	250	25	410	100
12"	300	30	460	110
14"	350	30	500	115
16"	400	35	550	125

ALL DIMENSIONS IN THIS TABLE ARE GIVEN AS ROUND NUMBERS FOR SIMPLIFICATION AND TO ALLOW FOR SIZE VARIATION IN THE SAME DIAMETER BETWEEN STEEL AND CAST IRON PIPES.



DETERMINATION OF P & L

$$P = 1.08 L$$

FOR INLET BEND PIPE:

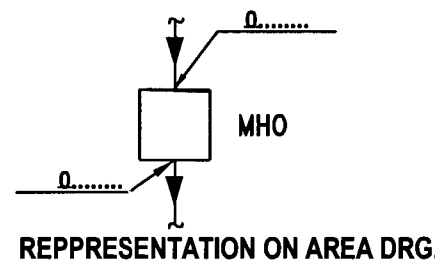
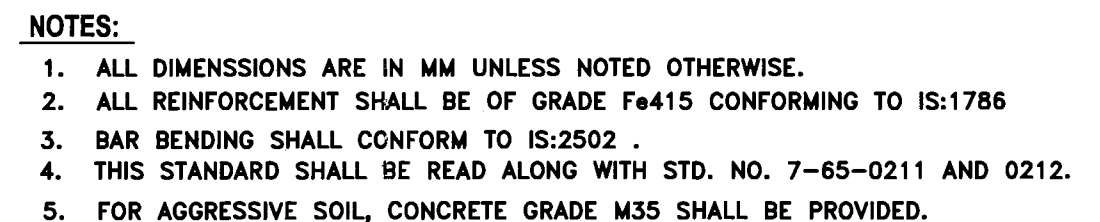
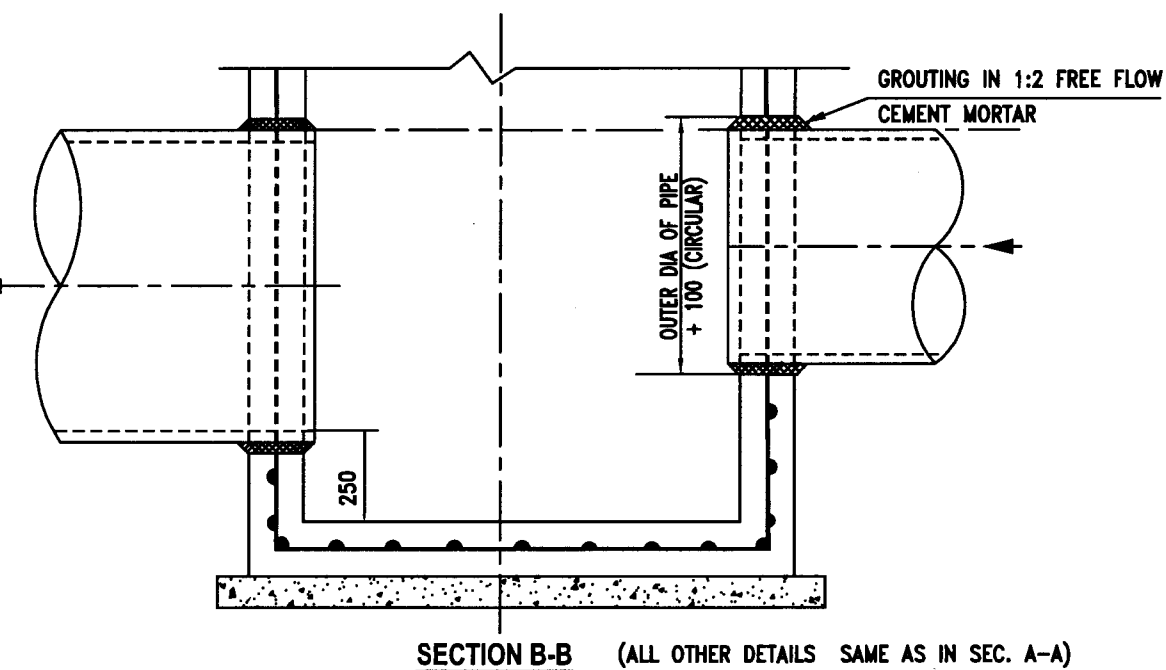
$$L = 2.414 [(LEVEL X - LEVEL Y) + B] + (a-b)$$

WHEN THERE ARE SEVERAL BEND PIPES IN THE SAME MANHOLE, USE VALUE B CORRESPONDING TO LARGEST DIAMETER LEVEL DIFFERENCE DIMENSION "L" CALCULATION OF EACH PIPE.

NOTE:

1. ALL DIMENSIONS ARE IN MM UNLESS SPECIFIED OTHERWISE.

2	11.09.06	REAFFIRMED AND ISSUED AS STANDARD	MEENA	RKS/UC	VDS	VC
1	15.07.98	REVISED AND ISSUED AS STANDARD	OPC	PSC	MMK	A.SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman

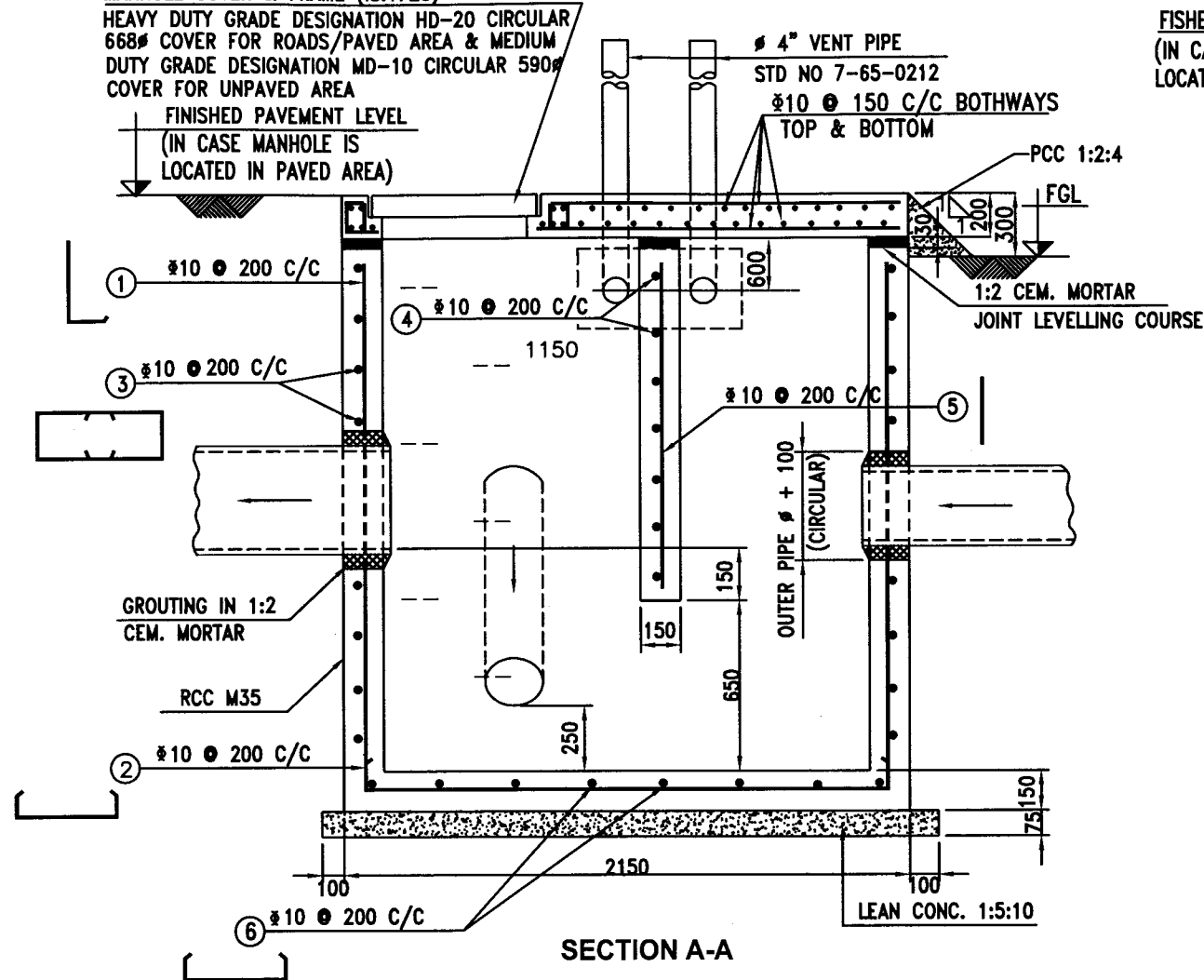


इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)	3	12.01.07	REVISED & ISSUED AS STANDARD	MEENA	VM/UCJ	VDS	VC	MANHOLE TYPE-6 FOR DEPTH ≤ 3M, (Ø ≤ 800)	STANDARD No.	
	2	15.12.98	REVISED & ISSUED AS STANDARD	AMIT	PCS	MMK	A.SONI		7-65-0256 Rev. 3	
	Rev.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman		Approved by	Page 1 of 1
	No.									

MANHOLE COVER & FRAME (IS:1726)

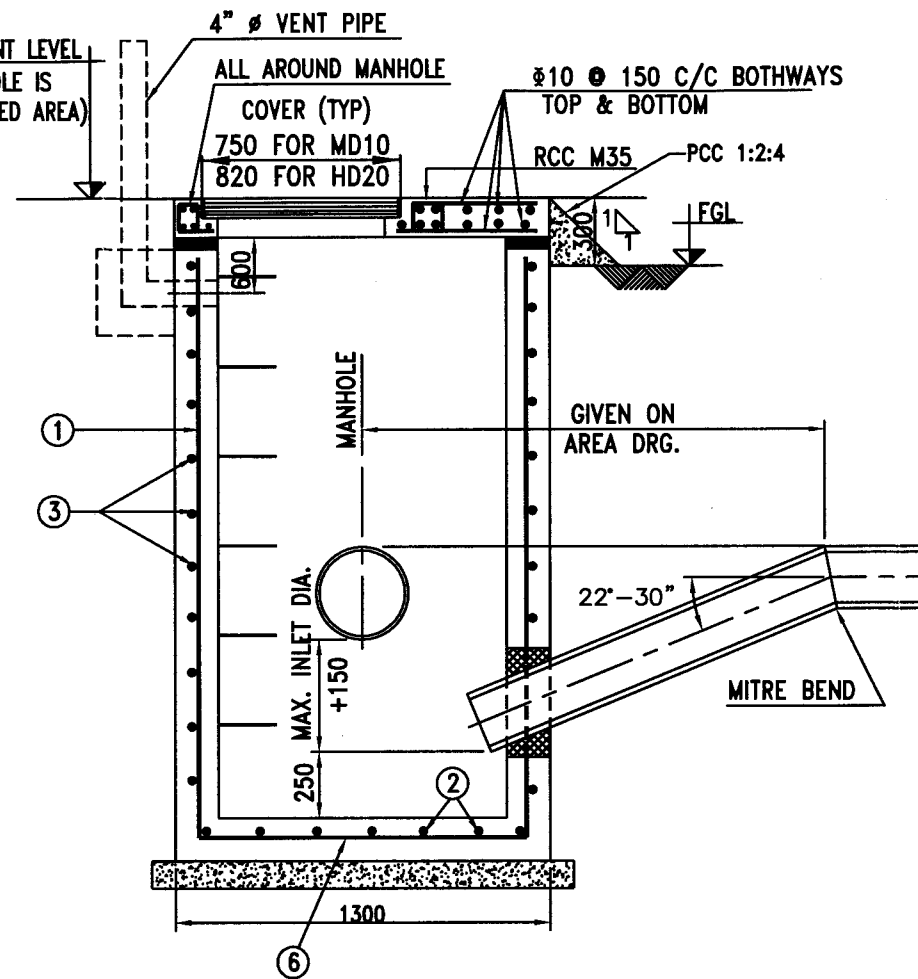
HEAVY DUTY GRADE DESIGNATION HD-20 CIRCULAR 668# COVER FOR ROADS/PAVED AREA & MEDIUM DUTY GRADE DESIGNATION MD-10 CIRCULAR 590# COVER FOR UNPAVED AREA

FINISHED PAVEMENT LEVEL
(IN CASE MANHOLE IS LOCATED IN PAVED AREA)

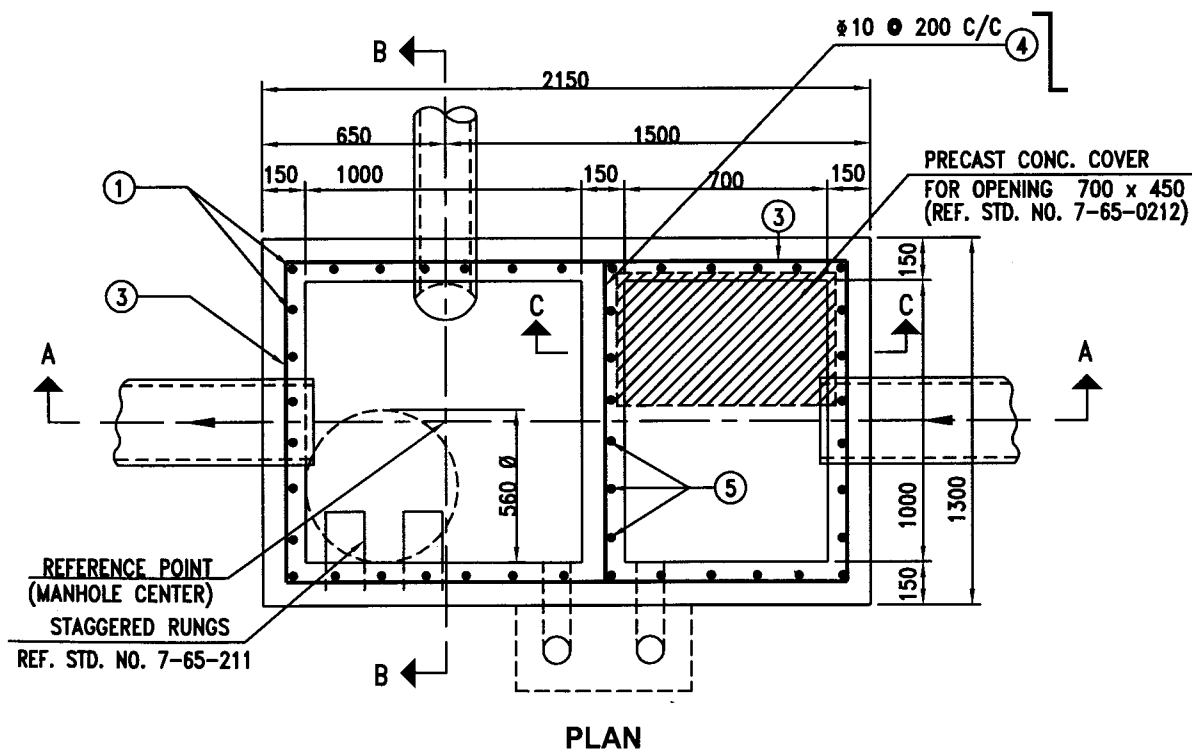
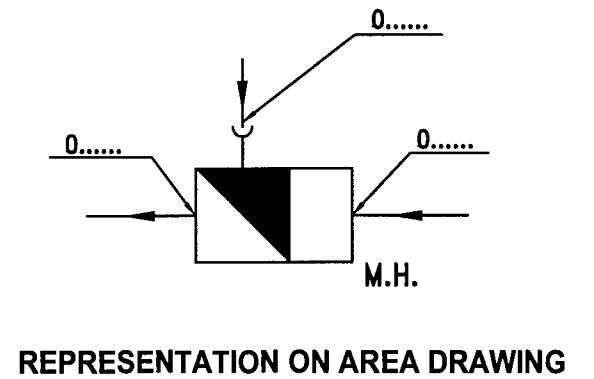


SECTION A-A

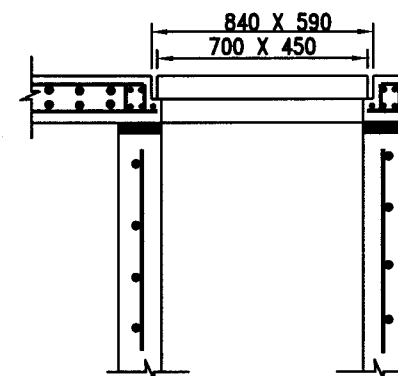
FISHED PAVEMENT LEVEL
(IN CASE MANHOLE IS LOCATED IN PAVED AREA)



SECTION-BB



PLAN

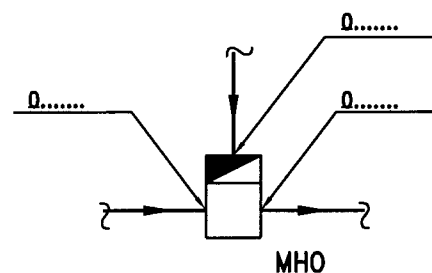
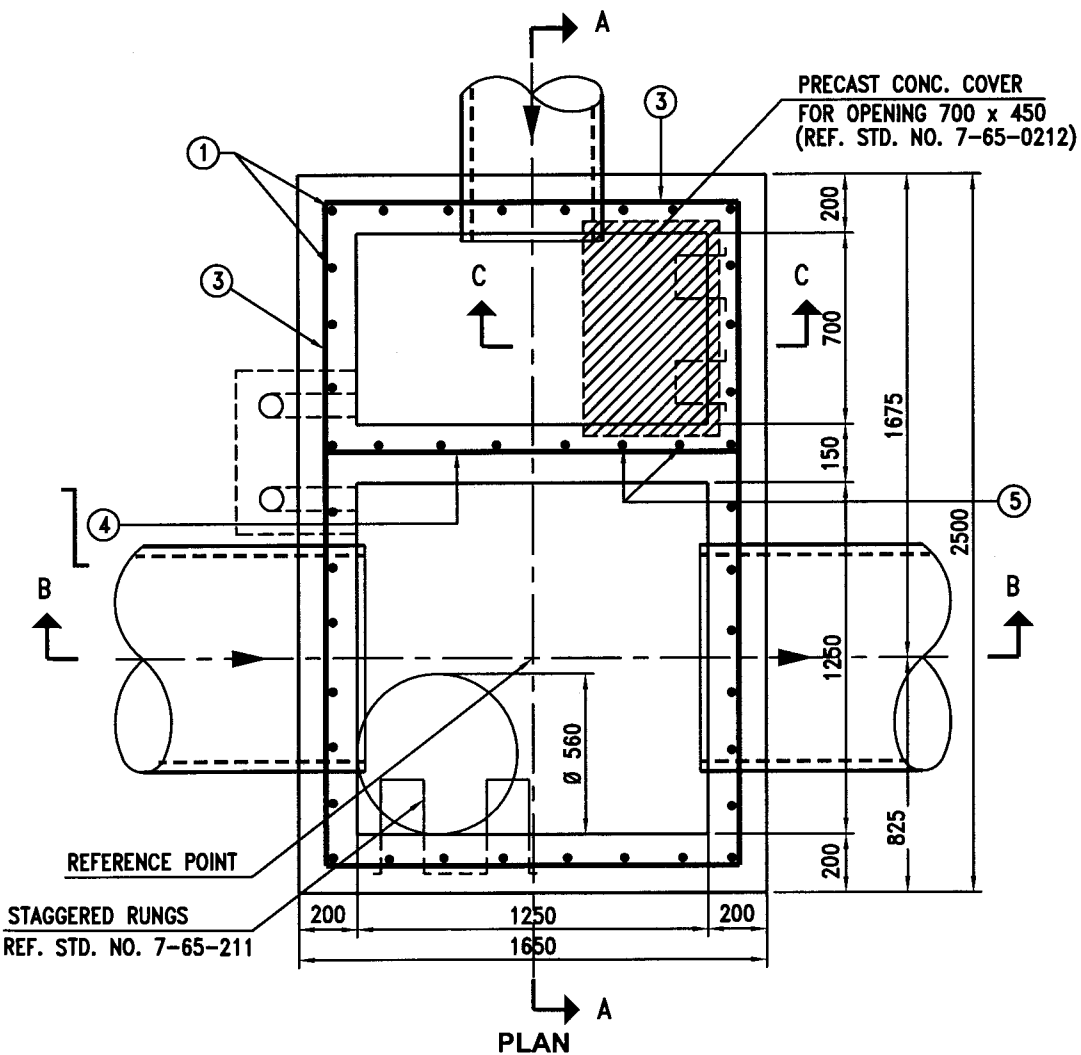
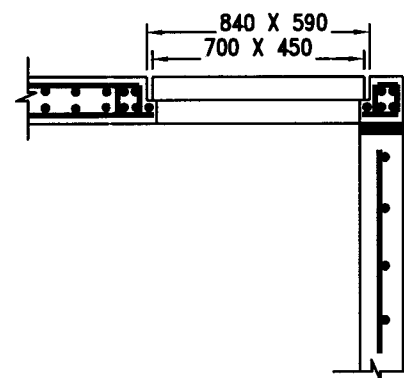
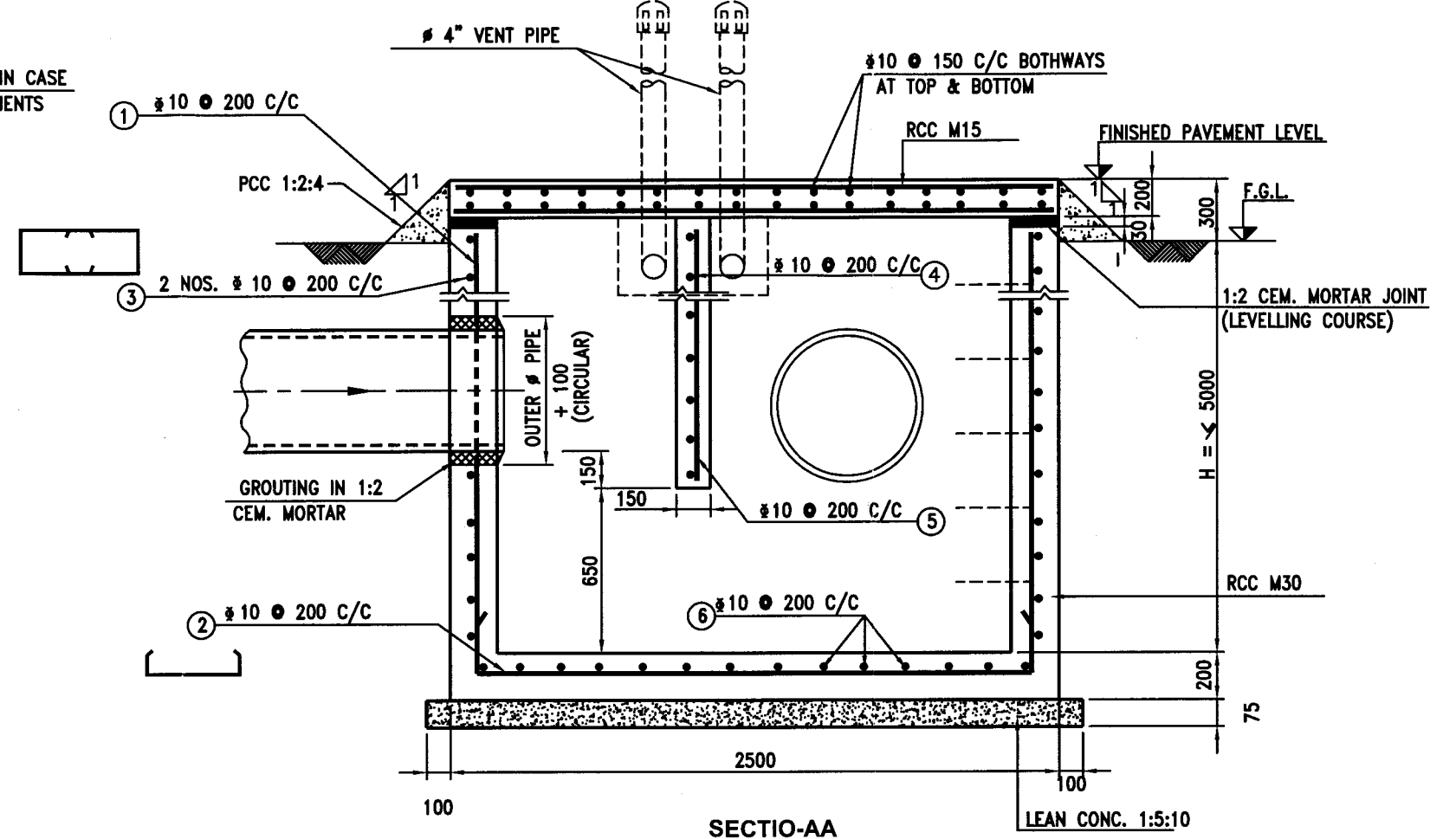
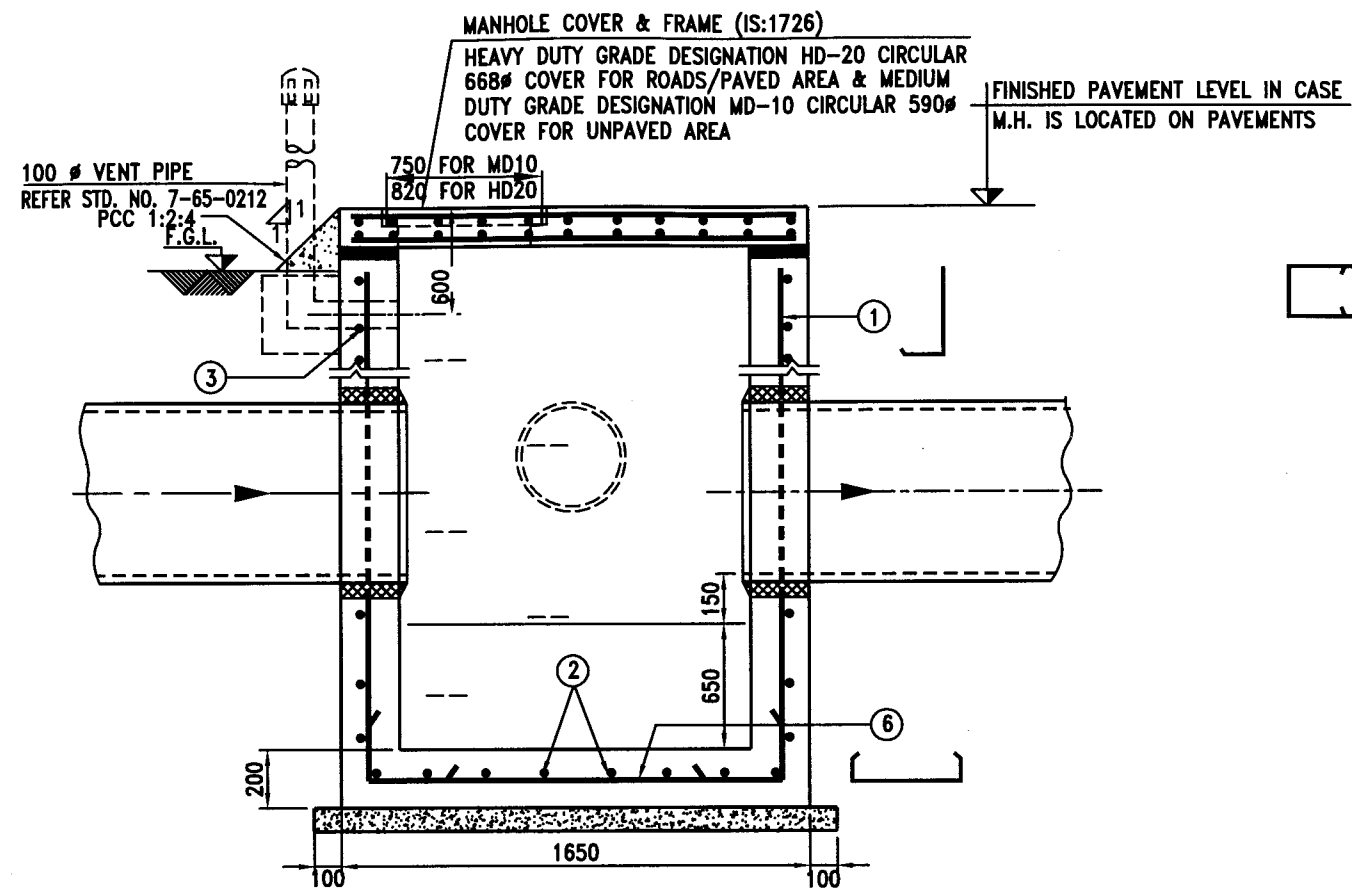


SECTION C-C

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRE UNLESS NOTED OTHERWISE.
2. ALL REINFORCEMENT SHALL BE OF GRADE Fe 415 CONFORMING TO IS:1786.
3. BAR BENDING SHALL CONFORM TO IS:2502.
4. THIS STANDARD SHALL BE READ ALONG WITH STD. NO. 7-65-0211, 0212, 0219 AND 0230.
5. CLEAR COVER TO REINFORCEMENT STEEL SHALL BE 45mm.
6. FOR AGGRESSIVE SOIL, CONCRETE GRADE M35 SHALL BE PROVIDED.
7. TOP SLAB SHALL BE CAST-IN-SITU AND REINFORCEMENT ON WALL SIDE OF MANHOLE OPENING SHALL BE ADJUSTED AT SITE.

3	26.12.07	REVISED AND ISSUED AS STANDARD	GAURAV	RKS	MMK	VC
2	15.12.92	REVISED AND ISSUED AS STANDARD	AMIT	PCS	MMK	A.SONI
Rev.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
No.					Approved by	

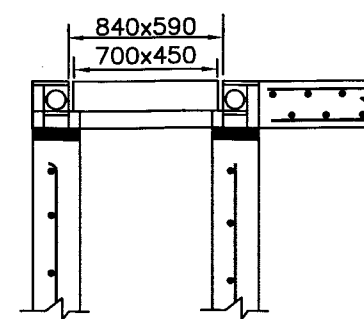
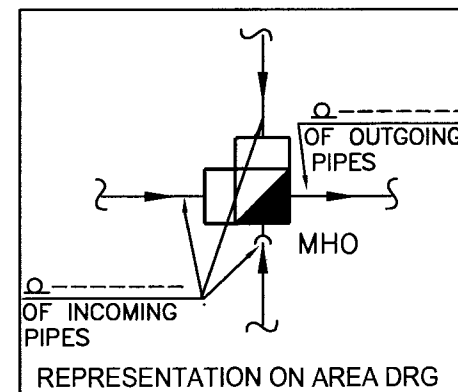
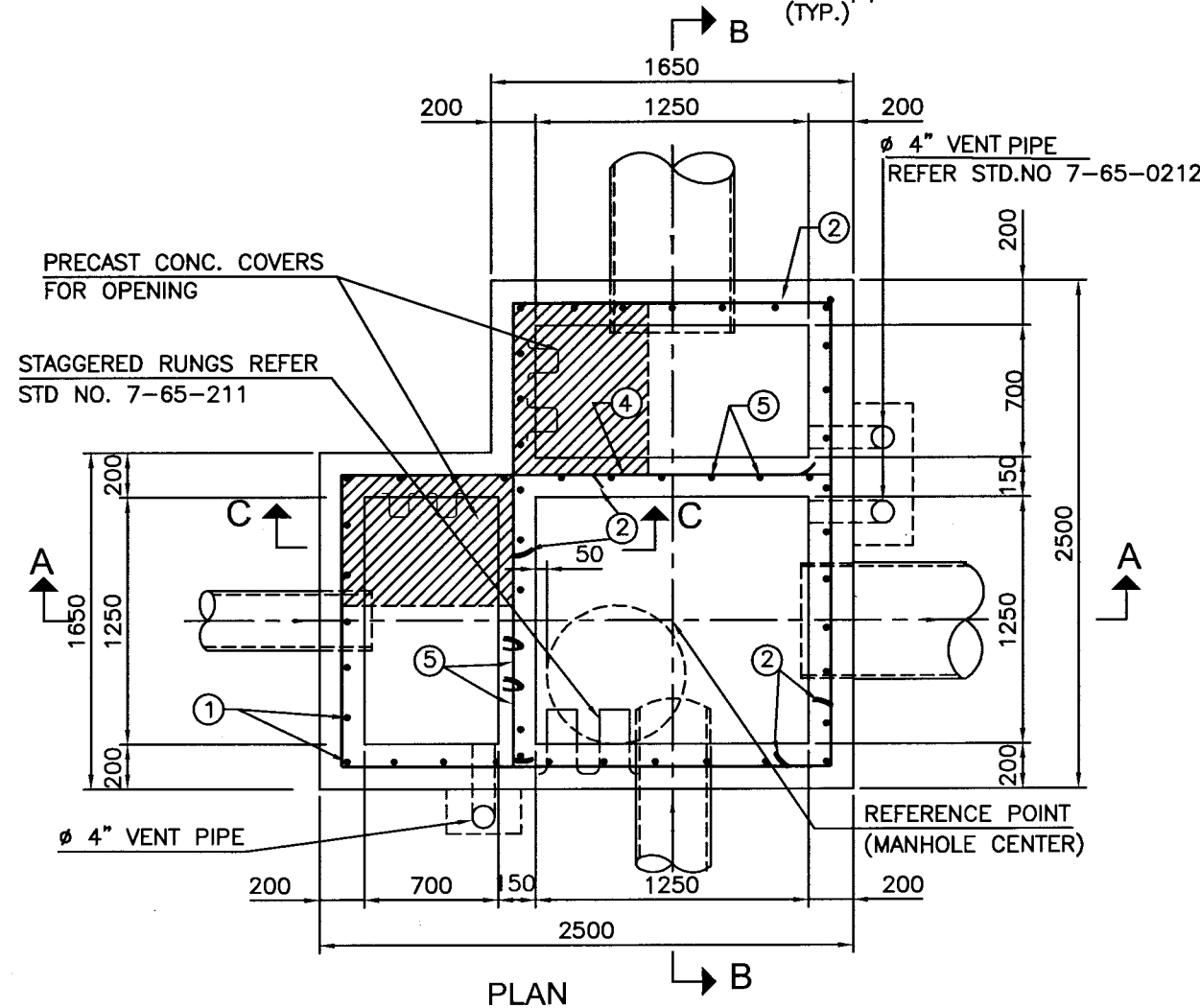
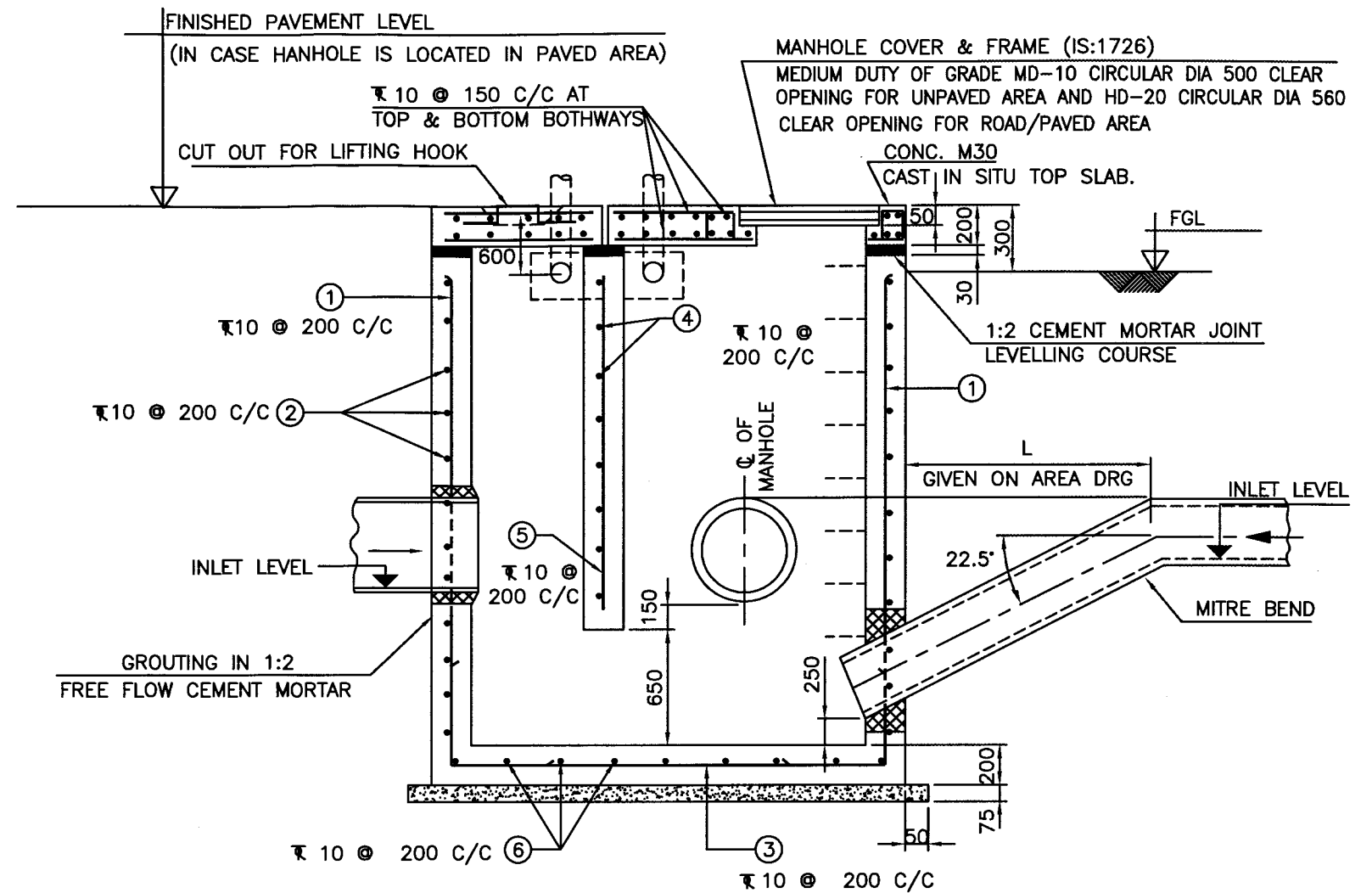
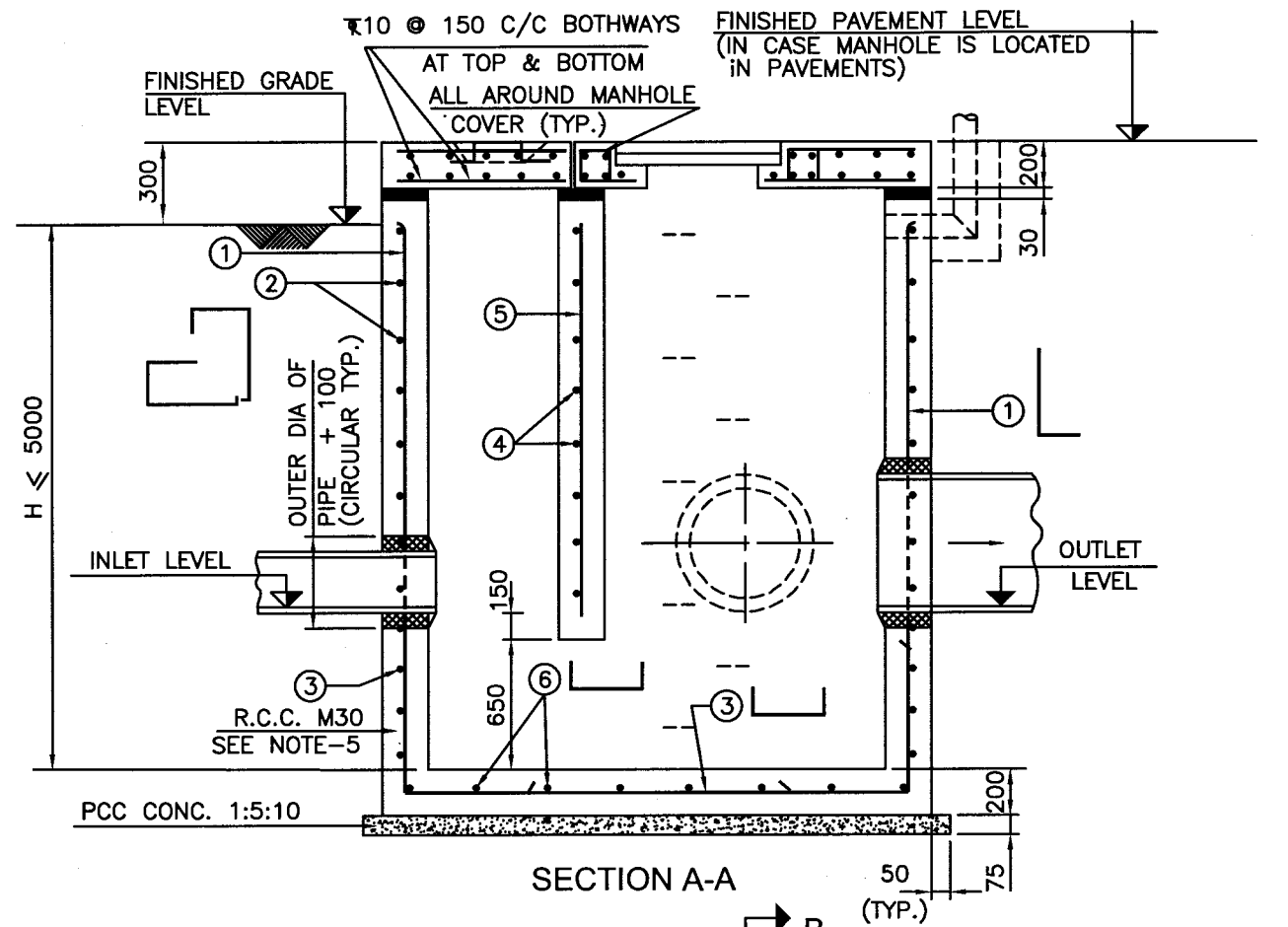


REPRESENTATION ON AREA DRG.

NOTES:

- ALL DIMENSIONS ARE IN MILLIMETRE UNLESS NOTED OTHERWISE.
- ALL REINFORCEMENT SHALL BE OF GRADE Fe 415 CONFORMING TO IS:1786.
- BAR BENDING SHALL CONFORM TO IS:2502.
- THIS STANDARD SHALL BE READ ALONG WITH STD. NO. 7-65-0211, 0212, 0219 AND 0230.
- CLEAR COVER TO REINFORCEMENT STEEL SHALL BE 45mm.
- FOR AGGRESSIVE SOIL, CONCRETE GRADE M35 SHALL BE PROVIDED.
- TOP SLAB SHALL BE CAST-IN-SITU AND REINFORCEMENT ON WALL SIDE OF MANHOLE OPENING SHALL BE ADJUSTED AT SITE.

3	26.12.07	REVISED AND ISSUED AS STANDARD	GAURAV	RKS	NK	VC
2	15.12.92	REVISED AND ISSUED AS STANDARD	AMIT	PCS	MMK	A.SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	



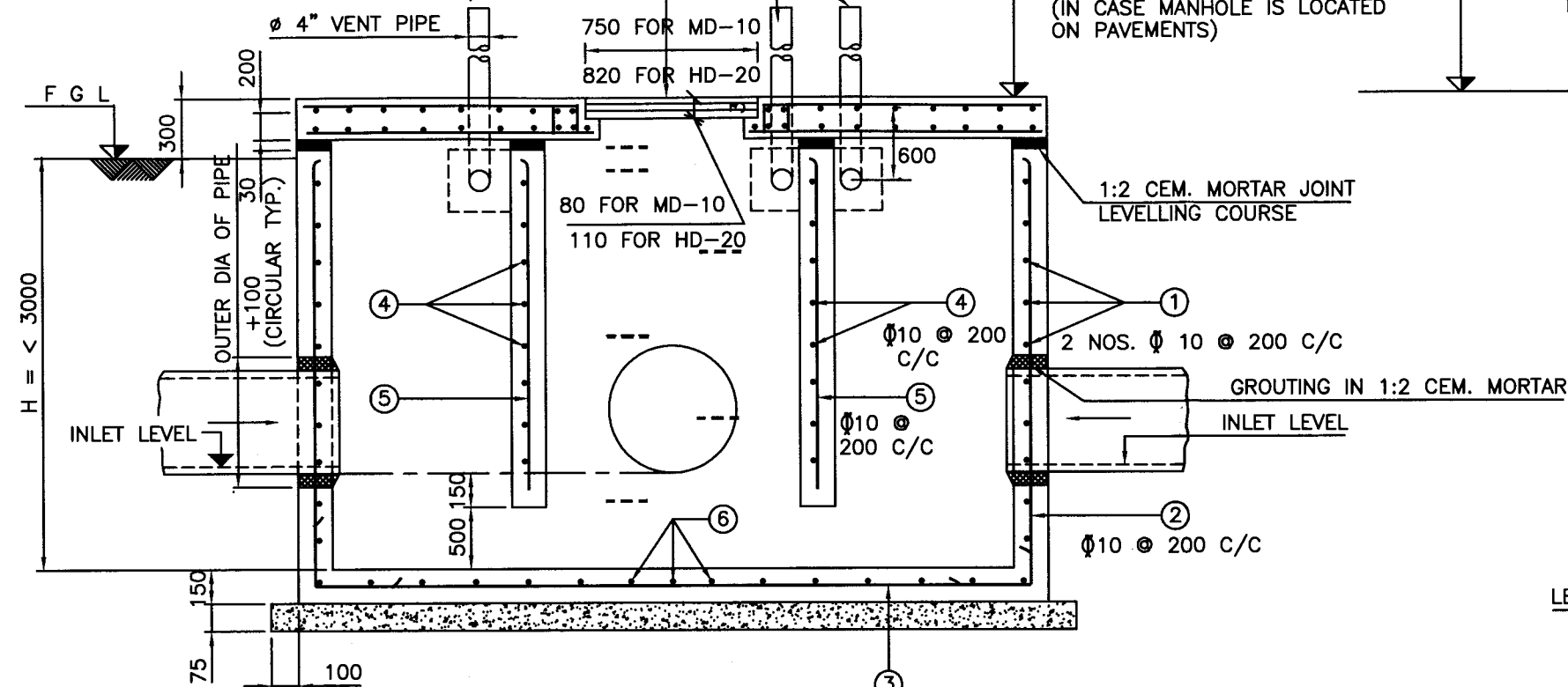
SECTION B-B

NOTES:-

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE
2. ALL REINFORCEMENT SHALL BE COLD TWISTED DEFORMED BARS CONFORMING TO IS:1786
3. BAR BENDING SHALL CONFORM TO IS:2502
4. THIS STANDARD SHALL BE READ ALONG WITH STD. NO 7-65-0212
5. FOR AGGRESSIVE SOIL CONCRETE GRADE M35 SHALL BE PROVIDED.

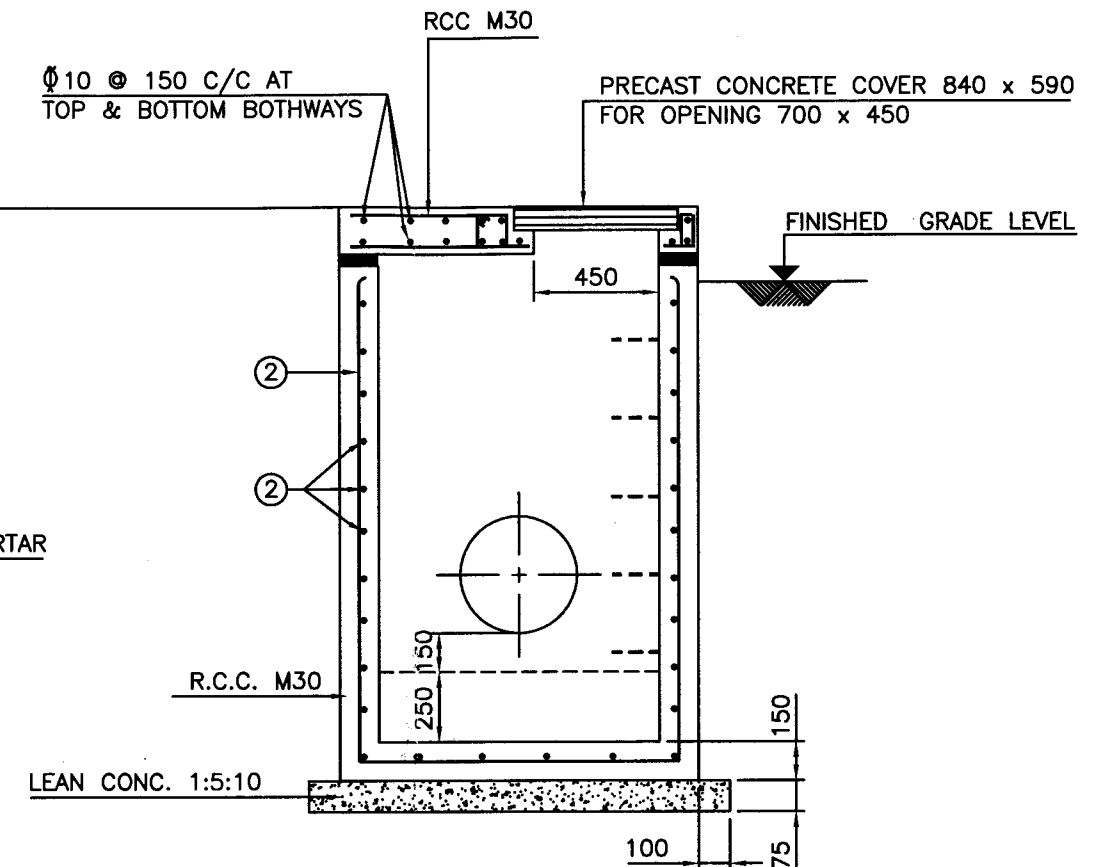
3	15/05/07	REVISED AND ISSUED AS STANDARD	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>
2	15/12/98	REVISED AND ISSUED AS STANDARD	AMIT	PCS	MMK	AS
Rev.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
No.					Approved by	

MANHOLE DUTY OF GRADE MD-10 CIRCULAR DIA.500
CLEAR OPENING FOR UNPAVED AREA AND HD-20
CIRCULAR DIA. 560 CLEAR OPENING FOR ROAD/PAVED AREA.

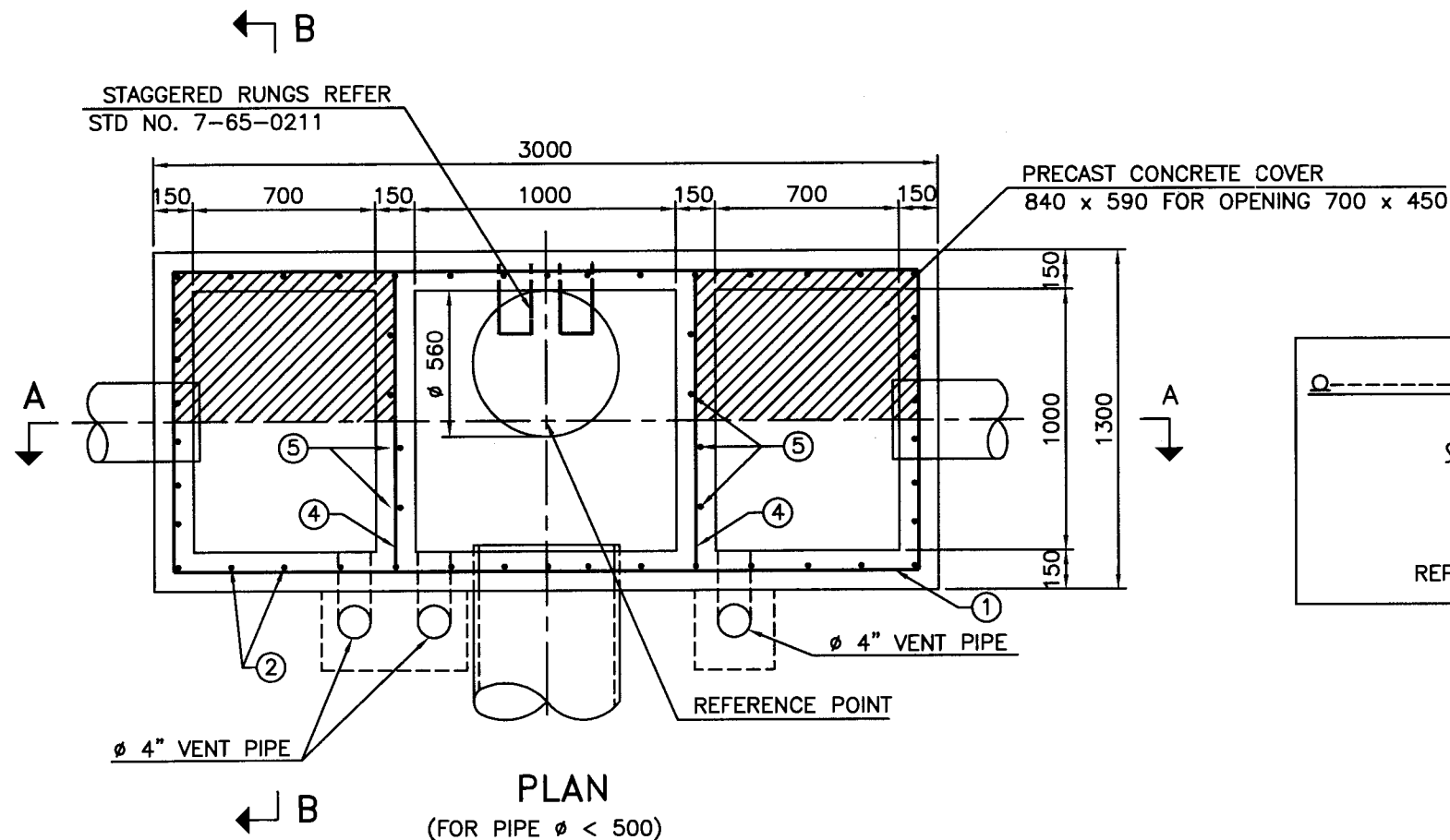


SECTION-A A

Ø 10 @ 200 C/C



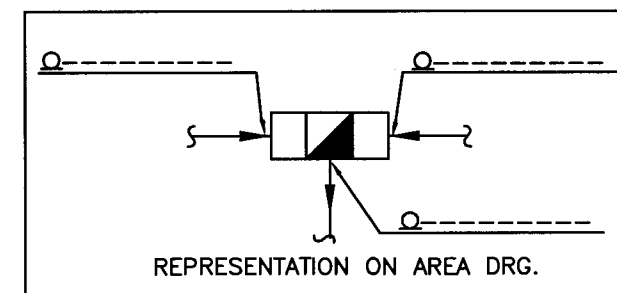
SECTION B-B



PLAN
(FOR PIPE Ø < 500)

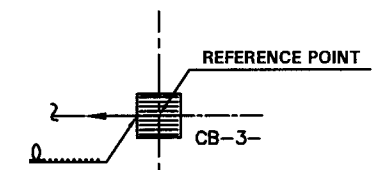
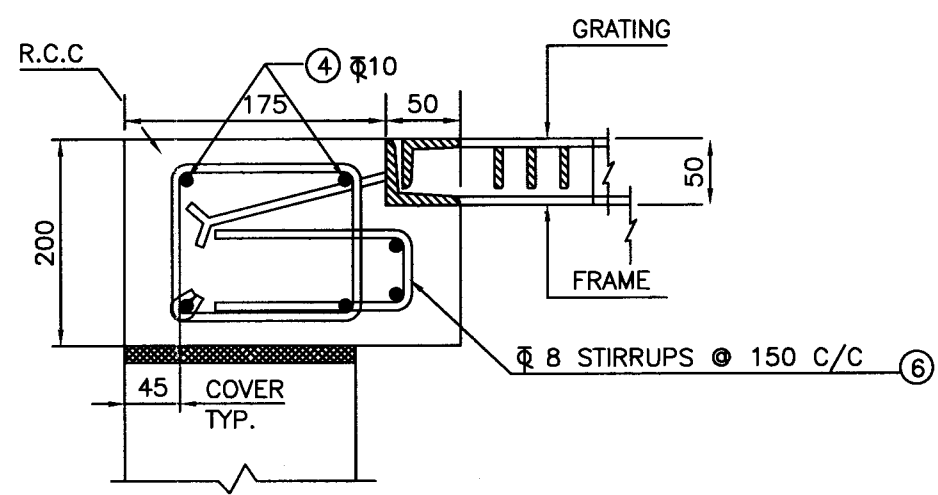
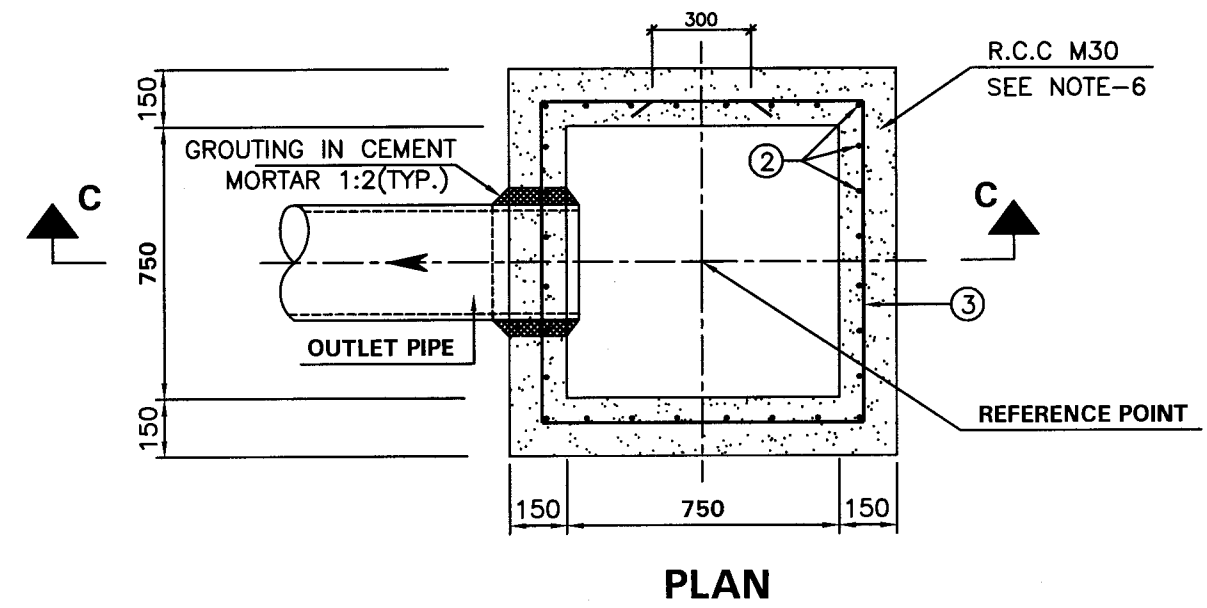
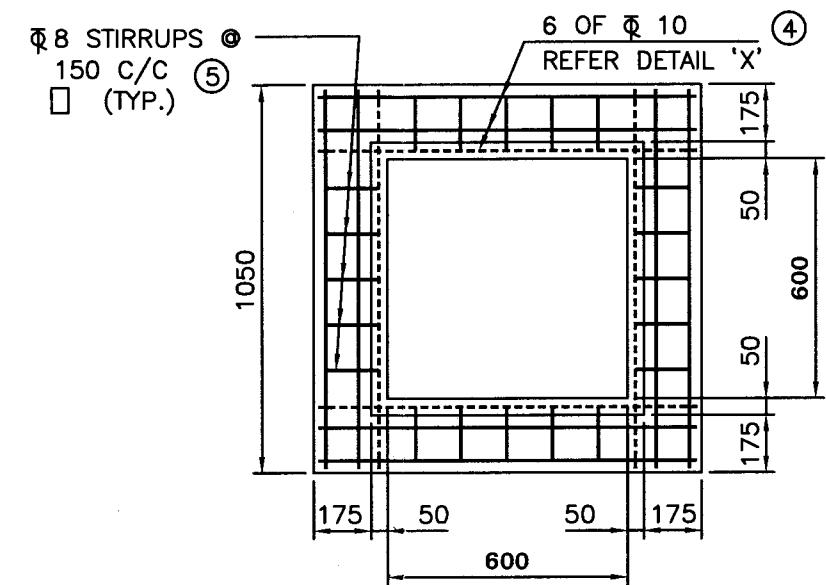
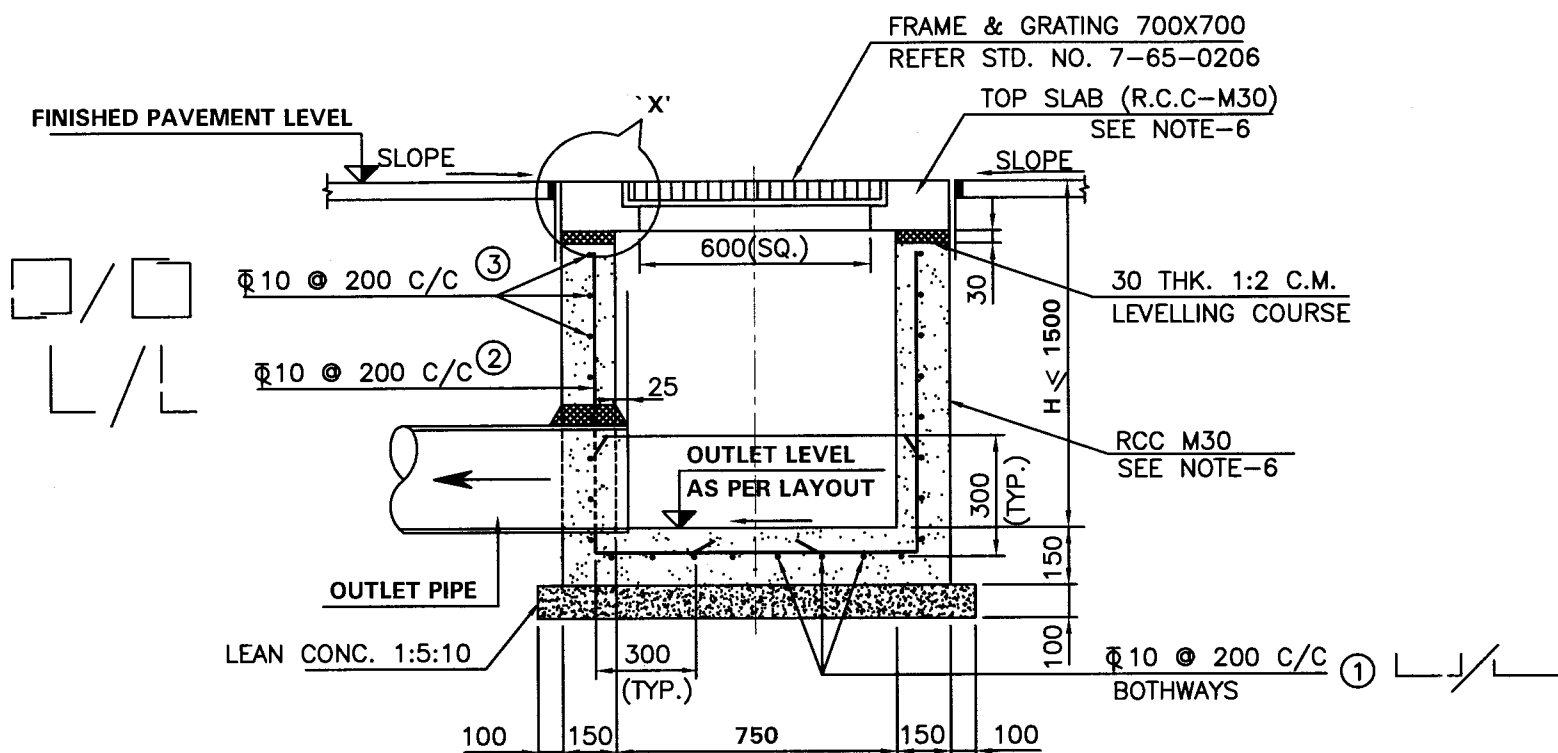
NOTES

1. ALL DIMENSIONS ARE IN MM UNLESS NOTED OTHERWISE
2. ALL REINFORCEMENT SHALL BE COLD TWISTED DEFORMED BARS CONFORMING TO IS:1786
3. BAR BENDING SHALL CONFORM TO IS:2502
4. THIS STANDARD SHALL BE READ ALONG WITH STD. NO 7-65-0212 & 0219.
5. TOP SLAB WALL SHALL BE CAST IN SITU AND REINF. ONE SIDES OF MANHOLE/PRECAST CONC.COVER SHALL BE SUITABLY ADJUSTED AT SITE.
6. FOR AGGRESSIVE SOIL CONCRETE GRADE M35 SHALL BE PROVIDED.



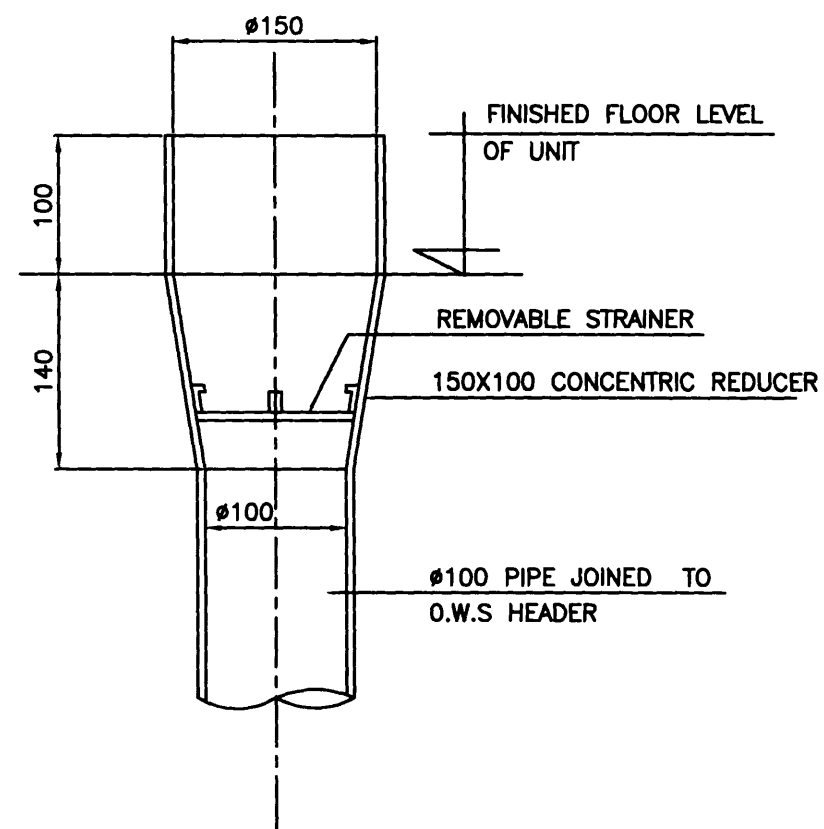
REPRESENTATION ON AREA DRG.

3	26.12.07	REVISED AND ISSUED AS STD.	MH	RKS	NK	VC
2	15.12.92	REVISED AND ISSUED AS STD.	AMIT	PCS	MMK	A.S
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
					Approved by	

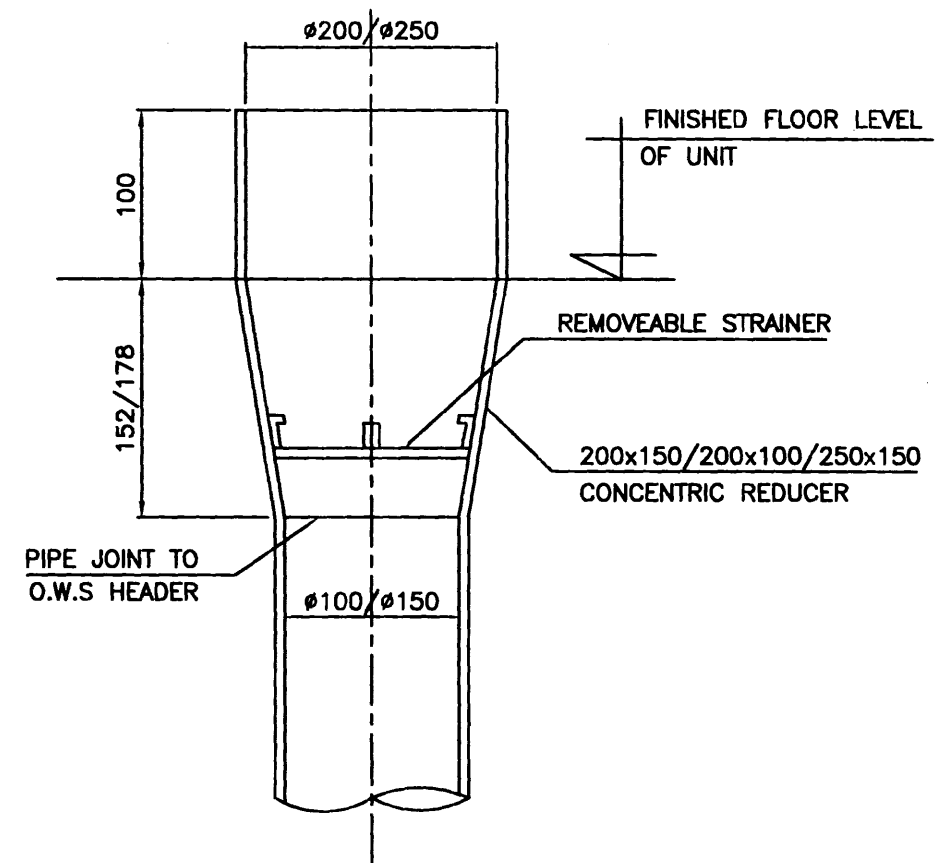


- NOTES:-**
1. ALL DIMENSIONS ARE IN MM. UNLESS NOTED OTHERWISE.
 2. BAR BENDING SHALL CONFORM TO IS:2502
 3. REINFORCEMENT SHALL BE OF GRADE Fe415 CONFORMING TO IS:1786.
 4. COVER TO REINFORCEMENT SHALL BE 45mm.
 5. FOR DETAILS OF BEND PIPE, REFER STD. NO. 7-65-0230.
 6. GRADE OF CONCRETE SHALL BE RCC. M30 FOR ORDINARY SOIL & FOR AGGRESSIVE SOIL, RCC M35 SHALL BE PROVIDED.

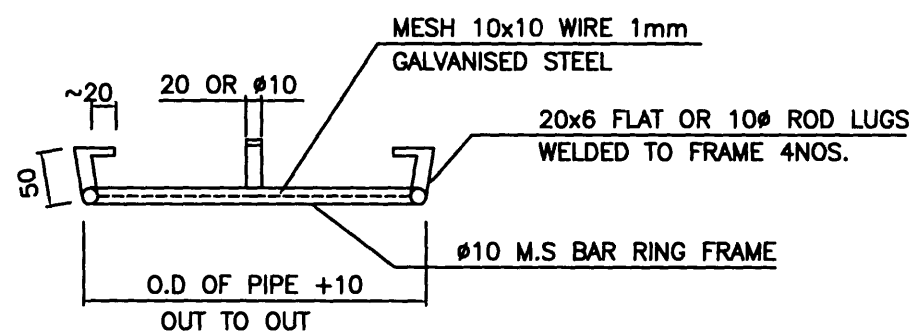
ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)	3	26.12.07	REVISED AND ISSUED AS STANDARD	GAURAV	PKS	NK	VC	UNIT DRAINAGE DETAILS (FOR CATCH BASIN TYPE-3)	STANDARD No.
	2	14.08.98	REVISED AND ISSUED AS STANDARD	HARISH	PCS	MMK	A.SONI		7-65-0265 Rev. 3
	Rev.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman		Page 1 of 1
	No.					Approved by			



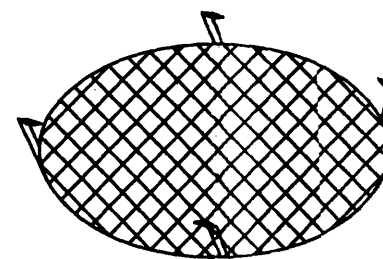
STANDARD EQUIPMENT
DRAIN FUNNEL



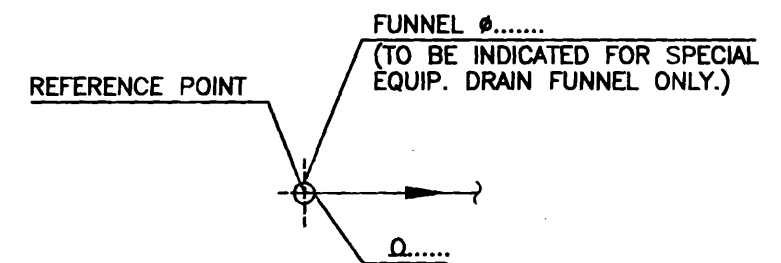
SPECIAL EQUIPMENT
DRAIN FUNNEL



DETAILS OF STRAINER



ISOMETRIC VIEW OF STRAINER

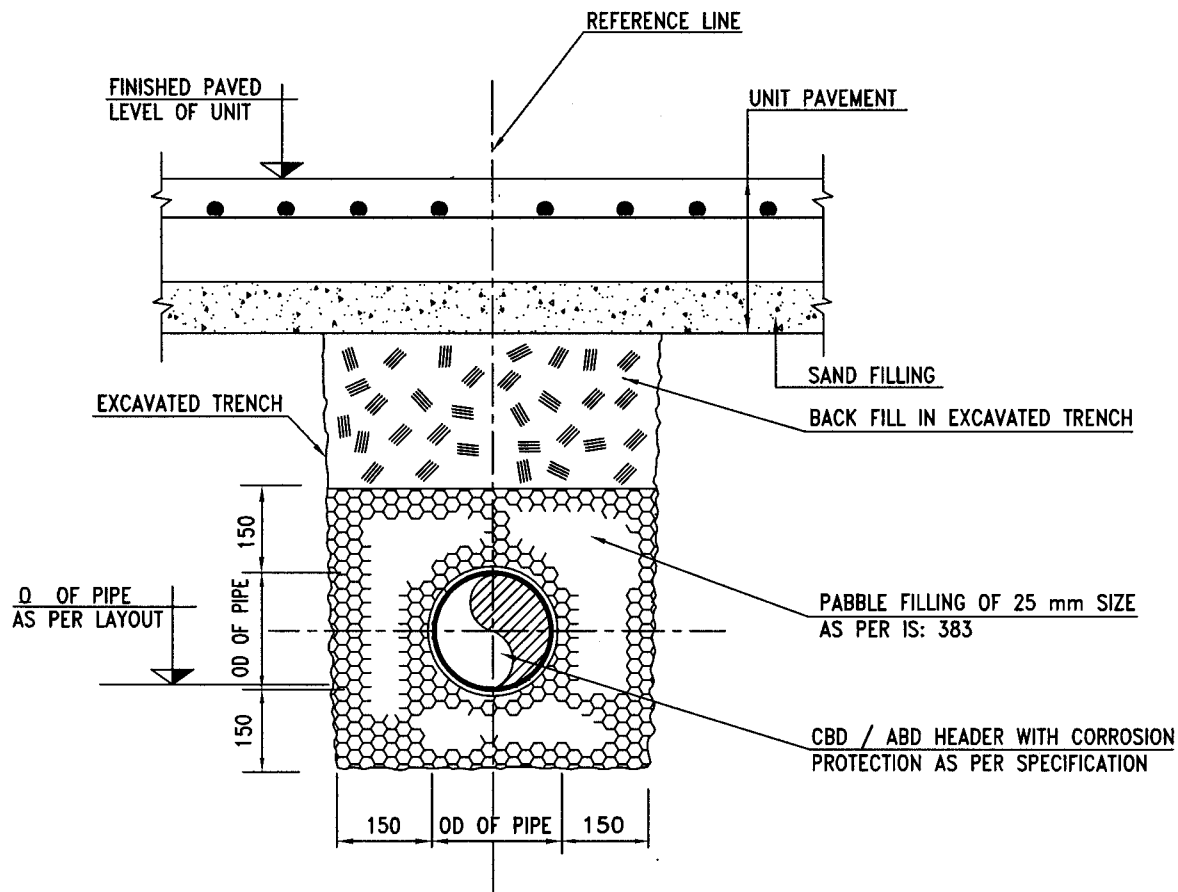


REPRESENTATION ON UNIT AREA DRG

NOTES:-

1. ALL DIMENSIONS ARE IN MM.

2	11.09.06	REAFFIRMED AND ISSUED AS STANDARD	MEENA	RKS/UCS	VDS	VC
1	14.08.98	REVISED & ISSUED AS STD.	HARISH	PCS	MMK	A. SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
					Approved by	



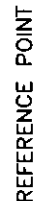
CROSS SECTION OF HEADER LAYING DETAIL

NOTE:-

1. ALL DIMENSIONS ARE IN MM.
2. PABBLE FILLING ALL AROUND THE CBD / ABD PIPE AFTER GIVING NECESSARY CORROSION PROTECTION AS PER SPECIFICATIONS, SHALL BE ENSURED ON HORIZONTAL AS WELL AS VERTICAL BRANCH LINE / RISER POINTS UPTO THE BOTTOM OF RCC PAVEMENT.

3	29.04.08	REAFFIRMED & ISSUED AS STANDARD	SKP	RKS	NK	VC
2	25.02.04	REVISED & ISSUED AS STANDARD	SSM	GG/SKC	AK	SKG
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman

1. ALL DIMENSIONS ARE IN MM.
2. ALL REINFORCEMENT SHOWN THUS Ø SHALL BE OF COLD TWISTED DEFORMED BARS CONFORMING TO IS:1786.
3. BAR BENDING SHALL CONFORM TO IS:2502.
4. THIS STANDARD SHALL BE READ ALONG WITH STD. NO. 7-65-0212.
5. FOR AGGRESSIVE SOIL, CONCRETE GRADE M35 SHALL BE PROVIDED.

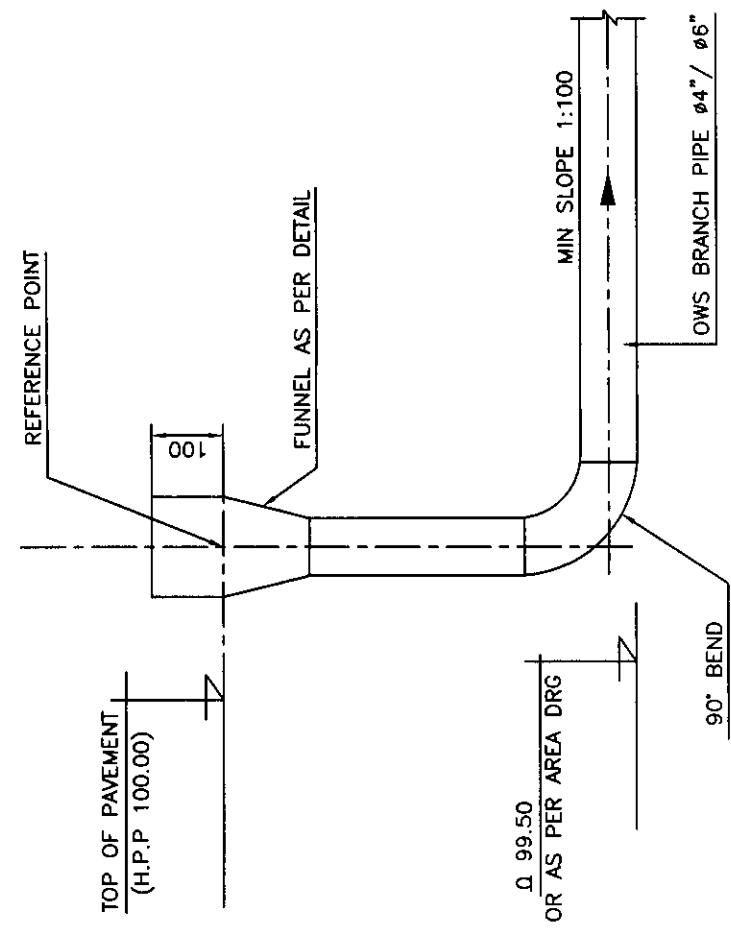


CLEAN OUT FOR C.B.D HEADER

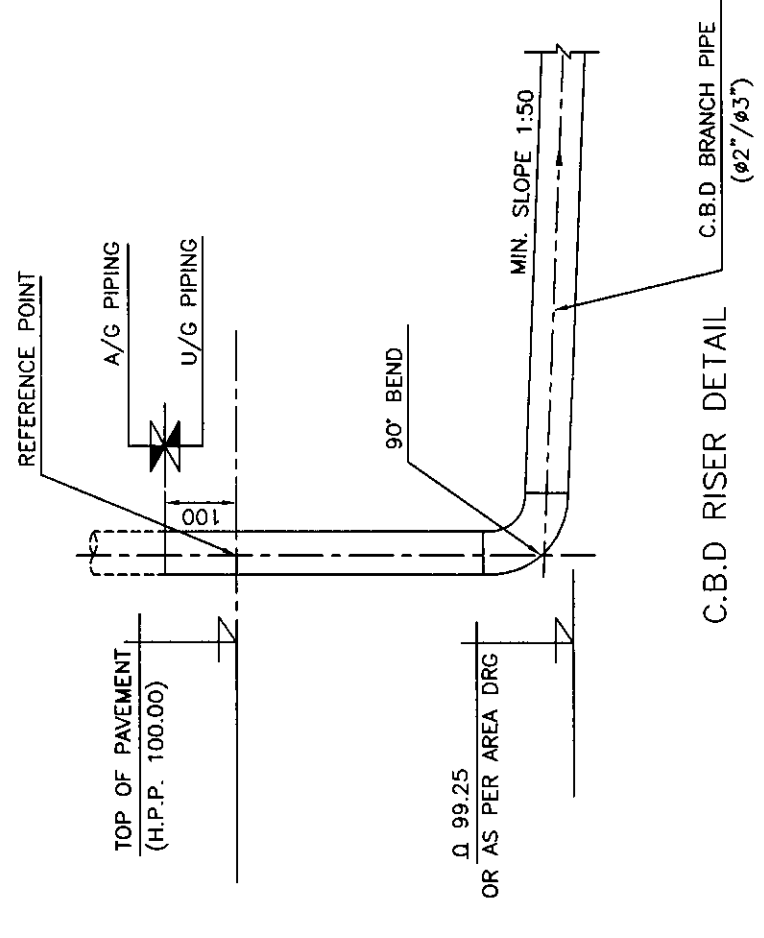


**PLAN FOR CHEQRD. PLATE
(2.NOS PER PIT)**

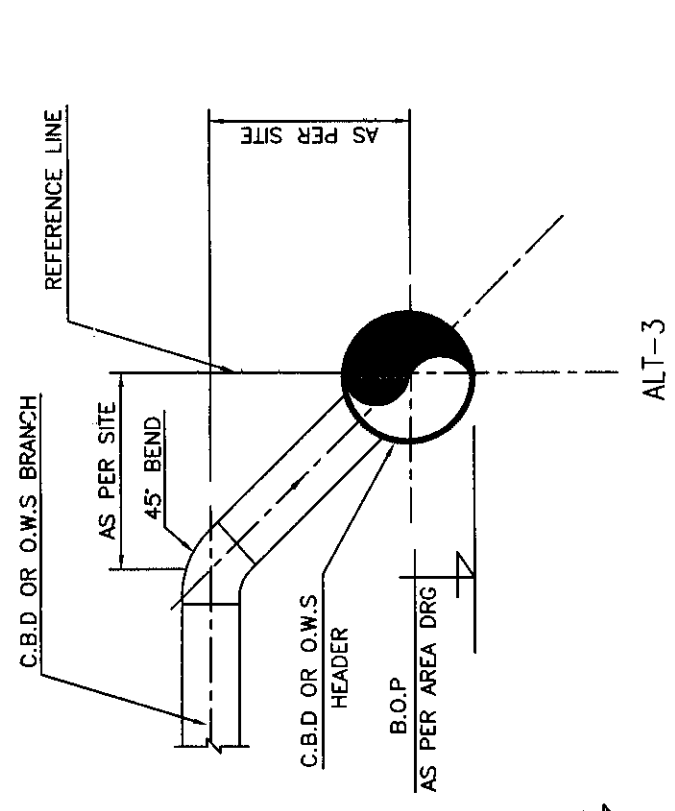
Format No. 8-00-0001-F5 Rev. 0



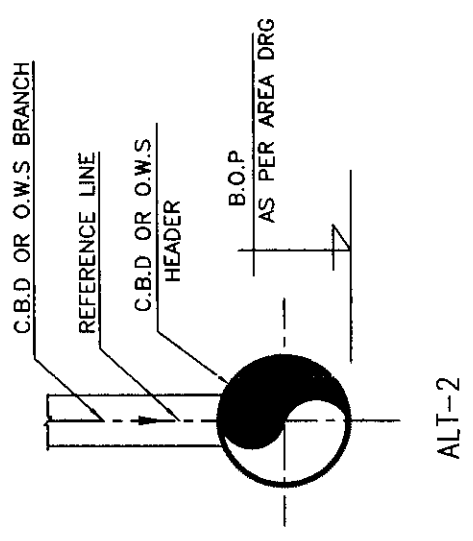
O.W.S FUNNEL DETAIL



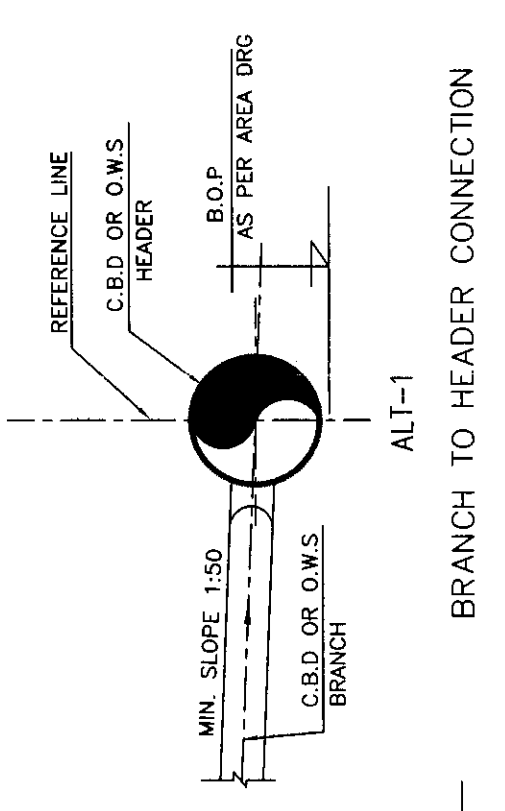
C.B.D RISER DETAIL



ALT-3



ALT-2

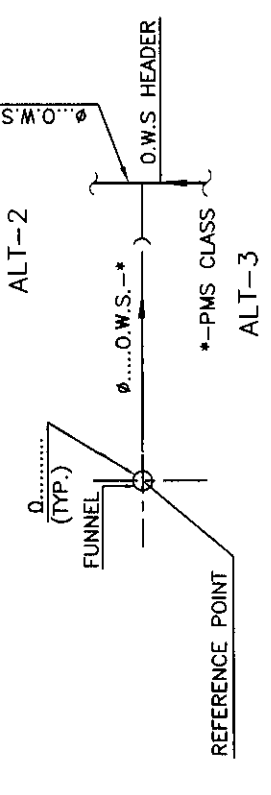
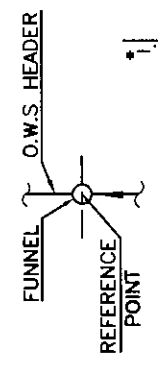
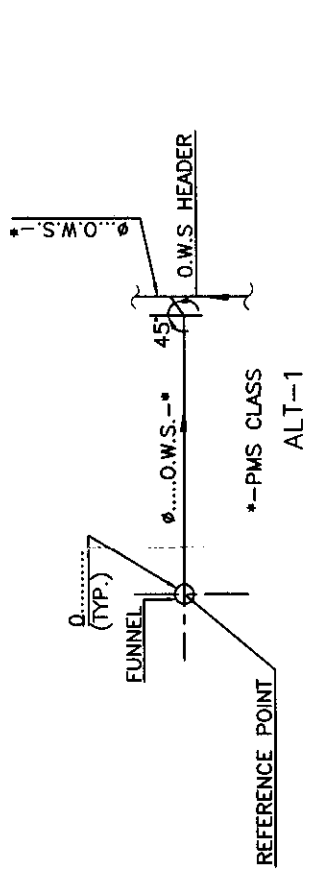


ALT-1

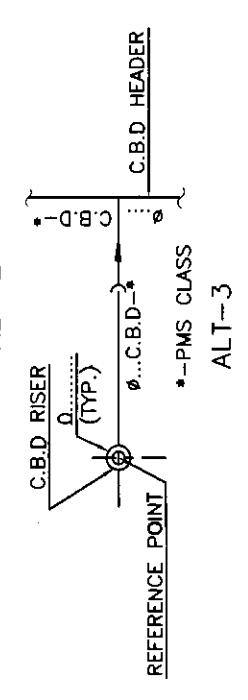
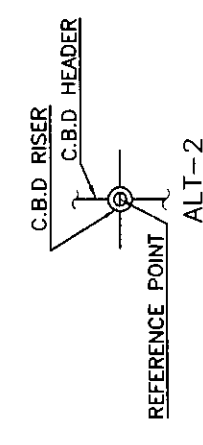
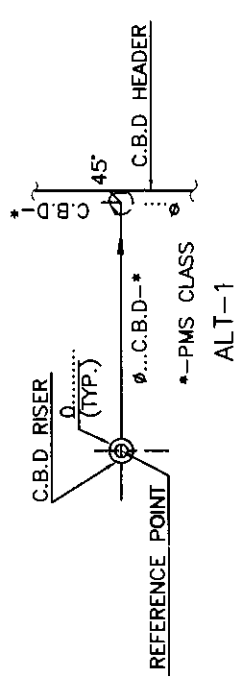
BRANCH TO HEADER CONNECTION

TYPICAL BRANCH CONNECTION FOR C.B.D AND O.W.S

NOTES: -
1. ALL DIMENSIONS ARE IN MILLIMETRE AND LEVELS IN METRE UNLESS STATED OTHER WISE.

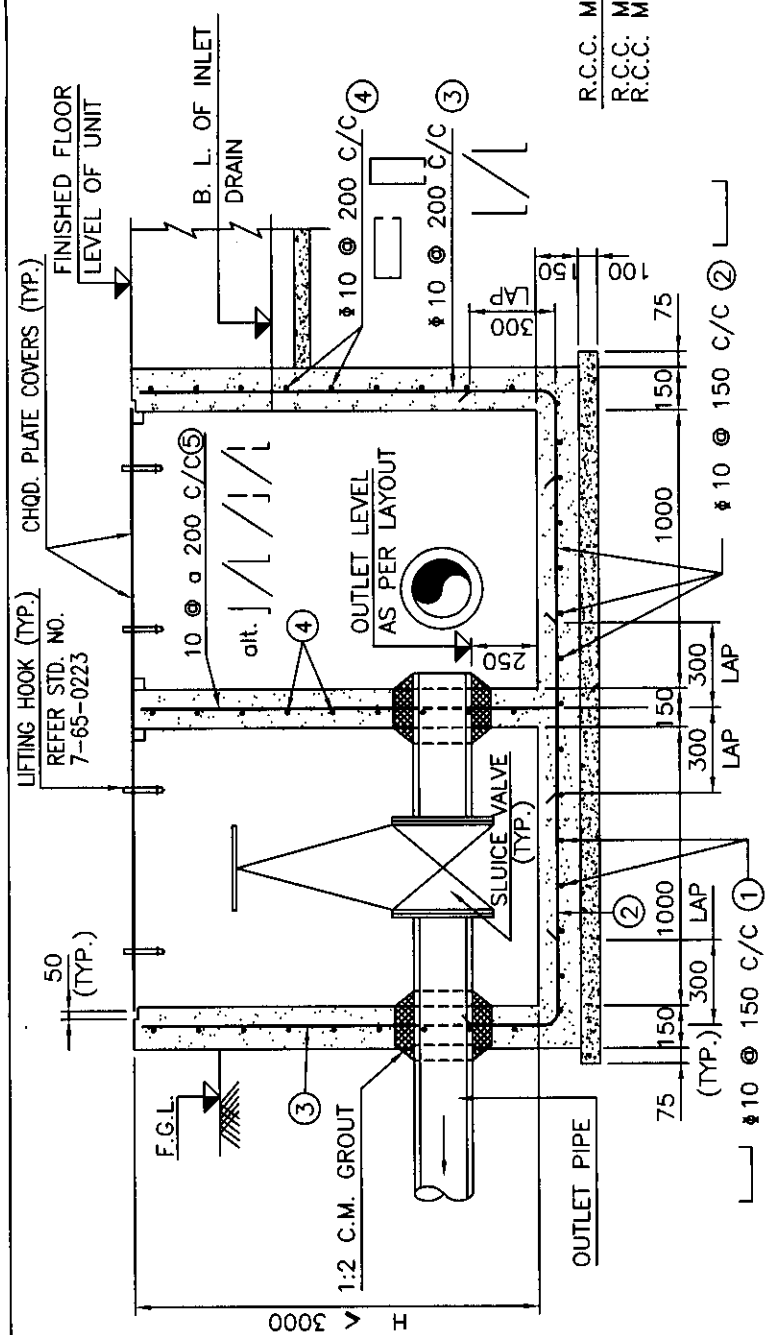


O.W.S REPRESENTATION ON UNIT AREA DRG.

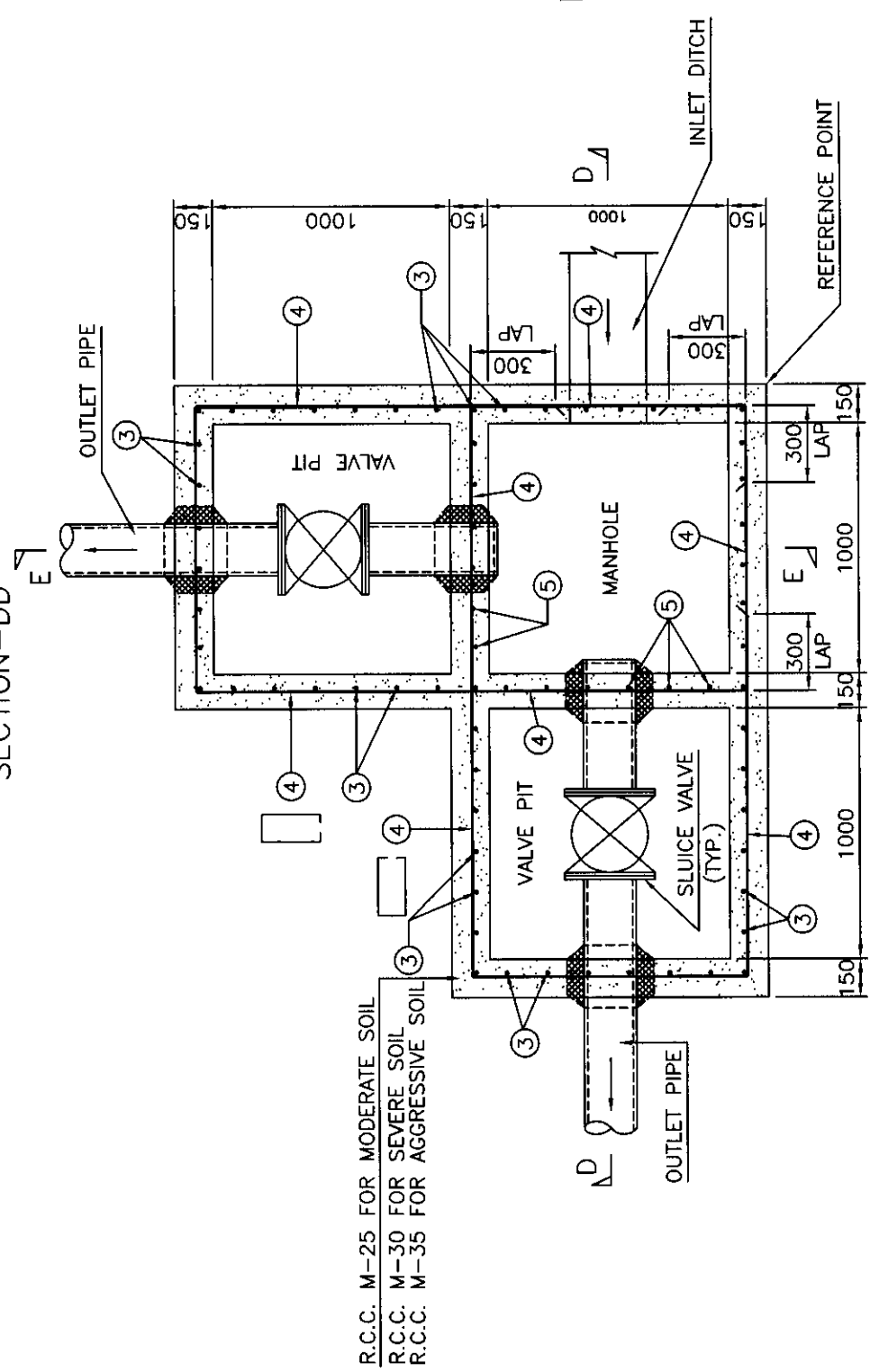


C.B.D REPRESENTATION ON UNIT AREA DRG

MANAS DCB NK VC
HARISH PCS VDS A. SONI
Prepared Checked by
by Approved by
Sds. Committee
Sds. Bureau
Chairman

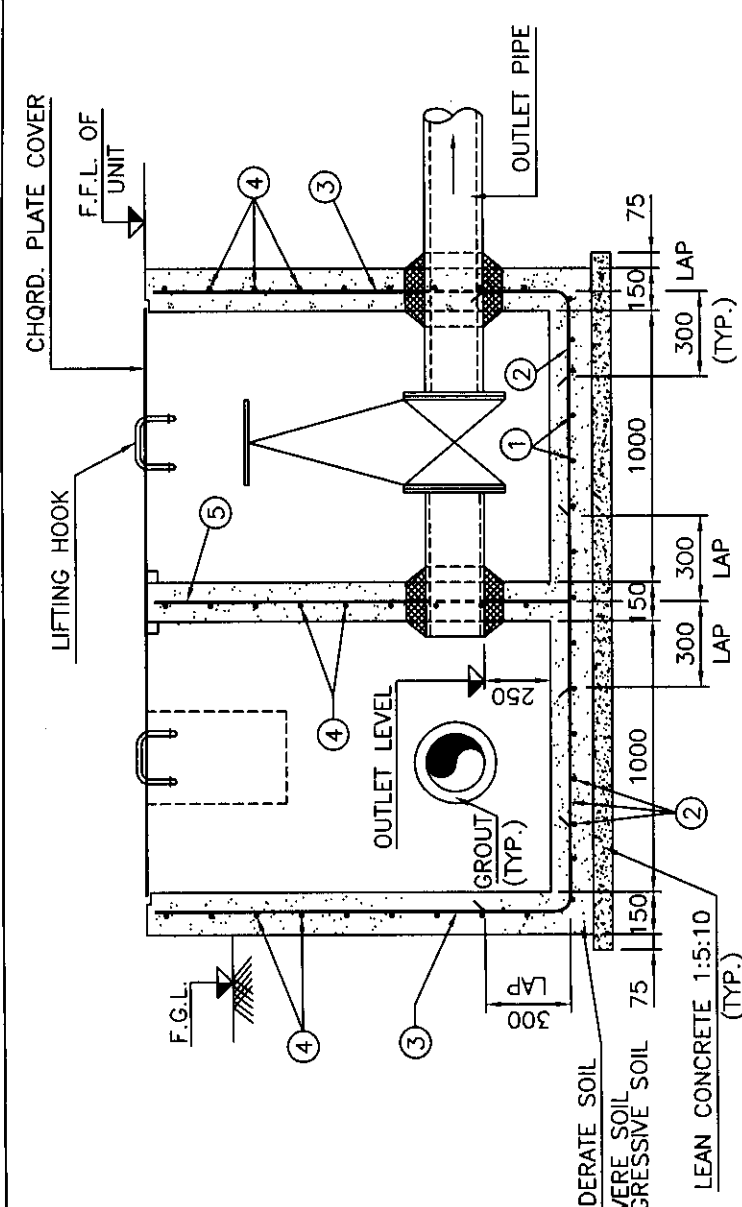


SECTION-DD

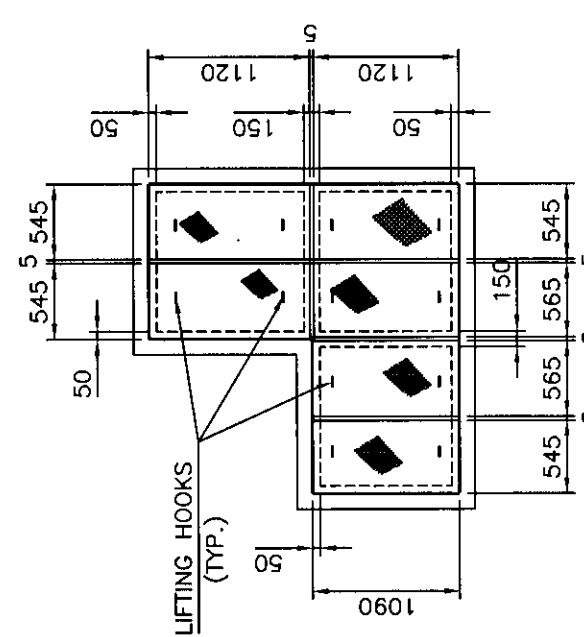


PLAN

MANHOLE COMBINED WITH DOUBLE VALVE PITS

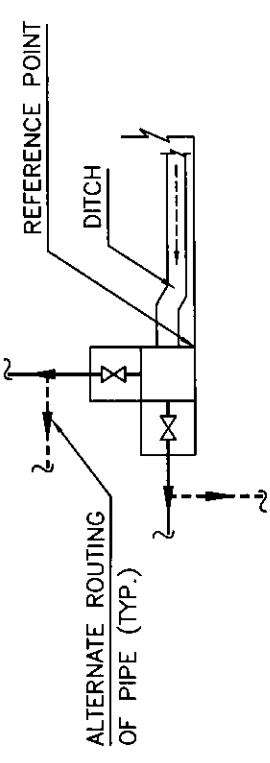


SECTION E-E



LAYOUT OF CHQD. PLATE COVERS

6 NOS. (REFER STD. NO. 7-65-0223)



REPRESENTATION ON UNIT AREA DRG.

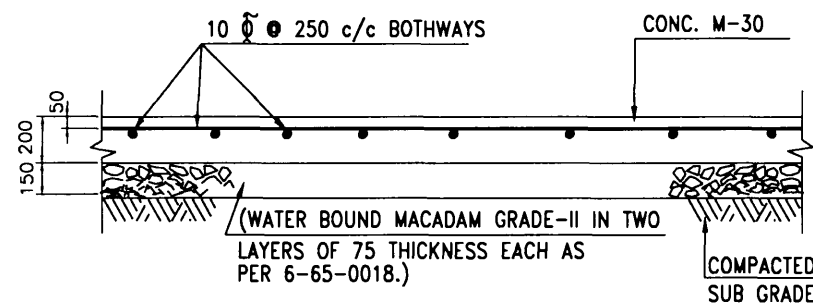
NOTES:-

1. ALL DIMENSIONS ARE IN MM.
2. ALL REINFORCEMENT SHOWN THUS Φ SHALL BE OF COLD TWISTED DEFORMED BARS CONFORMING TO IS:1786
3. BAR BENDING SHALL CONFORM TO IS:2502

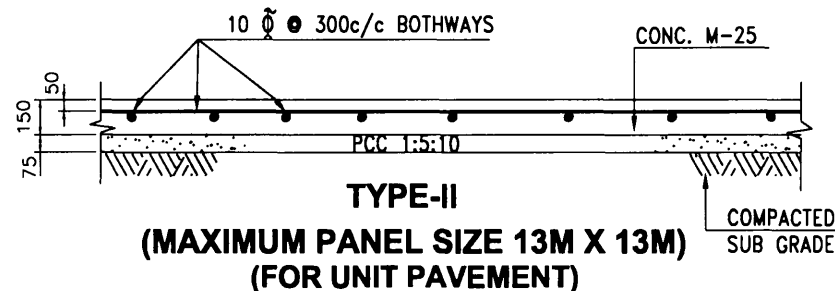
R.C.C. M-25 FOR MODERATE SOIL
R.C.C. M-30 FOR SEVERE SOIL
R.C.C. M-35 FOR AGGRESSIVE SOIL

R.C.C. M-25 FOR MODERATE SOIL
R.C.C. M-30 FOR SEVERE SOIL
R.C.C. M-35 FOR AGGRESSIVE SOIL

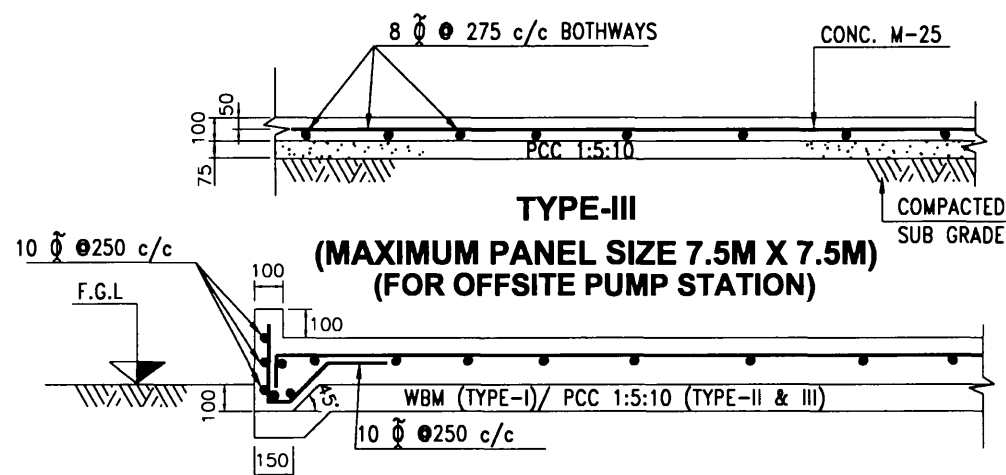
			3	08.10.07	REVISED AND ISSUED AS STD.	SK	SKN	NK	VC	UNIT DRAINAGE DETAILS (MANHOLE COMBINED WITH DOUBLE VALVE PITS)		STANDARD No.
			2	14.08.98	REVISED AND ISSUED AS STD.	HARISH	PCS	MMK	AS			7-65-0273 Rev. 3
Rev.			No.	Date	Purpose	Prepared	Checked	Sds. Committee Convenor	Stds. Bureau Chairman			Page 1 of 1
						by	by	Approved by				Copyright EIL - All rights reserved



TYPE-I
(MAXIMUM PANEL SIZE 14M X 14M)
(FOR VEHICULAR MOVEMENT AREA)



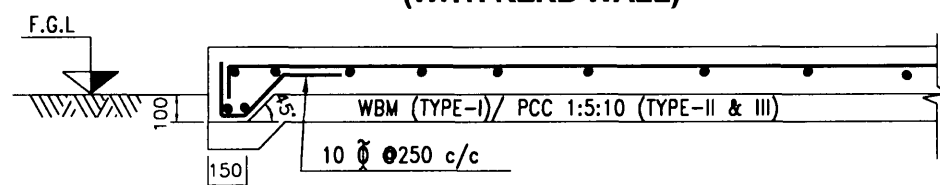
TYPE-II
(MAXIMUM PANEL SIZE 13M X 13M)
(FOR UNIT PAVEMENT)



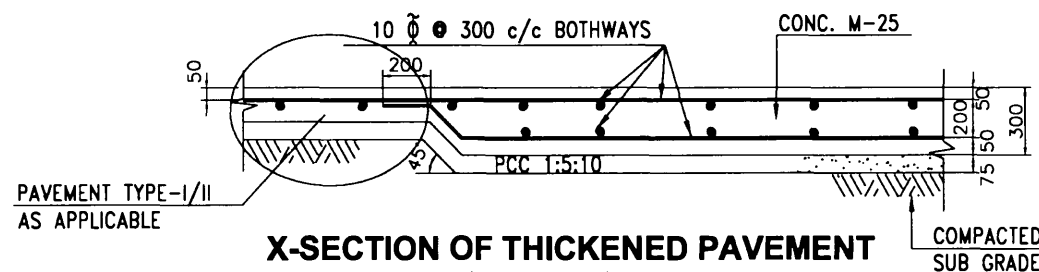
TYPE-III

(MAXIMUM PANEL SIZE 7.5M X 7.5M)
(FOR OFFSITE PUMP STATION)

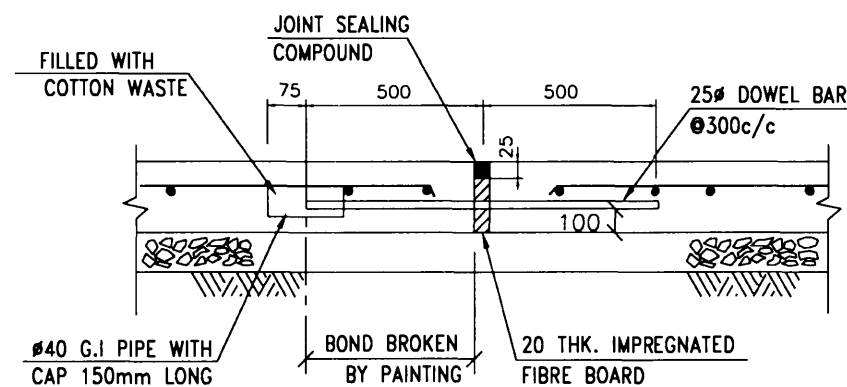
**TYP. EDGE DETAIL DEPENDING ON TYPE OF PAVEMENT
(WITH KERB WALL)**



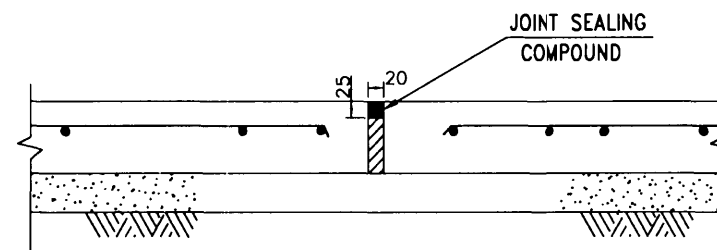
**TYP. EDGE DETAIL DEPENDING ON TYPE OF PAVEMENT
(WITHOUT KERB WALL)**



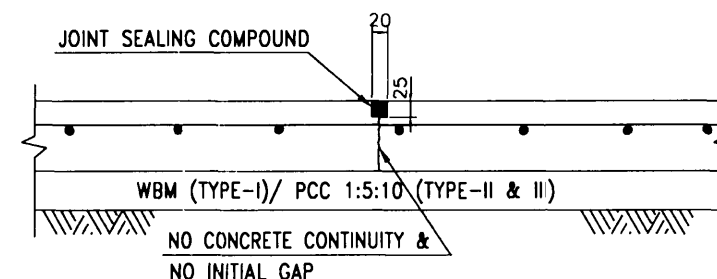
X-SECTION OF THICKENED PAVEMENT
(SEE NOTE-14)



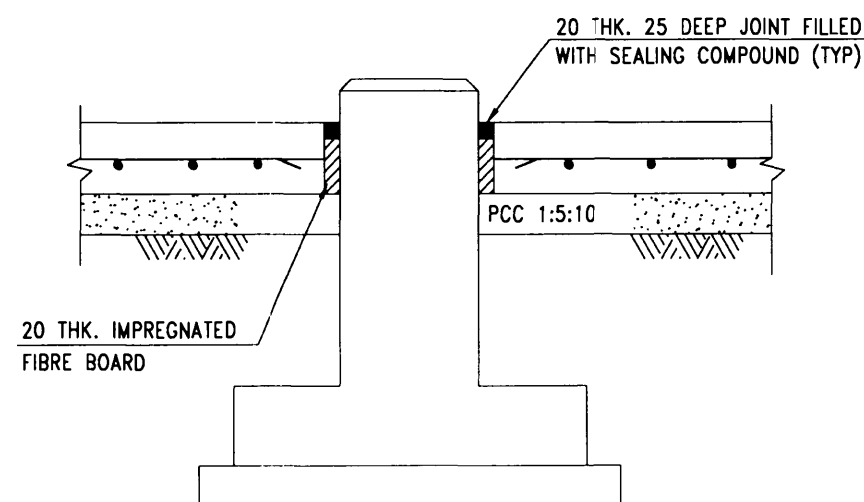
**DETAIL OF EXPANSION JOINT
(FOR TYPE-I PAVEMENT)**



**DETAIL OF EXPANSION JOINT
(FOR TYPE-II & III PAVEMENT)**



DETAIL OF CONSTRUCTION JOINT
(SEE NOTE-13)

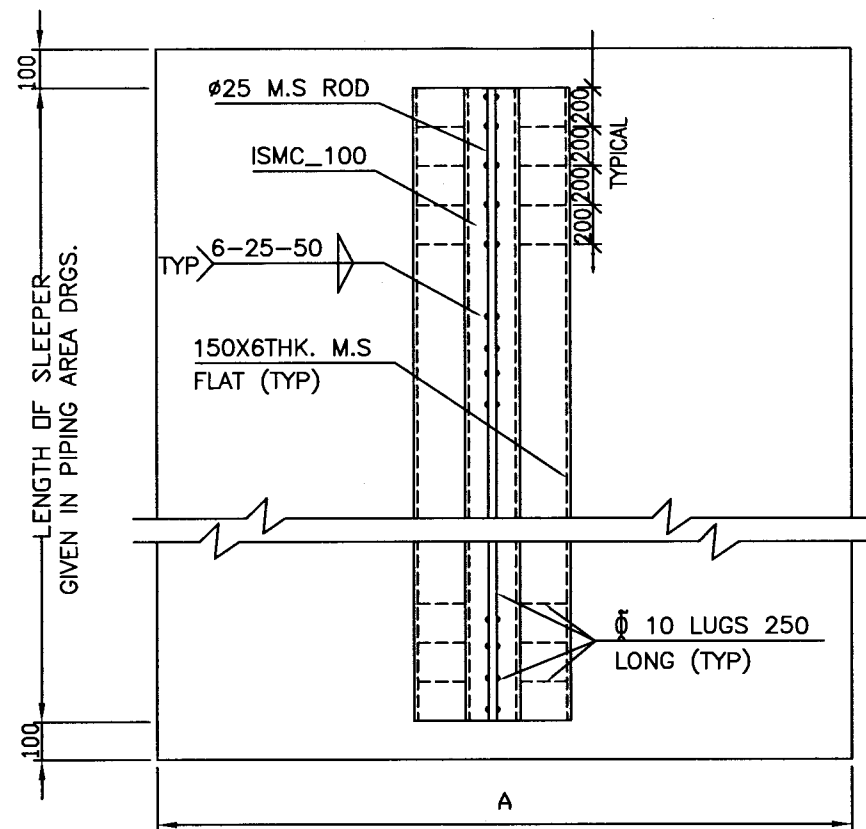


**TYP. DETAIL OF JOINT SEALING
AROUND FOUNDATION**

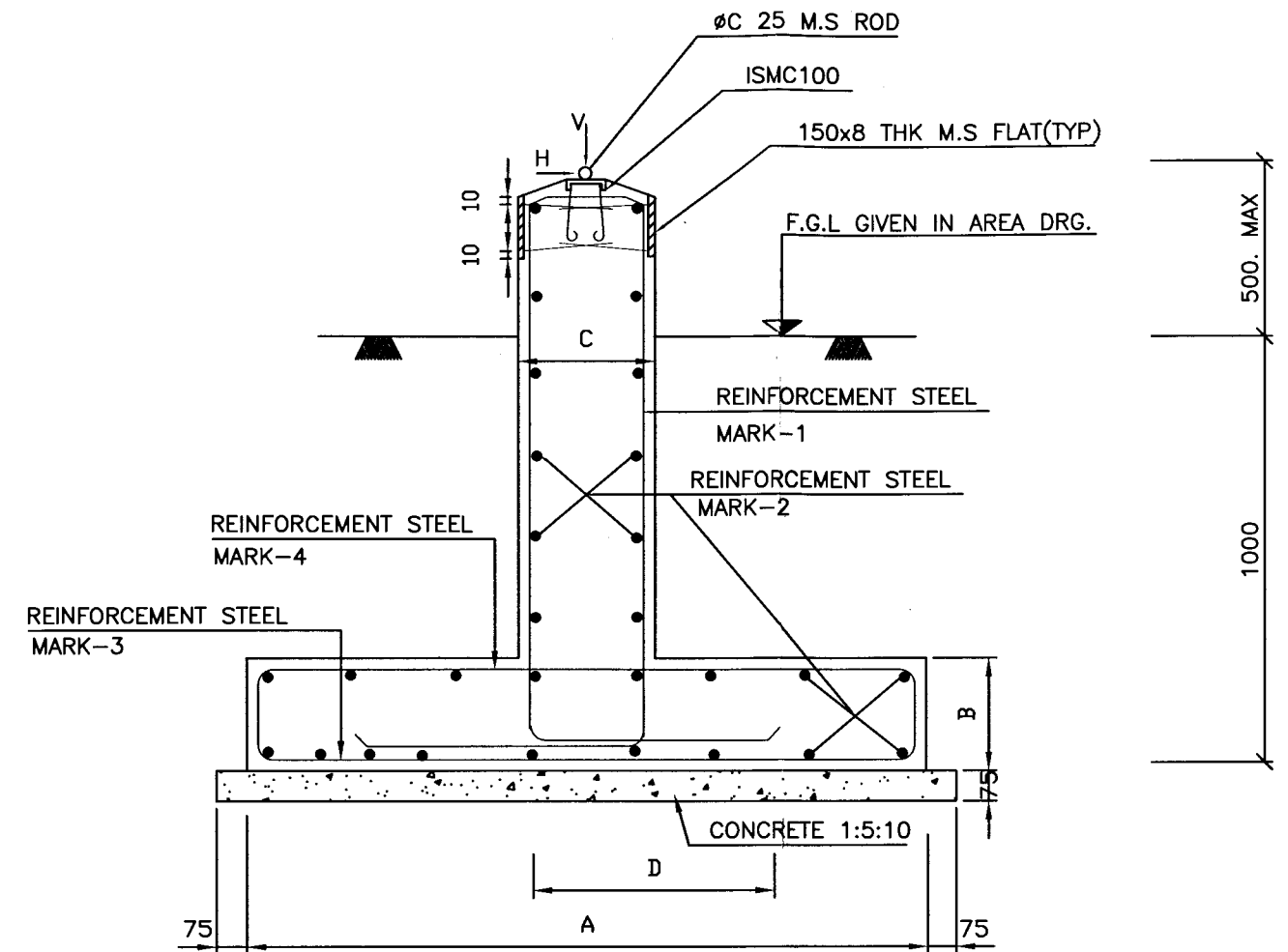
NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. CONC. OF SPECIFIED GRADE SHALL CONFORM TO IS:456.
3. Φ DENOTES HIGH YIELD DEFORMED BARS OF GRADE Fe 415 CONFORMING TO IS:1786 UNLESS OTHERWISE SPECIFIED.
4. JOINT SEALING COMPOUND IN PAVEMENT & AROUND EQUIPMENT FOUNDATIONS SHALL CONFORM TO IS:1834 TYPE-B.
5. EXPANSION AND SEALING JOINT FILLER MATERIAL SHALL BE PREFORMED FILLERS OF BITUMEN IMPREGNATED FIBRE, CONFORMING TO IS:1838, PART-1.
6. CONC. PAVING SHALL BE SLOPED STEEPEST TO 1:100 UNLESS OTHERWISE SHOWN IN DETAIL ENGINEERING DRAWING. SLOPE OF THE SUB GRADE SHALL BE PREPARED TO MATCH WITH THE SLOPE OF PAVEMENT.
7. SUB GRADE BELOW PAVEMENT SHALL BE THOROUGHLY COMPACTED TO 95% OF LAB DRY DENSITY AS PER IS:2720, PART VIII.
8. CAST IN SITU CONCRETE FOR PAVEMENT SHALL BE LAID IN ALTERNATE PANELS OF SIZES AS DEFINED IN THIS STANDARD DRAWING. HOWEVER, THE PANEL SIZE SHALL BE ADJUSTED AROUND COLUMNS & FOUNDATIONS.
9. EXPANSION JOINTS SHALL BE SPACED AT 14.0M (MAX.) FOR TYPE-I PAVEMENTS & 13M C/C (MAX.) FOR TYPE-II PAVEMENTS.
10. EXPANSION JOINTS SHALL BE SPACED AT 15 M C/C & CONSTRUCTION JOINTS SHALL BE SPACED AT 7.5M C/C (MAXIMUM) FOR TYPE-III PAVEMENTS.
11. THIS STANDARD IS NOT VALID FOR CAUSTIC HANDLING AREAS.
12. LIMITATION OF SINGLE AXLE LOAD ON RCC PAVEMENT:
FOR TYPE-I PAVEMENT : MAX. UPTO 12.0 TONNE
FOR TYPE-II PAVEMENT : MAX. UPTO 6.0 TONNE (FOR SMALL VEHICLES LIKE FORK LIFT)
FOR TYPE-III PAVEMENT : NO LOAD IS EXPECTED
13. CONSTRUCTION JOINTS MAY BE PROVIDED IN CASE PANEL SIZE IS LESS THAN THE REQUIREMENT OF EXPANSION JOINT, TO SUIT SITE REQUIREMENTS.
14. FOR PIPE SUPPORT DETAILS COMING IN THICKENED PAVEMENT AREA REFER RELEVANT PIPING GAD / PIPING STANDARDS.

GEOTECHNICAL RECOMMENDATION SHALL BE FOLLOWED FOR SUBGRADE TREATMENT FOR PAVEMENTS IN BLACK COTTON SOIL AREAS/JOB SPECIFIC REQUIREMENT.



PLAN



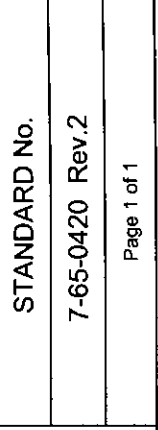
SECTION

S.NO	TYP OF ANCHOR SLEEPER	A	B	C	D	REINFORCEMENT MARK - 1	REINFORCEMENT MARK - 2	REINFORCEMENT MARK - 3	REINFORCEMENT MARK - 4
1	IA	2250	300	300	400	10 Ø @200c/c	10 Ø @250c/c	10 Ø @200c/c	10 Ø @200c/c
2	IB	3250	400	400	400	10 Ø @150c/c	10 Ø @200c/c	10 Ø @150c/c	10 Ø @150c/c
3	IC	4200	500	400	500	10 Ø @150c/c	10 Ø @200c/c	10 Ø @100c/c	10 Ø @125c/c
4	IIA	2250	300	300	400	10 Ø @200c/c	10 Ø @250c/c	10 Ø @175c/c	10 Ø @200c/c
5	IIB	3000	400	400	400	10 Ø @150c/c	10 Ø @200c/c	10 Ø @150c/c	10 Ø @150c/c
6	IIC	3600	500	400	500	10 Ø @150c/c	10 Ø @200c/c	10 Ø @150c/c	10 Ø @125c/c
7	IIIA	2000	300	300	400	10 Ø @200c/c	10 Ø @250c/c	10 Ø @150c/c	10 Ø @200c/c
8	IIIB	2600	400	400	400	10 Ø @150c/c	10 Ø @200c/c	10 Ø @150c/c	10 Ø @150c/c
9	IIIC	3200	500	400	500	10 Ø @150c/c	10 Ø @200c/c	10 Ø @150c/c	10 Ø @125c/c

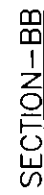
NOTES:-

1. ALL DIMENSIONS ARE IN MM
2. R.C.C SHALL BE OF GRADE M30 AND SHALL BE CONFIRM TO IS:456. FOR AGGRESSIVE SOILS PCC M20 AND RCC M35 SHALL BE USED
3. COLD TWISTED DEFORMED BARS TO CONFORM TO IS:1786 AND BAR BENDING SHALL BE CONFORM TO IS:2502
4. COVER TO THE REINFORCEMENT SHALL BE 45mm
5. TOP OF SLEEPER (T.O.S) SHALL BE STRICTLY MAINTAINED

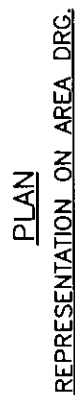
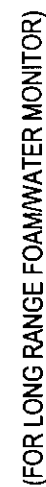
1. ALL DIMENSIONS ARE IN MM AND LEVEL IN M UNLESS STATED OTHERWISE.
2. IN CASE OF OPTIONAL LOCATION OF HYDRANT, STEPS SHALL BE PROVIDED ON ROAD SIDE SLOPE FOR ROAD TOP & GRADE LEVEL DIFFERENCE MORE THAN 500 MM, FOR ACCESS TO THE HYDRANT FROM THE ROAD.
3. IN CASE ROAD TOP LEVEL TO GRADE LEVEL DIFFERENCE IS LESS THAN 1000MM, PIPE LAYOUT SHALL BE FOLLOWED AS SHOWN.
4. WHERE ROAD TOP TO GRADE LEVEL DIFFERENCE IS MORE THAN 2000MM, PIPE LAYOUT SHALL BE FOLLOWED AS SHOWN.
5. CLASS OF BRICK SHALL BE AS PER APPROVED PROJECT DESIGN BASIS.



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1. ALL DIMENSIONS ARE IN MM.



(WATER MONITOR ON FIRE WATER HEADER)

(WATER MONITOR AWAY FROM FIRE WATER HEADER)

(FOR WATER OR WATER CUM FOAM MONITOR)

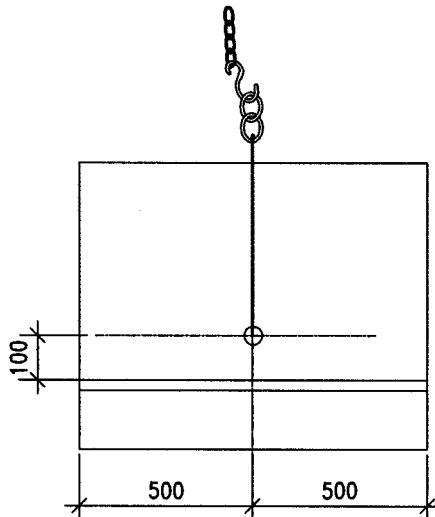
(FOR LONG RANGE FOAM/WATER MONITOR)

Format No. 8-00-0001-F5 Rev. 0

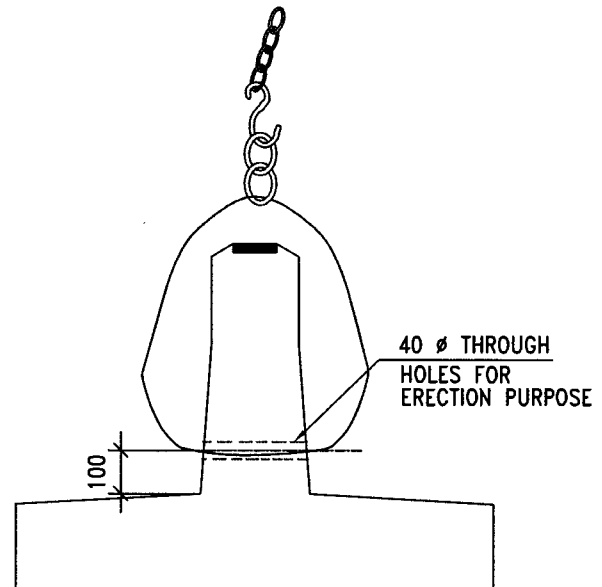
GENERAL NOTES:-

1. THE DETAILING HAS BEEN DONE SO AS TO KEEP SLEEPER OF SAME TYPE ADJACENT TO EACH OTHER FOR MAINTAINING THE LONGER LENGTH MAXIMUM LENGTH OF SLEEPER SHALL BE RESTRICTED ON FOLLOWING BASIS:
 - (a) WEIGHT OF EACH PIECE SHOULD NOT EXCEED 5.0 MT.
 - (b) MAXIMUM LENGTH OF SLEEPER SHALL NOT EXCEED 3.1 M.
 - (c) IN CASE REQUIRED LENGTH OF SLEEPER IS MORE THAN 3.1 M, IT SHALL BE DIVIDED INTO 2, 3 OR MORE EQUAL PARTS WITH LIMITATIONS AS GIVEN IN (a) & (b) ABOVE.
2. CONCRETE SHALL BE OF GRADE M-25, CONFORMING TO EIL SPECIFICATION.
3. REINFORCEMENT BARS SHALL BE OF GRADE Fe 415, CONFORMING TO IS 1786.
4. CLEAR COVER TO ALL REINFORCEMENT SHALL BE 45 MM.
5. FOR ERECTION ARRANGEMENT, REFER PAGE 2 OF 2.

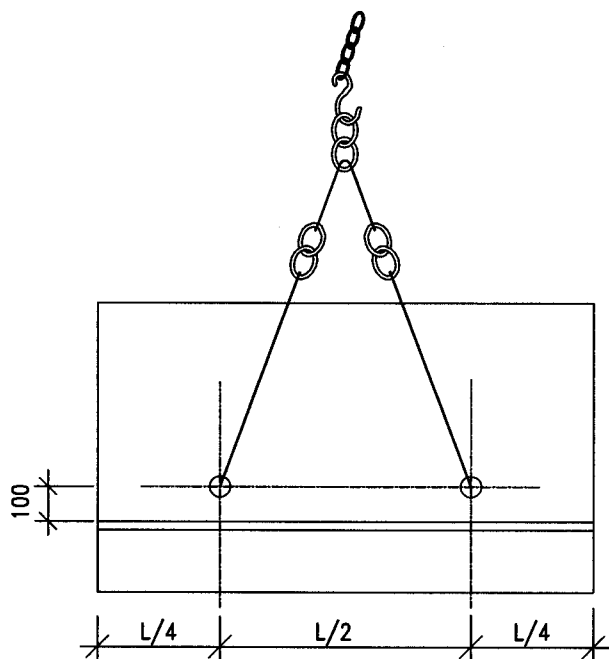
2	29.04.08	REAFFIRMED & ISSUED AS STANDARD	SKP	RKS	NK	VC
1	04.11.03	REVISED AS PER IS:456 2000 & ISSUED AS STANDARD	RS/SSM	G.GHOSH/SKC	AK	SKG
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
						Approved by



**TYP. ELEVATION FOR
LENGTH OF 1.00M**



**TYP. CROSS SEC. FOR
PRECAST SLEEPER**

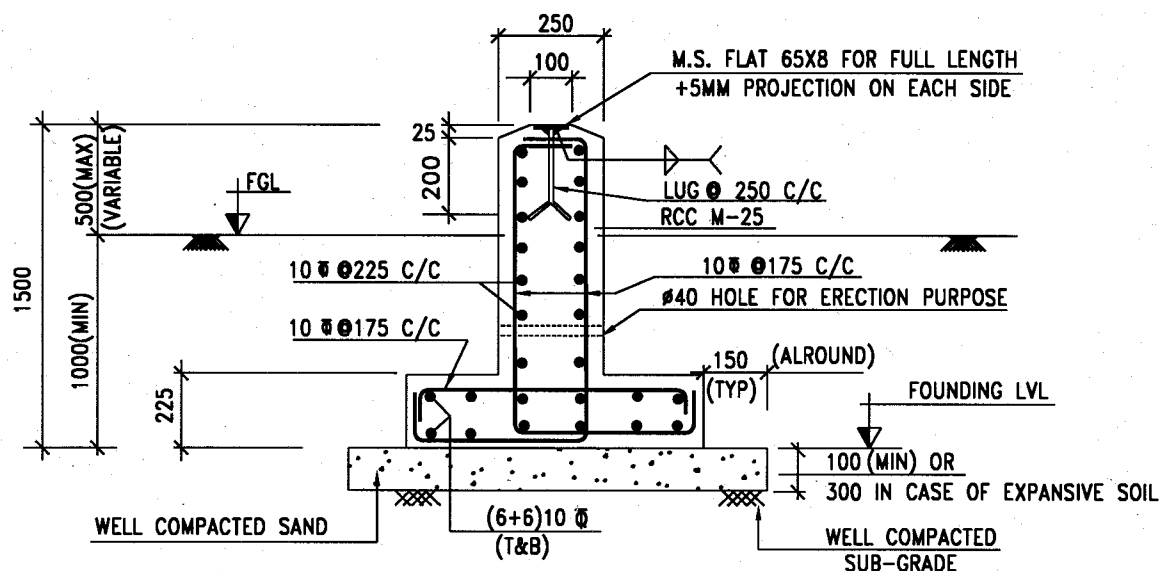


TYP. ELEVATION FOR LENGTH ABOVE 1.0M

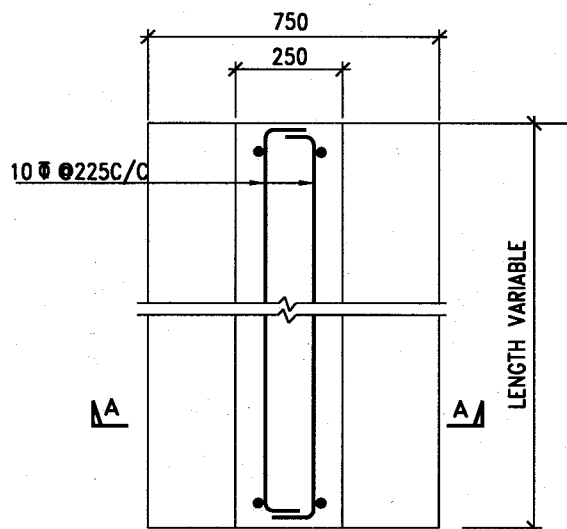
NOTE:-

1. ALL DIMENSIONS ARE IN MILLIMETRE, UNLESS NOTED OTHERWISE

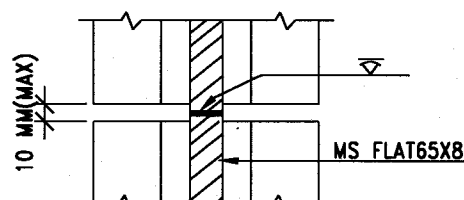
2	29.04.08	REAFFIRMED & ISSUED AS STANDARD	SKP	RKS	NK	VC
1	04.11.03	REVISED AS PER IS: 456 2000 & ISSUED AS STD.	RS/SSM	G.GHOSH/SKC	AK	SKG
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



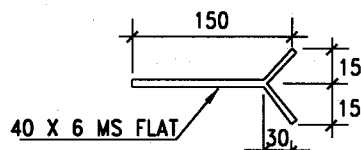
SECTION A-A



PLAN



DET. AT SLEEPER JOINT



DETAIL OF LUGS

NOTES:-

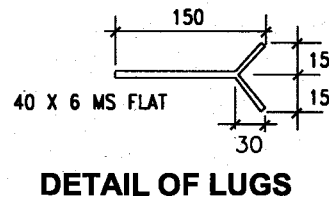
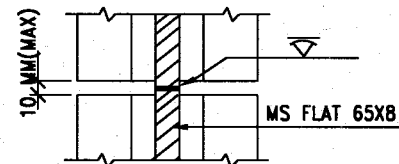
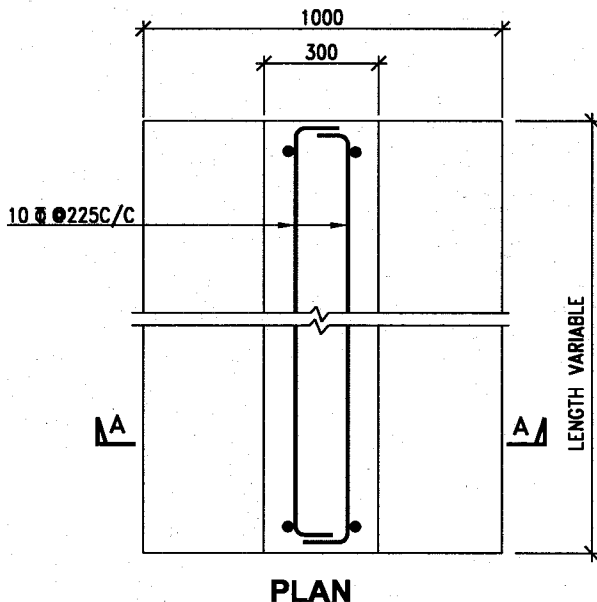
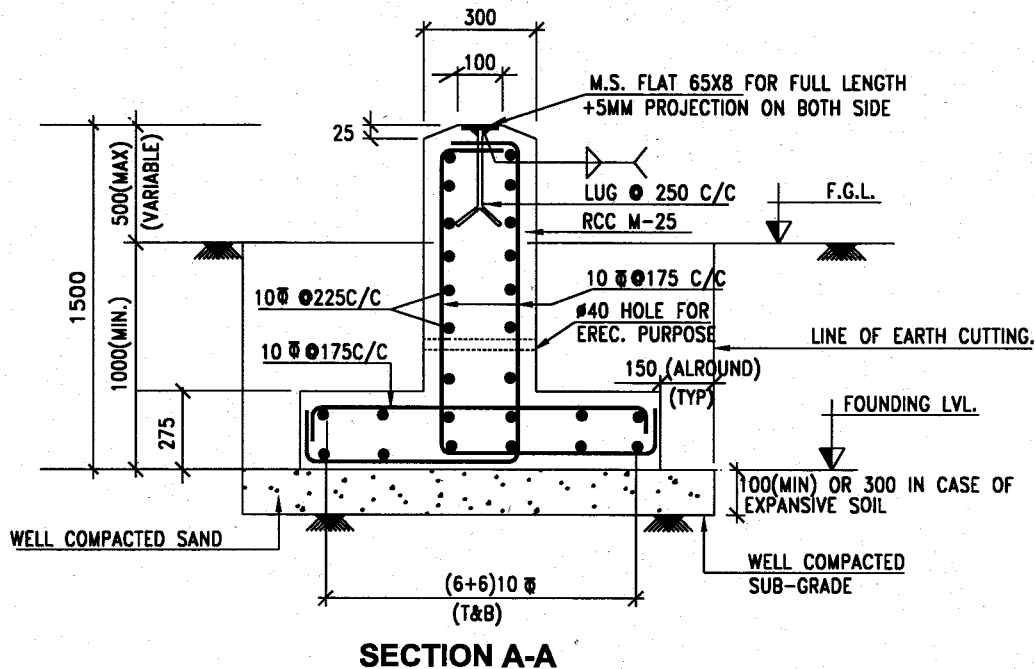
- ALL DIMENSIONS ARE IN MILLIMETRES.
- FOR GENERAL NOTES AND ERECTION ARRANGEMENT FOR PRECAST SLEEPERS REFER EIL STD. NO. 7-65-0422.
- FOR SLEEPERS LONGER THAN 3.10M OR DUE TO LIMITATION ON HANDLING FACILITIES THE TOTAL LENGTH SHALL BE SUB-DIVIDED INTO SUITABLE CONVENIENT LENGTHS.
- REINFORCING BARS SHALL BE OF GRADE Fe 415 CONFORMING TO IS:1786.
- COVER TO MAIN REINFORCEMENT SHALL BE 45 MM IN PEDESTAL AND 50MM IN BOTTOM SLAB.
- ALL LUGS SHALL BE WELDED WITH 6mm FILLET WELD WITH THE MS FLAT LOCATED AT TOP OF THE SLEEPER LEVEL.
- IN CASE BEARING CAPACITY OF SOIL IS $5.0T/M^2$ GEO TECH RECOMMENDATIONS TO BE OBTAINED PRIOR TO THE ISSUE OF DRAWING AND RECOMMENDATION TO BE SUITABLY ACCOMMODATED IN SLEEPER SCHEDULE.
- LOCATION, LENGTH AND TOP OF SLEEPER SHALL BE AS PER RELEVANT PIPING GAD.

1	12.01.06	REVISED AS PER IS:456-2000 & REISSUED	MANOV	SKC	VDS	VJN
0	15.06.99	ISSUED AS STANDARD	BS	PCS	MMK	A.SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman

CONCRETE SLIDING SLEEPER PRECAST TYPE-2B

STANDARD No.
7-65-0429 Rev. 1

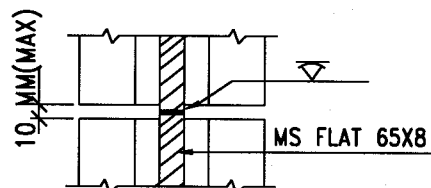
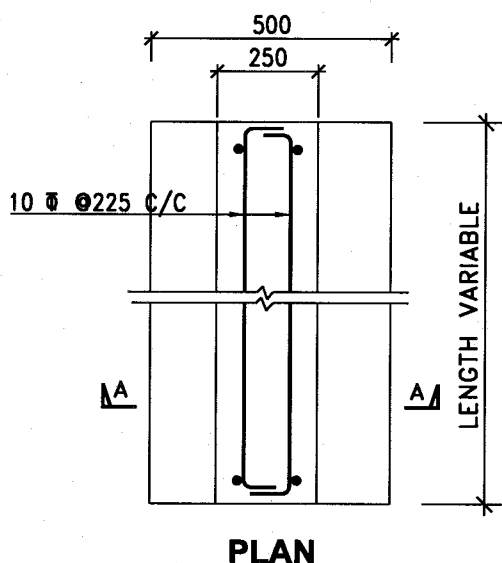
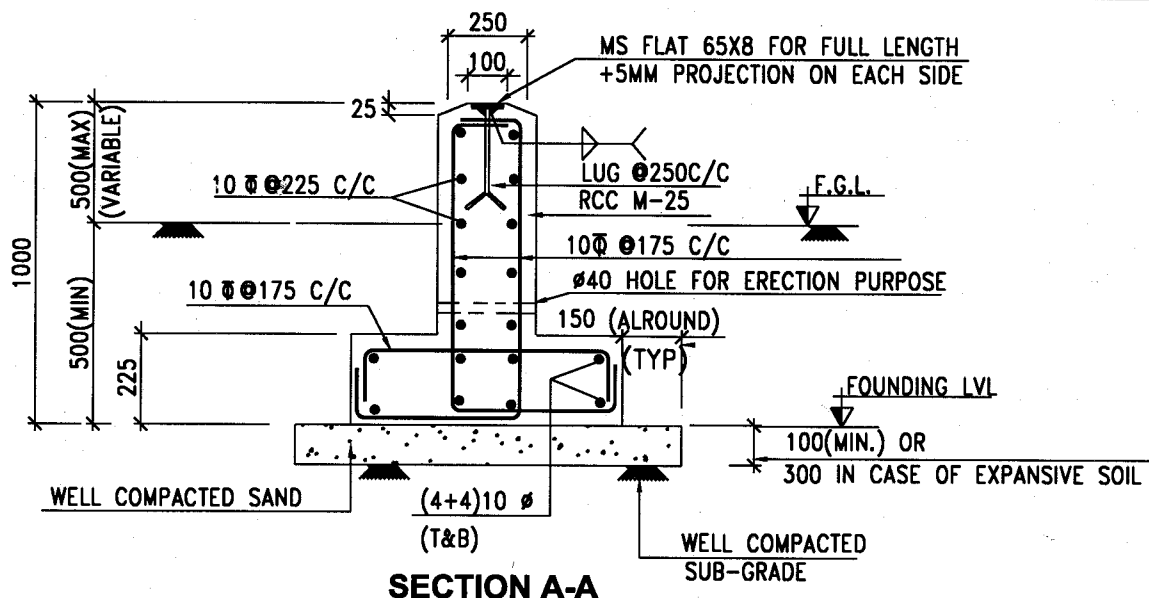
Page 1 of 1



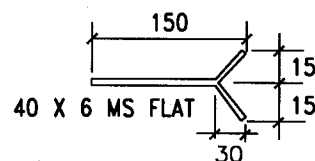
NOTES:-

- ALL DIMENSIONS ARE IN MILLIMETRES.
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- REINFORCING BARS SHALL BE OF GRADE Fe 415 CONFORMING TO IS:1786.
- COVER TO MAIN REINFORCEMENT SHALL BE 45 MM IN PEDESTAL AND 50MM IN BOTTOM SLAB.
- ALL LUGS SHALL BE WELDED WITH 6mm FILLET WELD WITH THE MS FLAT LOCATED AT TOP OF THE SLEEPER LEVEL.
- IN CASE BEARING CAPACITY OF SOIL IS $5.0T/M^2$, GEO TECH RECOMMENDATION TO BE OBTAINED PRIOR TO THE ISSUE OF DRAWING AND RECOMMENDATION TO BE SUITABLY ACCOMMODATED IN SLEEPER SCHEDULE.
- LOCATION, LENGTH AND TOP OF SLEEPER SHALL BE AS PER RELEVANT PIPING GAD.

1	12.01.06	REVISED AS PER IS:456-2000 & REISSUED	BS	PCS	MMK	A.SONI
0	15.06.99	REVISED & ISSUED AS STANDARD	BS	PCS	MMK	A.SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
						Approved by



DET. AT SLEEPER JOINT



DETAIL OF LUGS

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. FOR GENERAL NOTES AND ERECTION ARRANGEMENT FOR PRECAST SLEEPERS REFER EIL STD. NO. 7-65-0422.
3. FOR SLEEPERS LONGER THAN 3.10M OR DUE TO LIMITATION ON HANDLING FACILITIES THE TOTAL LENGTH SHALL BE SUB-DIVIDED INTO SUITABLE CONVENIENT LENGTHS.
4. REINFORCING BARS SHALL BE OF GRADE Fe 415 CONFORMING TO IS:1786.
5. COVER TO MAIN REINFORCEMENT SHALL BE 45 MM IN PEDESTAL AND 50MM IN BOTTOM SLAB.
6. ALL LUGS SHALL BE WELDED WITH 6mm FILLET WELD WITH THE MS FLAT LOCATED AT TOP OF THE SLEEPER LEVEL.
7. IN CASE BEARING CAPACITY OF SOIL IS 5.0T/M², GEO TECH RECOMMENDATIONS TO BE OBTAINED PRIOR TO THE ISSUE OF DRAWING AND RECOMMENDATION TO BE SUITABLY ACCOMODATED IN SLEEPER SCHEDULE.
8. LOCATION, LENGTH AND TOP OF SLEEPER SHALL BE AS PER RELEVANT PIPING GAD.

1	12.01.06	REVISED AS PER IS:456-2000 & REISSUED	MANOJ	SKC	VDS	VJN
0	15.06.99	REVISED & ISSUED AS STANDARD	BS	PCS	MMK	A.SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
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