

तकनीकी विनिर्देशन सिविल एवं संरचनात्मक कार्य

TECHNICAL SPECIFICATION CIVIL AND STRUCTURAL WORKS

सामान्य परिधि GENERAL SCOPE

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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

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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

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Mr S Chaturvedi
Mr PK Mittal
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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

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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:
- Setting out works, profiles, etc.;
 - Site clearance, such as cleaning grass and vegetation;
 - Unauthorized battering or benching of excavation;
 - Forming (or leaving 'dead men' or 'tell-tales' in borrow pits and their removal after measurements;
 - Forming (or leaving) steps in sides of deep excavation and their removal after measurements;
 - Excavation for insertion of planking and strutting;
 - Unless otherwise specified, removing slips or falls in excavations;
 - Bailing out or pumping of water in excavation from rains;
 - Bailing out or pumping of water in excavation from sub-soil water, and
 - 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.
- 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 (m³) 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 (m³) 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

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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

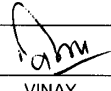
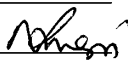
Payment shall be made as per clause 25.1 of this specification. The rate shall be deemed to be inclusive of all extra cost related to labor, shuttering, staging and making all other arrangements for such continuous casting e.g. provisions for adequate movement and storage spaces, special gangways, scaffolding, 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 विनिर्देश सिविल एवं संरचनात्मक कार्य

STANDARD SPECIFICATION CIVIL & STRUCTURAL WORKS

संरचनात्मक इस्पात कार्य

STRUCTURAL STEEL WORKS

5	18.06.09	REAFFIRMED & REISSUED	 AS	 PKM	 VINAY KUMAR	 N. DUARI
4	18.04.00	UPDATED & REISSUED	DPN	RS	SCJ	MI
3	MAY'94	UPDATED & REISSUED	DPN	RS	GPL	A. SONI
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	

Abbreviations:

BIS : Bureau of Indian Standards

IS : Indian Standards

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.)
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1.0 SCOPE

This specification covers the requirements for material, storage, preparation of fabrication drawings, fabrication, assembly, tests/examinations, transportation, erection and painting of all types of bolted and/or welded structural steel works for general construction work. Fabrication of structures shall also include fabricating:

- (a) Built up sections/plate girders made out of rolled section and/or plates.
- (b) Compound sections made out of rolled sections.

2.0 REFERENCES

2.1 BIS Codes

IS: 800, 808, 816, 819, 822, 919, 1024, 1261, 1323, 1477, 1852, 2074, 7205, 7215, 7307, 7310, 7318, 9595, 12778 and other relevant BIS Codes.

SP: 6(1)

2.2 EIL Specifications

6-68-0002- Materials

6-44-0004 (or the relevant Job Specification) - Shop & Field Painting

- 2.3** In case of conflict between the clauses mentioned in this specification and those in the Indian Standards, this specification shall govern. Any special provision as shown or noted on the design drawings shall govern over the provisions of this specification.

3.0 MATERIALS

3.1 General

All materials shall conform to their respective specifications given in EIL Specification no. 6-68-0002. The use of equivalent or alternative materials shall be permitted only in very special cases and for all such cases prior written approval of the Engineer-in-Charge shall be obtained.

3.2 Receipt & Storing of Materials

- 3.2.1** Each section shall be marked for identification and each lot shall be accompanied by manufacturer's quality certificate, chemical analysis and mechanical characteristics.
- 3.2.2** All sections shall be checked, sorted out and arranged by grade and quality in the store. Any instruction given by the Engineer-in-Charge in this respect shall be strictly followed.
- 3.2.3** All material shall be free from surface defects such as pitting, cracks, laminations, twists etc. Defective material shall not be used and all such rejected material shall be immediately removed from the store/site. The decision of the Engineer-in-Charge in this regard shall be final and binding.
- 3.2.4** Welding wires and electrodes (packed in their original cartons) shall be stored separately by quality and lots inside a dry and enclosed room in compliance with IS:9595 and as per the instructions given by the Engineer-in-Charge. Electrodes shall be kept perfectly dry to ensure satisfactory operation and weld metal soundness.

3.2.5 Each lot of electrodes, bolts, nuts etc. shall be accompanied by manufacturer's quality/test certificates.

3.2.6 All bolts (including nuts & washers) shall be checked, sorted out and arranged diameter-wise by grade and quality in the store.

3.3 Material Tests

3.3.1 The Contractor shall submit manufacturers' quality certificates for all the materials supplied by him. In case, quality certificates are not available or are incomplete or when material quality differs from standard specifications, such materials shall not be used in the construction. However, the Contractor shall get all appropriate tests conducted in approved test houses for such materials as directed by the Engineer-in-Charge, at no extra cost, and submit the same to Engineer-in-Charge for his approval. The Engineer-in-Charge may approve the use of such materials entirely at his discretion.

3.3.2 The Contractor shall ensure that all materials brought to site are duly approved by the Engineer-in-Charge. Rejected materials shall not be used and shall be removed from site forthwith. Any material of doubtful quality for which specific tests are to be carried out as per the instruction of the Engineer-in-Charge shall be separately stacked and properly identified and shall not be used. These shall be removed from site forthwith.

4.0 FABRICATION DRAWINGS

4.1 Fabrication and erection drawings shall be prepared by the Contractor on the basis of "Approved for Construction (AFC)" design drawings, EIL Standards issued to the Contractor. These drawings shall be prepared by the Contractor or by an agency appointed by the Contractor and approved by the Engineer-in-Charge.

4.2 Fabrication and erection drawings shall be thoroughly checked, stamped "Approved for Construction" and signed by the Contractor's own responsible Engineer irrespective of the fact that such drawings are prepared by the Contractor or his approved agency, to ensure accuracy and correctness of the drawings. Unchecked and unsigned drawings shall not be used for the purpose of proceeding with the work. The Contractor shall proceed with the fabrication and erection work only after thoroughly satisfying himself in this regard.

4.3 All fabrication and erection drawings shall be issued for construction by the Contractor directly to his work- site. Six copies of such drawings shall simultaneously be submitted to the Engineer-in-Charge who may check/ review some or all such drawings at his sole discretion and offer his comments for incorporation in these drawings by the Contractor.

However, the Contractor shall not proceed with the fabrication of such structures whose fabrication drawings are required to be reviewed before taking up the fabrication work as noted on "Approved for Construction (AFC)" design drawings issued to the Contractor or as conveyed by the Engineer-in-Charge. The fabrication of such structures shall be done only as per the reviewed fabrication drawings.

The review of such drawings by EIL shall be restricted to the checking of the following only:

- i) Structural layout, orientation and elevation of structures/members.
- ii) Sizes of members.
- iii) Critical joint details.

- 4.4 Fabrication drawings shall be drawn to scale and shall convey the information clearly and adequately. Following information shall be furnished on such drawings:
- i) Reference to design drawing number (along with revision number) based on which fabrication drawing has been prepared.
 - ii) Structural layout, elevations & sections (with distinct erection marking of all members).
 - iii) Framing plans, member sizes, orientation and elevations.
 - iv) Layout and detailing of rain water pipes and gutters showing all necessary levels, connections and provisions wherever required.
 - v) Detailing of shop/field joints, connections, splices, for required strength and erection.
 - vi) Location, type, size and dimensions of welds and bolts.
 - vii) Shapes and sizes of edge preparation for welding.
 - viii) Details of shop and field joints/welds.
 - ix) Bill of materials/D.O.D. Lists.
 - x) Quality of structural steel, plates etc., welding electrodes, bolts, nuts and washers to be used.
 - xi) Erection assemblies identifying all transportable parts and sub-assemblies with special erection instructions, if required.
 - xii) Method of erection and special precautions to be taken during erection as required.
- 4.5 The Contractor shall additionally ensure accuracy of the following and shall be solely responsible for the same:
- i) Provision for erection and erection clearances.
 - ii) Marking of members
 - iii) Cut length of members
 - iv) Matching of joints and holes.
 - v) Provision kept in the members for other interconnected members.
 - vi) Bill of materials/D.O.D. Lists.
- 4.6 Connections, splices and other details where not shown on the design drawings shall be suitably designed and shown on the fabrication drawings based on good engineering practice developing full member strength. **Design calculations for such connections/splices shall be submitted to the Engineer-in-Charge alongwith the fabrication drawings.**

- 4.7 Any substitution or change in section shall be allowed only when prior written approval of the Engineer-in-Charge has been obtained. Fabrication drawings shall be updated incorporating all such substitutions/changes by the Contractor at no extra cost to the Owner.
- 4.8 In case during execution of the work, the Engineer-in-Charge on review of drawings considers any modifications/substitutions necessary to meet the design parameters/good engineering practice, these shall be brought to the notice of the Contractor who shall incorporate the same in the drawings and works without any extra cost to the owner. The Contractor will be totally responsible for the correctness of the detailed fabrication drawings and execution of the work.
- 4.9 Contractor shall incorporate all the revisions made in the design drawings during the course of execution of work in his fabrication drawings, and resubmit the drawings at no extra cost to the Owner. All fabrication shall be carried out only as per the latest AFC design drawings and corresponding fabrication drawings.
- 4.10 The Contractor shall supply two prints each of the final/as built drawings alongwith their native soft file to Engineer-in-Charge for reference and record. The rates quoted shall include for the same.

5.0 FABRICATION

5.1 General

- 5.1.1 Fabrication of structures shall be done strictly as per "Approved for Construction" fabrication drawings (prepared by the Contractor based on the latest design drawings) and in accordance with IS:800, 9595 & other relevant BIS Codes and BIS Hand Book SP:6(1).
- 5.1.2 Prior to commencement of structural fabrication, undulations in the fabrication yard, if any, shall be removed and area levelled and paved by the Contractor.
- 5.1.3 Any defective material used in the work shall be replaced by the Contractor at his own expense. Necessary care and precautions shall be taken so as not to cause any damage to the structure during any such removal and replacement.
- 5.1.4 Any faulty fabrication pointed out at any stage of work by the Engineer-in- Charge, shall be made good or replaced by the Contractor at his own cost.
- 5.1.5 Tolerances for fabrication of steel structures shall be as per IS:7215.

5.2 Fabrication Procedure

5.2.1 Straightening & Bending

- 5.2.1.1 All materials shall be straight and, if necessary, before being worked shall be straightened and/or flattened (unless required to be of curvilinear form) and shall be free from twists.
- 5.2.1.2 Bending of rolled sections and plates shall be done by cold process to shape/s as shown on drawings.

5.2.2 Clearances

The erection clearance for cleated ends of members shall be not greater than 2mm at each end. The erection clearance at ends of beams without web cleats and end plates shall be not

more than 3mm at each end but where for practical reasons, greater clearance is necessary, suitably designed seatings approved by the Engineer-in-Charge shall be provided.

5.2.3 Cutting

5.2.3.1 Prior to cutting, all members shall be properly marked showing the requisite cut length/width, connection provisions e.g. location and dimensions of holes, welds, cleats etc. Marking for cutting shall be done judiciously so as to avoid wastages or unnecessary joints as far as practicable. Marking shall be done by placing the members on horizontal supports/pads in order to ensure accuracy. Marking accuracy shall be limited to + 1mm.

5.2.3.2 Cutting may be affected by shearing, cropping or sawing. Gas cutting by mechanically controlled torch shall be permitted for mild steel. Hand flame cutting may be permitted subject to the approval of the Engineer-in-Charge.

5.2.3.3 Except where the material is subsequently joined by welding, no loads shall be transmitted into metal through a gas cut surface.

5.2.3.4 Shearing, cropping and gas cutting shall be clean, square, free from any distortion & burrs, and should the Engineer-in-Charge find it necessary, the edges shall be ground afterwards, to make the same straight and uniform at no extra cost to the Owner.

5.2.4 Holing

5.2.4.1 Holes for bolts shall not be formed by gas cutting process.

5.2.4.2 Holes through more than one thickness of material of members such as compound stanchions and girder flanges shall, where possible, be drilled after the members are assembled and tightly clamped/bolted together. Punching may be permitted before assembly, provided the thickness of metal is less than 16mm and the holes are punched 3mm less in diameter than the required size and reamed, after assembly, to the full diameter. Punching shall not be adopted for dynamically loaded structures.

5.2.4.3 Holes may be drilled in one operation through two or more separable parts and burrs removed from each part after drilling.

5.2.4.4 Holes in connecting angles and plates, other than splices, also in roof members and light framing, may be punched full size through material not over 12mm thick, except where required for close tolerance bolts or barrel bolts.

5.2.4.5 All matching holes for black bolts shall register with each other so that a gauge of 2mm less in diameter than the diameter of hole shall pass freely through the assembled members in the direction at right angle to such members. Finished holes shall be not more than 2mm in diameter larger than the diameter of the black bolt passing through them, unless otherwise specified by the Engineer-in-Charge.

5.2.4.6 Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to H8 tolerance specified in IS:919. Parts to be connected with close tolerance or barrel bolts shall be firmly held together by tacking bolts or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all the thicknesses in one operation shall be drilled to a smaller size and reamed out after assembly. Where this is not possible, the parts shall be drilled and reamed separately.

5.2.4.7 To facilitate grouting, holes shall be provided in column bases or seating plates exceeding 300mm in width for the escape of air.

5.2.4.8 To avoid accumulation of water in gusseted column bases of laced, battened or box type stanchions, suitable reverse U-type holes shall be provided at the junction of base plate and column section in the vertical gussets for draining out of any water.

5.2.5 **Assembly**

The component parts shall be assembled and aligned in such a manner that they are neither twisted nor otherwise damaged, and shall be so prepared that the required camber, if any, is provided. Proper clamps, clips, jigs and other fasteners (bolts and welds) shall be placed in a balanced pattern to avoid any distortion in the members and to ensure their correct positioning (i.e. angles, axes, nodes etc.). Any force fitting, pulling/stretching of members to join them shall be avoided. Proper care shall be taken for welding shrinkage & distortion so as to attain the finished dimensions of the structure shown on the drawings.

5.2.6 **Welding**

5.2.6.1 **General**

- a) All joints shall be welded unless noted otherwise on the design drawings.
- b) Welding shall be in accordance with IS:816, IS:819, IS:1024, IS:1261, IS:1323 and IS:9595 as appropriate.
- c) The Contractor shall make necessary arrangement for providing sufficient number of welding sets of the required capacity, all consumables, cutting and grinding equipment with requisite accessories/ auxiliaries, equipment & materials required for carrying out various tests such as dye penetration, magnetic particle, ultrasonic etc.
- d) Adequate protection against rain, dust, snow & strong winds shall be provided to the welding personnel and the structural members during welding operation. In the absence of such a protection no welding shall be carried out.
- e) It shall be the responsibility of the Contractor to ensure that all welding is carried out in accordance with the terms of this specification and relevant BIS codes. The Contractor shall provide all the supervision to fulfil this requirement.

5.2.6.2 **Preparation of Member for Welding**

a) **Edge Preparation**

Edge preparation/bevelling of fusion faces for welding shall be done strictly as per the dimensions shown in the drawings. In case, the same are not indicated, edges shall be prepared (depending on the type of weld indicated in the drawing) as per the details given in IS:9595. Bevelling of fusion faces shall be got checked and approved by the Engineer- in-Charge. The tolerances on limits of gap, root face & included angle shall be as stipulated in IS:9595.

b) **Cleaning**

Welding edges and the adjacent areas of the members (extending upto 20mm) shall be thoroughly cleaned of all oil, grease, scale and rust and made completely dry. Gaps between the members to be welded shall be kept free from all foreign matter.

c) Preheating

Preheating of members, shall be carried out as per IS:9595 when the base metal temperature is below the requisite temperature for the welding process being used. Preheating shall be done in such a manner that the parts, on which the weld metal is being deposited, are above the specified minimum temperature for a distance of not less than 75mm on each side of the weld line. The temperature shall be measured on the face opposite to that being heated. However, when there is access to only one face, the heat source shall be removed to allow for temperature equalization (1 minute for each 25mm of plate thickness) before measuring the temperature.

d) Grinding

- i) Column splices & butt joints of struts and compression members (depending on contact for load transmission) shall be accurately ground and close-butted over the whole section with a tolerance not exceeding 0.2mm locally at any place. In column caps & bases, the ends of shafts together with the attached gussets, angles, channels etc., shall be accurately ground so that the parts connected butt over minimum 90% surface of contact. In case of connecting angles or channels, care shall be taken so that these are fixed with such accuracy that they are not reduced in thickness by grinding by more than 2mm.
- ii) Ends of all bearing stiffeners shall be ground to fit tightly at both top and bottom. Similarly bottom of the knife edge supports along with the top surface of column brackets shall be accurately ground to provide effective bearing with a tolerance not exceeding 0.2mm locally at any place.
- ii) Slab bases and caps shall be accurately ground over the bearing surfaces and shall have effective contact with the ends of stanchions. Bearing faces which are to be grouted direct to foundations need not be ground if such faces are true & parallel to the upper faces.

5.2.6.3 Welding Processes

Welding of various materials under this specification shall be carried out using one or more of the following processes.

- Manual Metal Arc Welding Process (MMAW)
- Submerge Arc Welding Process (SAW)
- Gas Metal Arc Welding Process (GMAW)
- Flux Cored Arc Welding Process (FCAW)

The welding procedure adopted and consumables used shall be specifically approved by the Engineer-in-Charge. A combination of different welding processes or a combination of electrodes of different classes/makes may be employed for a particular joint only after qualifying the welding procedures to be adopted and obtaining the written approval of the Engineer-in-Charge.

5.2.6.4 Approval & Testing of Welders

The Contractor shall satisfy the Engineer-in-Charge that the welders are suitable for the work upon which they will be employed. For this purpose the welders shall have satisfied the relevant requirements of IS:7318. If the welders will be working to approved welding procedures, they shall have satisfied the relevant requirements of IS:7310.

Adequate means of identification shall be provided to enable each weld to be traced to the welder by whom it was made. The Contractor shall intimate the Engineer-in-Charge sufficiently in advance, the commencement of tests, to enable him to be present to witness the same.

5.2.6.5 Approval & Testing of Welding Procedures

The Contractor shall carry out procedure tests in accordance with IS:7307 to demonstrate by means of a specimen weld of adequate length on steel representative of that to be used, that he can make welds with the welding procedure to be used for the work to the complete satisfaction of the Engineer-in-Charge. The test weld shall include weld details from the actual construction and it shall be welded in a manner simulating the most unfavourable instances of fit-up, electrode condition etc., which are anticipated to occur on the particular fabrication. Where material analysis are available, the welding procedure shall be carried out on material with the highest carbon equivalent value.

After welding, but before the relevant tests given in IS:7307 are carried out, the test weld shall be held as long as possible at room temperature, but in any case not less than 72 hours, and shall then be examined for cracking. The examination procedure shall be sufficiently rigorous to be capable of revealing significant defects in both parent metal and weld metal.

After establishing the welding method, the Contractor shall finally submit to the Engineer-in-Charge for his approval the welding procedure specification in standard format given in IS:9595 before starting the fabrication.

5.2.6.6 Sequence of Welding

- a) As far as practicable, all welds shall be made in a sequence that will balance the applied heat of welding while the welding progresses.
- b) The direction of the general progression in welding on a member shall be from points where the parts are relatively fixed in position with respect to each other towards points where they have a greater relative freedom of movement.
- c) All splices in each component part of a cover-plated beam or built up member shall be made before the component part is welded to other component parts of the member.
- d) Joints expected to have significant shrinkage shall be welded before joints expected to have lesser shrinkage.
- e) Welding shall be carried continuously to completion with correct number of runs.
- f) The Contractor shall choose the welding sequence after carefully studying each case such as to minimize distortion and shrinkage & submit the same to the Engineer-in-Charge for comments and approval.

5.2.6.7 Welding Technique

- a) After the fusion faces are carefully aligned and set with proper gaps, the root pass of butt joints shall be executed properly so as to achieve full penetration with complete fusion of the root edges.
- b) On completion of each run, all slag and spatters shall be removed and the weld and the adjacent base metal shall be cleaned by wire brushing and light chipping. Visible defects such as cracks, cavities and other deposition faults, if any, shall be removed to sound metal before depositing subsequent run of weld.
- c) All full penetration butt welds shall be completed by chipping/gouging to sound metal and then depositing a sealing run of weld metal on the back of the joints. Where butt welding is practicable from one side only, suitable backing steel strip shall be used and joint shall be arranged in such a way as to ensure that complete fusion of all the parts is readily obtained.
- d) While welding is in progress care shall be taken to avoid any kind of movement of the components, shocks, vibrations to prevent occurrences of weld cracks.
- e) Any deviation desired from the recommended welding technique and electrodes shall be adopted only after obtaining written approval of the Engineer-in-Charge.

5.2.6.8 Inspection & Testing of Welds

The method of inspection shall be according to IS:822 and extent of inspection and testing shall be in accordance with the relevant applicable standard or, in the absence of such a standard, as specified by the Engineer-in-Charge. Welds shall not be painted or otherwise obscured until they have been inspected, approved and accepted.

The Engineer-in-Charge or his representative shall have access to the Contractor's work at all reasonable times and the Contractor shall provide him with all facilities necessary for inspection during all stages of fabrication and erection with, but not limited to, the following objectives.

- i) To check the conformity with the relevant standards and suitability of various welding equipments and their performance.
- ii) To witness/approve the welding procedure qualification.
- iii) To witness/approve the welders performance qualification.
- iv) To check whether shop/field welding being executed is in conformity with the relevant specifications and codes of practice.

Inspection and testing of all fabricated structures shall be carried out by the Contractor by any, or, a combination of all the following methods as directed by the Engineer-in-Charge and no separate payment shall be made, unless otherwise mentioned, for inspection and testing of welds/fabricated structures:

A. Visual Inspection

All finished welds (i.e. 100 percent) shall be visually inspected for identification of the following types of weld defects & faults.

- | | |
|--|---|
| b) Shrinkage cracks, cracks in parent plates and craters | - Defective portions removed down to sound metal and re-welded. |
| c) Under cutting. | - Additional weld metal deposited. |
| d) Improperly fitted/ misaligned parts. | - Welding cut & edges suitably prepared and parts. |
| e) Members distorted by the heat of welding | - Member straightened by mechanical means or careful application of limited amount of heat, temperature of such area not to exceed 650 degree Centigrade (dull red heat). |

In removing defective parts of a weld, gouging, chipping, oxygen cutting or grinding shall not extend into the parent metal to any substantial amount beyond the depth of weld penetration, unless cracks or other defects exist in the parent metal. The weld or parent metal shall not be undercut in chipping, grinding, gouging or oxygen cutting.

Any fabricated structure or its component which, in the opinion of Engineer- in-Charge, is defective and/or beyond any corrective action shall be removed forthwith from the site as instructed by the Engineer-in-Charge without any extra claim. The owner reserves the right to recover any compensation due to any loss arising out of such rejections.

5.2.7 Bolting

- 5.2.7.1 All bolts shall be provided such that no part of the threaded portion of the bolts is within the thickness of the parts bolted together. Washers of suitable thickness shall be used under the nuts to avoid any threaded portion of the bolt being within the thickness of parts bolted together.
- 5.2.7.2 The threaded portion of each bolt shall project through the nut at least one thread.
- 5.2.7.3 Flat washers shall be circular and of suitable thickness. However, where bolt heads/nuts bear upon the bevelled surfaces, they shall be provided with square tapered washers of suitable thickness to afford a seating square with the axis of the bolt.

5.2.8 Splicing

- 5.2.8.1 Splicing of built up/compound/latticed sections shall be done in such a fashion that each component of the section is joined in a staggered manner.
- 5.2.8.2 Where no butt weld is used for splicing, the meeting ends of two pieces of joist/channel/built up section shall be ground flush for bearing on each other and suitable flange and web splice plates shall be designed and provided for the full strength of the flange/ web of the section and welds designed accordingly.
- 5.2.8.3 Where full strength butt weld is used for splicing (after proper edge preparation of the web and flange plates) of members fabricated out of joist/ channel/ angles/ built up section, additional flange and web plates shall be provided, over and above the full strength butt welds, to have 40% strength of the flange and web.
- 5.2.8.4 Where a cover plate is used over a joist/channel section the splicing of the cover plate and channel/joist sections shall be staggered by minimum 500mm. Extra splice plate shall be used for the cover plate and joist/channel section as per clause 5.2.8.2 or 5.2.8.3.

- 5.2.8.5 Prior approval shall be obtained by the Contractor for locations of splices where not shown on design drawings. For members upto a length of 7m, generally no splice shall be allowed but in exceptional cases one splice shall be allowed at approved location. Maximum two numbers of splices shall be allowed for members exceeding this length.

5.2.9 **Machining & Grinding**

- 5.2.9.1 All slab bases and slab caps shall be accurately machined over the bearing surfaces and shall be in effective contact with the ends of column sections (shafts).
- 5.2.9.2 For slab bases and slab caps, ends of column shafts shall be accurately machined. However, for gussetted bases and caps, the column shafts shall be ground flush for effective contact with parts connected together.
- 5.2.9.3 Gussetted bases and caps shall be ground flush for effective contact with ends of column sections.
- 5.2.9.4 End of all bearing stiffeners shall be machined or ground to fit tightly at top and bottom without any air gap.
- 5.2.9.5 While machining or grinding care shall be taken so that the length or thickness of any part does not get reduced by more than 2.0mm.
- 5.2.9.6 For all machining or grinding works for gassetted base and cap plates, the clearance between the parts joined shall not exceed 0.2mm at any location.

6.0 **MARKING FOR IDENTIFICATION**

- 6.1 Each component shall be distinctly marked (with paint) before delivery in accordance with the marking diagrams and shall bear such other marks as will facilitate erection.
- 6.2 For small members which are delivered in bundles or crates, the required marking shall be done on small metal tags securely tied to the bundle.

7.0 **SHOP ERECTION**

The steel work shall be temporarily shop erected complete or as directed by the Engineer-in-Charge, so that the accuracy of fit may be checked before despatch.

8.0 **INSPECTION & TESTING OF STRUCTURES**

- 8.1 The Engineer-in-Charge (or his authorised representative) shall have free access at all times to those parts of the Contractor's works which are concerned with the fabrication of the steel work and shall be provided with all reasonable facilities for satisfying himself that the fabrication is being undertaken in accordance with the provisions of these specifications & other relevant BIS Codes.
- 8.2 Should any structure or part of a structure be found not to comply with any of the provisions of this specification (or relevant BIS Codes as referred to), it shall be liable to rejection. No structure or part of the structure, once rejected shall be resubmitted for inspection, exception cases where the Engineer-in-Charge or his authorised representative considers the defect as rectifiable.
- 8.3 Defects which may appear during/after fabrication/ erection shall be made good only with the consent of the Engineer-in-Charge and procedure laid down by him.

- 8.4 All necessary gauges and templates shall be supplied free to the Engineer-in-Charge by the Contractor whenever asked for during inspection. The Engineer-in-Charge, may at his discretion, check the test results obtained at the Contractor's works by independent tests at a test house, and the cost of such tests shall be borne by the Contractor.

9.0 SHOP PAINTING

- 9.1 All components and members of steel work shall be given one shop coat of primer, as specified in the tender, immediately after the surfaces have been properly prepared (i.e. degreased, derusted, descaled & cleaned) in accordance with the job specification or 6-44-0004, as applicable.

The primer coat shall be applied over completely dry surfaces (using brushes of good quality) in a manner so as to ensure a continuous and uniform film without "holidaying". Special care shall be taken to cover all the crevices, corners, edges etc. However, in areas which are difficult to reach by brushing, daubers/mops shall be used by dipping the same in paint and then pulling/ pushing them through the narrow spaces. The primer coat shall be air dried and shall have the thickness as per EIL Specification no. 6-44-0004 or the relevant job specification.

- 9.2 Surfaces which are inaccessible after shop assembly, shall receive the full specified protective treatment before assembly (this shall not apply to the interior of sealed hollow sections).
- 9.3 Steel surfaces shall not be painted within a suitable distance of any edges to be welded if the paint specified would be harmful to welders or impair the quality of the welds.
- 9.4 Welds and adjacent parent metal shall not be painted prior to deslagging, inspection and approval by the Engineer-in-Charge.
- 9.5 Parts to be encased in concrete shall have only one coat of primer and shall not be painted after erection.

10.0 PACKING

- 10.1 All items shall be suitably packed in case these are to be despatched from the fabrication shop to the actual site of erection so as to protect them from any damage/distortion or falling during transit. Where necessary, slender projecting parts shall be temporarily braced to avoid warping during transportation.
- 10.2 Small parts such as gussets, cleats etc., shall be securely wired on to their respective main members.
- 10.3 Bolts, nuts washers etc. shall be packed in crates.

11.0 TRANSPORTATION

Loading and transportation shall be done in compliance with transportation rules. In case, certain parts can not be transported in the lengths stipulated on the drawings, the position details of such additional splice joints shall be got approved by the Engineer-in-Charge.

12.0 SITE (FIELD) ERECTION

12.1 Plant & Equipment

The suitability and capacity of all plant and equipment used shall be to the complete satisfaction of the Engineer-in-Charge.

12.2 Storing & Handling

All steel work shall be so stored and handled at site so that the members are not subjected to excessive stresses and any damage.

12.3 Setting Out

Prior to setting out of the steel work, the Contractor shall get himself satisfied about the correctness of levels, alignment, location of existing concrete pedestals/columns/brackets and holding down bolts/pockets provided therein. Any minor modification in the same including chipping, cutting and making good, adjusting the anchor bolts etc., if necessary, shall be carried out by the Contractor at his own expense. The positioning and levelling of all steel work including plumbing of columns and placing of every part of the structure with accuracy shall be in accordance with the drawings and to the complete satisfaction of the Engineer-in-Charge.

12.4 Tolerances

Tolerances for erection of steel structures shall be as per Annexure 'A'

13.0 SAFETY & SECURITY DURING ERECTION

13.1 The contractor shall comply with IS:7205 for necessary safety and adhere to safe erection practices and guard against hazardous as well as unsafe working conditions during all stages of erection.

13.2 During erection, the steel work shall be securely bolted or otherwise fastened and when necessary, temporarily braced/guyed to provide for all loads to be carried by the structure during erection till the completion, including those due to the wind, erection equipment & its operation etc. at no extra cost to the owner. For the purpose of guying, the Contractor shall not use other structure in the vicinity without prior written permission of the Engineer-in-Charge.

13.3 No permanent bolting or welding shall be done until proper alignment has been achieved.

13.4 Proper access, platform and safety arrangement shall be provided for working and inspection, (at no extra cost to the owner) whenever required.

14.0 FIELD CONNECTIONS

14.1 Field Bolting

Field bolting shall be carried out with the same care as required for shop bolting.

14.2 Field Welding

All field assembly and welding shall be executed in accordance with the requirements for shop assembly and welding. Holes for all erection bolts - where removed after final erection shall be plugged by welding. Alternatively erection bolts may be left and secured.

15.0 GROUTING

15.1 Prior to positioning of structural columns/girders/ trusses over the concrete pedestals/columns/brackets, all laitance & loose material shall be removed by wire brushing & chipping. The bearing concrete surfaces shall be sufficiently levelled, hacked with flat chisels to make them rough, cleaned (using compressed air) and made thoroughly wet. All pockets for anchor bolts shall also be similarly cleaned and any excess water removed. Thereafter, the structural member shall be erected, aligned & plumbed maintaining the base plates/shoe plates at the levels shown in the drawings, with necessary shims/pack plates/wedges.

15.2 After final alignment and plumbing of the structure, the forms shall be constructed allround and joints made tight to prevent leakage. Grouting (under the base plates/shoe plates including grouting of sleeves & pockets) shall be done with non-shrink grout having compressive strength (28 days) not less than 40N/sq.mm Non shrink grout shall be of free flow premix type and of approved quality and make. It shall be mixed with water in proportion as specified by the manufacturer. Ordinary 1:2 cement/sand mortar grout shall be used only for small, isolated structures e.g. operating platforms not supporting any equipment, pipe supports, crossovers, stairs & ladders. The thickness of grout shall be as shown on the drawings but not less than 25 mm nor more than 40mm in any case.

15.3 The grout mixture shall be poured continuously (without any interruption till completion) by grouting pumps from one side of the base plate and spread uniformly with flexible steel strips and rammed with rods, till the space is filled solidly and the grout mixture carried to the other side of the base plate.

15.4 The grout mixture shall be allowed to harden for a period as decided by the Engineer-in-Charge. At the end of this period, the shims/wedges/pack plates may be removed and anchor bolts tightened uniformly. The alignment of the structure shall now be rechecked and if found correct, the voids left by the removal of shims/wedges/pack plates (if removed) must be filled up with a similar mixture of grout. In case after checking, serious misalignment is indicated, the grout shall be removed completely and fresh grouting done after making appropriate correction of alignment.

16.0 SCHEME AND SEQUENCE OF ERECTION

The Contractor shall furnish the detailed scheme and sequence of erection to match with the project schedule and get the same approved by the Engineer-in- Charge. All necessary co-ordination and synchronization shall be done with the Civil contractor where Civil works are not included in the scope of structural contractor at no extra cost so as to match with the project schedule.

17.0 PAYMENT

This clause shall apply to Item Rate tender only.

17.1 Payment for structural steel works shall be made on the basis of admissible weight in metric tons (determined as described in clause 17.2 and 17.3) of the structure accepted by the Engineer-in-Charge. The rate shall include supplying (as per supply conditions given in the

Tender) fabricating, erecting in position (at all levels & locations), testing/examining (excluding radiography only) of bolted and/or welded structural steel works of all types (including all built up/compound sections made out of rolled sections and/or plates) including all handling, transporting, storing, straightening if required, cutting, edge preparation, preheating, bolting and welding of joints (including sealing the joints of box sections with continuous welding), finishing edges by grinding/machining as shown, fixing in line & level with temporary staging & bracing and removal of the same after erection, grouting with non-shrink/ordinary grout as specified, preparation of fabrication & erection drawings, & erection schedule and getting them reviewed, preparation and submission of as built drawings, preparing the surfaces for painting, and applying the primer as specified after fabrication, return of surplus materials to owner's stores and material reconciliation in the case of materials supplied by the owner as per relevant contract conditions etc. all complete for all the operations mentioned in the foregoing clauses.

17.2 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 Contractor shall prepare full scale template in order to supplement/verify the actual cutting dimensions where so directed by the Engineer-in-Charge. The weight shall be calculated on the basis of BIS Hand Book wherever applicable. In case sections used are different from BIS sections, then Manufacturers' Hand Book shall be adopted. No allowance in weight shall be made for rolling tolerances.

17.3 Welds, bolts, nuts, washers, shims, pack plates, wedges, grout and shop painting shall not be separately measured. The quoted rate shall be deemed to include the same.

17.4 The rate shall include all expenses related to safety & security arrangements during erection and all plants & tools required for fabrication, transportation & erection.

18.0 PAINTING AFTER ERECTION

18.1 General

18.1.1 The scope of painting after erection shall be at the sole discretion of the Engineer-in-Charge and the Contractor shall obtain written instruction in this regard sufficiently prior to taking up any procurement of paint and execution of painting work after erection of steel structures.

18.1.2 The Contractor shall carry out the painting work in all respects with the best quality of approved materials (conforming to relevant EIL Specification no. 6-44-0004 or the job specification, as applicable) and workmanship in accordance with the best engineering practice. The Contractor shall furnish characteristics of paints (to be used) indicating the suitability for the required service conditions. The paint manufacturer's instructions supplemented by Engineer-in-Charge's direction, if any, shall be followed at all times. Particular attention shall be paid to the following:

- Proper storage to avoid exposure & extremes of temperature.
- surface preparation prior to painting.
- Mixing & thinning.
- Application of paint and the recommended limit on time intervals between consecutive coats.

18.1.3 Painting shall not be done in frost or foggy weather, or when humidity is such as to cause condensation on the surfaces to be painted.

18.1.4 Surface which shall be inaccessible after site assembly shall receive the full specified protective treatment before assembly.

18.1.5 Primers & finish coat paints shall be from the same manufacturer in order to ensure compatibility. Painting colour code shall be as per Annexure-'B' or the job specification.

18.2 Rub Down & Primer Application

The shop coated surfaces shall be rubbed down thoroughly with emery/abrasive paper to remove dust, rust, other foreign matters and degreased, if required, in accordance with EIL specification no. 6-44-0004 or the job specification, as applicable, cleaned with warm fresh water and air dried. The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry.

Primer coat as per EIL specification no. 6-44-0004 or the job specification, as applicable, shall be applied by brushing/ spraying over the shop coat in a manner so as to ensure a continuous and uniform film throughout. Special care shall be taken to cover all the crevices, corners, edges etc. The final primer coat shall be air dried and shall have a minimum film thickness as per EIL Specification no. 6-44-0004 or job specification after drying, as applicable.

In case a different cleaning procedure & primer specifications are specified in the drawing/Tender, the same shall be adopted.

18.3 Final Paint Application

After the primer is hard dry, the surfaces shall be dusted off and the paint as per EIL specification no. 6-44-0004 or the job specification, as specified, shall be applied by brushing/spraying so that a film free from "holidaying" is obtained. The colour & shade of first coat of paint shall be slightly lighter than the second coat in order to identify the application of each coat. The second coat of paint shall be applied after the first coat is hard dry. The minimum thickness of each film shall be 20 microns ($\pm 10\%$ tolerance) after drying.

In case a different type of paint & painting procedure are specified in the drawing/tender, the same shall be adopted.

18.4 Inspection & Testing of Painting Works

18.4.1 All painting materials including primers & thinners brought to site by the Contractor for application shall be procured directly from reputed and approved manufacturers and shall be accompanied by manufacturer's test certificates. Paint formulations without certificates shall not be accepted.

18.4.2 The Engineer-in-Charge at his discretion may call for additional tests for paint formulations. The Contractor shall arrange to have such tests performance including batch wise test of wet paints for physical & chemical analysis. All costs shall be borne by the Contractor.

18.4.3 The painting work shall be subject to inspection by the Engineer-in-Charge at all times. In particular, the stage inspection will be performed and Contractor shall offer the work for inspection and approval at every stage before proceeding with the next stage. The record of inspection shall be maintained. Stages of inspection are as follows:

- (a) Surface preparation
- (b) Primer application
- (c) Each coat of paint

- 18.4.4 Any defect noticed during the various stages of inspection shall be rectified by the Contractor to the entire satisfaction of the Engineer-in-Charge before proceeding further. Irrespective of the inspection, repair and approval at intermediate stages of work the Contractor shall be responsible for making good any defects found during final inspection/guarantee period/defect liability period, as defined in General Conditions of Contract. Dry film thickness (DFT) shall be checked and recorded after application of each coat. The thickness shall be measured at as many locations as decided by the Engineer-in-Charge. The Contractor shall provide standard thickness measuring instrument such as elcometer (with appropriate range for measuring dry film thickness of each coat) free of cost to the Engineer-in-Charge whenever asked for.

18.5 Payment

Payment for painting of structural steel works shall be made on the basis of admissible weight in metric tons of the painted structures accepted by the Engineer-in-Charge.

The rate shall include supplying & applying the paint, specified in the tender, of approved quality and shade over the primer, specified in the tender, over the shop primer already applied to structural steel works of all types/shapes at all levels, locations & positions including storage, surface preparation, degreasing, cleaning, drying, touching up of shop primer coat, providing temporary staging, testing etc. all complete to the entire satisfaction of the Engineer-in-Charge.

ANNEXURE-'A'
(Clause 12.4)

Maximum Permissible Erection Tolerances

A. Columns

1. Deviation of column axes at foundation top level with respect to true axes.
 - i) In longitudinal direction $\pm 5 \text{ mm}$
 - ii) In lateral direction $\pm 5 \text{ mm}$
2. Deviation in the level of bearing surface of columns at foundation top with respect to true level $\pm 5 \text{ mm}$
3. Out of plumb (Verticality) of column axis from true vertical axis, as measured at top:
 - i) Upto and including 30m height
whichever is less. $\pm H/1000 \text{ or } \pm 25 \text{ mm}$
 - ii) Over 30m height $\pm H/1200 \text{ or } \pm 35 \text{ mm}$
whichever is less.
4. Deviation in straightness in longitudinal & transverse planes of column at any point along the height. $\pm H/1000 \text{ or } \pm 10 \text{ mm}$
whichever is less.
5. Difference in the erected positions of adjacent pairs of columns along length or across width of building prior to connecting trusses/beams with respect to true distance. $\pm 5 \text{ mm}$
6. Deviation in any bearing or seating level with respect to true level. $\pm 5 \text{ mm}$
7. Deviation in difference in bearing levels of a member on adjacent pair of columns both across & along the building. $\pm 5 \text{ mm}$

Note: 1. Tolerance specified under 3 should be read in conjunction with 4 & 5.

Note: 2. 'H' is the column height in mm.

B. Trusses

1. Shift at the centre of span of top chord member with respect to the vertical plane passing through the centre of bottom chord. $\pm 1/250 \text{ of height of truss in mm at centre of span or } \pm 15 \text{ mm}$
whichever is less.
2. Lateral shift of top chord of truss at the centre of span from the vertical plane passing through the centre of supports of the truss. $\pm 1/1500 \text{ of span of truss in mm or } \pm 10 \text{ mm}$
Whichever is less.
3. Lateral shift in location of truss from its true position. $\pm 10 \text{ mm}$

- | | | |
|----|---|--|
| 4. | Lateral shift in location of purlin from true position. | ± 5mm |
| 5. | Deviation in difference of bearing levels of truss from the true level. | ± 1/1200 of span of truss in mm or 20mm whichever is less. |

C. Gantry Girders & Rails

- | | | |
|----|---|---|
| 1. | Shift in the centre line of crane rail with respect to centre line of web of gantry girder. | $\pm \left[\frac{\{\text{web thickness (mm)}\} + 2 \text{ mm}}{2} \right]$ |
| 2. | Shift of alignment of crane rail (in plan) with respect to true axis of crane rail at any point. | ± 5 mm |
| 3. | Deviation in crane track gauge with respect to true gauge. | |
| | i) For track gauge upto and including 15 m. | ± 5 mm. |
| | ii) For track gauge more than 15m.
Subject to maximum ± 10mm, where S in metres is true gauge. | ± [5 + 0.25 (S-15)] |
| 4. | Deviation in the crane rail level at any point from true level. | ± 10 mm. |
| 5. | Difference in level between crane track rails (across the bay) at | |
| | i) Supports of gantry girders | 15 mm. |
| | ii) Mid span of gantry girders | 20 mm. |
| 6. | Relative shift of crane rail surfaces (at a joining) in plan and elevation. | 2 mm. |

ANNEXURE-'B'
(Clause 18.2)

PAINTING COLOUR CODE FOR STRUCTURAL STEEL

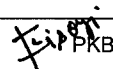
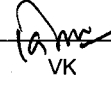
1.	GANTRY GIRDER & MONORAIL	DARK GREEN
2.	GANTRY GIRDER & MONORAIL STOPPER SIGNAL	RED
3.	BUILDING STRUCTURAL STEEL COLUMNS, BRACKETS, BEAMS, BRACINGS, ROOF TRUSS, PURLINS, SIDEGIRTS, LOUVERS, STRINGERS	DARK ADMIRALITY GREY
4.	PIPE RACK STRUCTURE & TRESTLE	DARK ADMIRALITY GREY
5.	CHEQUERED PLATE (BOTH FACES)	BLACK
6.	GRATING	BLACK
7.	LADDER RUNGS	BLACK
8.	HAND RAILING	VERTICALS & CAGE RED
-	HANDRAIL, MIDDLE RAIL, TOE PLATE	SIGNAL RED
-	VERTICAL POST	BLACK

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-incharge 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-incharge.

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-in-charge.

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-in-charge 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.

मानक विनिर्देशन
सिविल एवं संरचनात्मक कार्य
**STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS**
गिराने एवं तोड़ने सम्बंधी कार्य
DEMOLITION AND DISMANTLING

3	10.06.08	REAFFIRMED & REISSUED	 PKB	 PKM	 VK	 VC
2	25.04.01	REVISED & ISSUED AS STANDARD SPECIFICATION	SKP	RS	SCJ	MI
1	16.03.98	REVISED & ISSUED AS STANDARD SPECIFICATION	SARITA	SKP	SCJ	AS
0	AUG'89	ISSUED AS STANDARD SPECIFICATION		AKV	GPL	RCPC
Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

GI : Galvanized Iron

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.)

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1.0 SCOPE

This specification covers the procedure and safety requirements for demolition and dismantling of masonry (Brick & Stone), concrete (Plain /Reinforced), structural steel (sheeted / unsheeted) works .

2.0 GENERAL

2.1 Apart from this specification, the demolition and dismantling of structures (part or whole) shall be in compliance with all statutory safety regulations and any other special requirement as shown/noted on the drawings and General Conditions of Contract. Prior consent and approval of the Engineer-in-charge shall be obtained in writing before starting any dismantling works. Any restrictions imposed regarding working hours shall also be strictly followed by the Contractor.

2.2 All materials obtained from dismantling/demolition operations shall be the property of the Owner unless otherwise specified and shall be kept in safe custody until handed over to the Engineer-in-charge.

2.3 Where it becomes necessary to disconnect any existing service line(s) (such as electrical, piping etc.) during dismantling/demolishing operation and where so required by the Engineer-in-charge, suitable alternate arrangement shall be made by the Contractor to maintain the continuity and proper functioning of the affected service line(s) with the approval of the Engineer-in-charge at no extra cost to the Owner.

2.4 Specification No. 6-68-0003 (Earthwork) shall be referred to the extent applicable.

3.0 SAFETY PRECAUTIONS

3.1 The Contractor shall adhere to safe demolishing/dismantling practice at all stages of work to guard against accidents, hazardous and unsafe working procedures.

3.2 Necessary propping , shoring ,strutting and/or underpinning shall be done for the safety of all surrounding structures (whose safety is likely to be endangered) before taking up the demolishing and dismantling work.

3.3 Temporary enclosures made out of GI sheets, fencings, danger lights etc. shall be provided by the Contractor and got approved by the Engineer-in-charge before start of work to prevent accidents.

3.4 Contractor must ensure the availability of adequate fire fighting equipment / arrangements before starting actual demolishing/dismantling works. These facilities shall be made available throughout the entire operation of demolition and dismantling of structures.

3.5 All equipments, pipes , fittings and instruments, underground utilities etc. located in the vicinity shall be protected by suitable means, as decided by the Engineer-in-charge, during demolishing, dismantling operations.

3.6 Roads and working spaces shall be kept free of any debris/dismantled materials at the end of day's work.

3.7 Necessary measures shall be taken to keep the dust and noise nuisance to minimum levels.

3.8 Dismantled elements/components shall not be dropped from a height or thrown from a distance. Dismantling of elements fixed by screws/bolts/hooks etc. shall be done by taking

out the fixtures with proper tools only. Such fixtures may be allowed to be cut by sawing or flame cutting, in the event of their being stuck up due to corrosion etc. However, the decision of Engineer-in-charge in this regard shall be final and binding. Welds shall be removed by flame cutting. Tearing or ripping of elements shall not be resorted to under any condition.

4.0 PROCEDURE

- 4.1** Entire work of demolishing & dismantling shall be meticulously planned. Prior to start of work, the Contractor shall thoroughly understand the scope and nature of the work, and then prepare and submit the proposed work execution plan of demolishing & dismantling to the Engineer-in-charge for his review. Comments if any, shall be taken care by the contractor and execution of the work shall be done based on the revised execution plan.
- 4.2** Demolition and dismantling shall be restricted to the extent shown on drawings or as directed by the Engineer-in-charge.
- 4.3** Demolition of any structure shall be carried out in the sequence reverse to that followed at the time of its construction.
- 4.4** Dismantling shall be done in a systematic manner. All elements shall be carefully removed without causing any damage.
- 4.5** Blasting in any form shall not be permitted.
- 4.6** Chipping of concrete/grout shall be done with precision by chiselling. The finished surfaces shall be made true to the requisite size and shape.
- 4.7** Pockets/holes of specified size shall be made/cut by drilling/chiselling.

5.0 CLEANING & STACKING

All demolished/dismantled serviceable materials such as bricks, stones, reinforcement bars, structural steel, sheeting etc. shall be separated out, cleaned and stacked in separate lots within the plant boundary as directed by the Engineer-in-charge.

6.0 DISPOSAL

All unserviceable materials shall be disposed off in spoil heaps within or outside the plant boundary as per the directions of the Engineer-in-charge. Areas required outside the plant boundary for dumping of disposed material shall be arranged by the contractor and got approved by the Engineer-in-charge.

7.0 PAYMENT

7.1 General

Measurement of all works shall be taken prior to start of demolishing / chipping / dismantling works.

7.2 Masonry/Concrete Works (Demolition)

- 7.2.1** Payment shall be made on the basis of actual volume in cubic metres (cu.m.) of masonry/concrete works demolished. The thickness of plaster/bitumen felt shall be included in measurements.

- 7.2.2 The rate for demolishing shall include supply of all labour, tools & tackles, necessary safety measures, propping, underpinning, scaffolding, handling, cutting, straightening, scraping & cleaning of reinforcement bars and other embedments (in case of reinforced concrete works), sorting out and stacking of all serviceable materials, disposal of all unserviceable material, clearing the site, etc. all complete as specified and directed by the Engineer-in-charge.

7.3 Excavation & Backfilling

- 7.3.1 Excavation and backfilling shall be paid separately as per relevant clauses of Specification No. 6-68-0003 for Earth Work.

7.4 Chipping of Concrete Works

- 7.4.1 Payment shall be made on the basis of admissible area in square metres (sq.m.) of concrete surfaces chipped, pertaining to the different categories of thicknesses specified in the schedule of items.

- 7.4.2 The rate for chipping shall include supply of all labour, tools and tackles, necessary safety measures, scaffolding, chiselling, handling, exposing, cutting, straightening, scraping, clearing the reinforcement bars (in case of reinforced concrete works), wire brushing and washing the exposed surfaces, disposal of all unserviceable material etc. all complete as directed.

7.5 Making Pockets/Holes in Concrete Works

- 7.5.1 Payment shall be made on the basis of number (Each) of pockets/holes of sizes upto & inclusive of 200x200x500 mm, made or cut in the concrete works.

- 7.5.2 The rate for making pockets/holes shall include supply of all labour, tools & tackles, necessary safety measures, scaffolding, chiselling, drilling, handling, cutting or relocating reinforcement bars, cleaning, disposal of all unserviceable material etc. all complete as directed.

7.6 Dismantling of Structural Steel Works

- 7.6.1 Payment shall be made on the basis of weight (MT) of the structure/components being dismantled. Assessment of weight shall be done as per the specifications or as per the direction of Engineer-in-charge.

- 7.6.2 The rate for dismantling shall include supply of all labour, tools and tackles, equipment, consumables, necessary safety measures, scaffolding, propping, handling, unbolting, cutting (by sawing or flame cutting) of gussets/plates/bolts/hooks/welds, cleaning, sorting out and stacking of all serviceable materials, disposal of all unserviceable material, etc. all complete as specified and directed.

7.7 Dismantling of Roof & Wall Sheeting

- 7.7.1 Payment shall be made on the basis of dismantled sheeted area in square metres (sq.m.) of plan area in case of roof sheeting and area in elevation in case of side and louver sheeting.

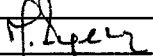
- 7.7.2 The rate for dismantling shall include supply of all labour, tools and tackles, equipments, consumables, necessary safety measures, handling, scaffolding, unbolting, cutting (by saw or flame cutting) of hook bolts, removal of ridges, gutters, flashings, transporting, stacking of all serviceable materials, disposal of all unserviceable material, etc. all complete as directed.

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तकनीकी विनिर्देशन
सिविल एवं संरचनात्मक कार्य

TECHNICAL SPECIFICATIONS
CIVIL AND STRUCTURAL WORKS

विविध मदें
MISCELLANEOUS ITEMS

2	26.04.01	UPDATED & REISSUED				
1	AUG'94	UPDATED & REISSUED	SBJ	RSOOD	GPL	ASONI
0	AUG'89	ISSUED AS STANDARD SPECIFICATION		AKV	GPL2	RCPC
REV.	DATE	REVISIONS	BY	CHECKED	CONVENOR	CHAIRMAN(S.B.)



ENGINEERS INDIA LIMITED
NEW DELHI

MISCELLANEOUS ITEMS

SPECIFICATION

6-68-0013

REV.

2

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6.0	ANTI-CORROSIVE LAYER
7.0	DRESSING & TRIMMING
8.0	CUTTING PILE HEADS
9.0	BUILDING-UP PILE HEADS
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11.0	SAND FILLING IN PLINTH/FOUNDATIONS
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1.0 SCOPE

The scope shall be as specified separately for different items below.

2.0 REFERENCES

2.1 BIS Codes

IS:73, 383, 6613

2.2 EIL specifications

6-68-0002 : Materials

6-68-0004 : Plain and Reinforced Cement Concrete

3.0 MATERIALS

The materials shall be as specified separately for different items below.

4.0 GENERAL REQUIREMENTS

4.1 The Contractor shall test the materials, where applicable, in approved laboratory as required by the Engineer-in-Charge and furnish test certificates for materials and obtain the approval of the Engineer-in-Charge prior to the use of such materials in the works. All tests shall be in accordance with relevant Indian Standards.

5.0 PRE-CONSTRUCTIONAL ANTI-TERMITE TREATMENT

5.1 Scope

This EIL specification establishes the materials and method of accomplishing pre-constructional anti-termite treatment of soil for protection of buildings against attack by subterranean termites with the usage of chemical emulsions in accordance with the procedure laid down.

5.2 Materials

Refer EIL specification no. 6-68-0002.

5.3 Procedure for Treatment

5.3.1 The treatment shall be carried out by an approved agency specialised in the field. Apart from this specification, the work shall be carried out in compliance with IS:6313. In case of any contradiction, this EIL specification shall govern.

5.3.2 Site Preparation

Prior to start of chemical treatment, area(s) shall be made free from logs, stumps, timber offcuts, leveling pegs, roots of plants/trees etc. Soil treatment shall start when foundation trenches/pits are ready to take concrete/masonry in foundations and plinth area ready for laying the subgrade. Treatment shall not be carried out when it is raining or the subsoil water level is at the same or higher than the level of treatment. In the event of water-logging of foundations, the water shall be pumped out and the chemical emulsion applied when the soil is absorbent.



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5.3.3 Treatment of the excavated pits/trenches and backfill for Foundations

- a) The bottom surface and the lower 300 mm side surfaces of the excavated pits/trenches for foundations of masonry works and RCC plinth beams supporting such masonry works, shall be treated with specified chemical emulsion @ 5 litres /m² of the surface area. However, no such treatment shall be required in case of pits/trenches made for RCC foundations supporting RCC walls and/or columns.
- b) On completion of construction of masonry foundations, the backfill in immediate contact with the substructure shall be treated in layers, of 300mm, with emulsion @ 7.5 litres/m² of the vertical surface of the substructure (i.e. $7.5 \times 0.300 = 2.25$ litres/meter of perimeter) for each side. The treatment shall be given after ramming of each layer of soil, by rodding the earth at 150mm centres close to the wall surface and working the rod backward and forward (parallel to the wall surface) and then spraying the specified dosage of emulsion. The emulsion shall be directed towards the masonry surfaces so that the soil in contact with these surfaces is well treated with the chemical. After the treatment, the soil shall be tamped back into place. This shall be done for full depth of the fill.
- c) For RCC walls and columns, the treatment as specified in (b) shall start from a depth 500 mm below the finished ground level, and shall be done upto the FGL.

5.3.4 Treatment of Plinth/Basement and Apron

- a) The top surface of the consolidated earth below the non-suspended floor slabs and the peripheral aprons of widths upto 750mm, the bottom surface and side surfaces of the excavated pits for the basements shall be treated with chemical emulsion @ 5 litres/m² of the surface area. Holes 50 to 75mm deep at 150mm centres, both ways, shall be made on the surface with 12mm diameter mild steel rod and then emulsion shall be sprayed uniformly over the area. At expansion joint locations, anti-termite treatment shall be supplemented by treating through the expansion joint @ 2.0 litres per linear metre of joint after the subgrade has been laid.
- b) Treatment of Junctions of plinth filling and wall/column faces shall be done after making a small channel 30mmx30mm, by making rod holes 150mm apart (upto the ground level) in the channel and then by moving the rod backward and forward to break up the earth. The chemical emulsion shall be poured along the channel @ 7.5 litres/m² of the vertical wall/column surface so as to soak the soil right to the bottom. The soil shall be tamped back into place after the treatment.

5.3.5 Treatment of Soil along External Perimeter of Building

After the building is complete, the earth along the external perimeter shall be rodded at intervals of 150mm and to depth of 300mm. The rod shall be moved backward and forward parallel to the wall to break up the earth and chemical emulsion poured along the wall @ 7.5 litres/m² of vertical surface (i.e. $7.5 \times 0.300 = 2.25$ litres/metre of perimeter). After the treatment, the earth shall be tamped back into place.

5.4 Payment

This clause shall apply to Item Rate tender only.

Payment for pre-constructional anti-termite treatment shall be made on square metre (sq.m.)



basis of plinth area of the building at ground floor only.

The rate shall include supplying all materials, spray pumps, tools, tackles & other accessories, labour, site preparation, rodding, tamping, mixing, spraying the specified chemical emulsion at prescribed dosage, storage facilities, handling, transporting etc. all complete as directed & specified.

6.0 ANTI-CORROSIVE LAYER

6.1 Scope

This EIL specification covers the requirement of materials, method of preparation and procedure for laying an anticorrosive layer over top surface of tank foundations for protection of bottom plates of steel tanks against corrosion attack.

6.2 Materials

6.2.1 Sand shall be clean, dry, coarse, hard, angular, free from coatings of clay, dust and mix of vegetable and organic matter and shall conform to IS:383 - Grade III.

6.2.2 Bitumen shall be of grade A 90 conforming to IS:73.

6.3 Mixing and Laying

The bitumen shall be heated to a temperature of 175°C to 190°C with 3% kerosene if required and sand (8 to 10% by volume) shall be thoroughly mixed with it in a mixing drum to give a uniform mixture and shall be laid over clean and dry surface of tank foundation to line, grade and levels as shown on the drawings and directed by the Engineer-in-Charge. Bitumen shall not be heated beyond the specified temperature limits. The layer shall be tamped to form hard mass of specified compacted thickness.

6.4 Payment

This clause shall apply to Item Rate tender only.

The payment shall be made on square metre (sq.m.) basis of the area covered with the anticorrosive layer.

The rate shall include supplying all materials, tools, plants, labour, transportation, handling, heating, mixing, laying, tamping etc. all complete as specified.

7.0 DRESSING & TRIMMING

7.1 Scope

This EIL specification covers the procedure for dressing, trimming and paving with earth the peripheral area around the completed building/structure.

7.2 Procedure

The ground all around the completed building/structure for 3 metres width or as specified by the Engineer-in-Charge, shall be cleaned and dressed to suitable slope. Over the prepared



ground a layer of approved earth shall be spread, watered and well consolidated so as to achieve an average thickness of 75mm.

7.3 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made on square metre (sq.m.) basis of the actual area dressed and paved with earth.

The rate shall include supplying all materials, labour including cleaning, dressing the ground to required slope, spreading of earth, watering, ramming, consolidating etc. all complete as directed.

8.0 CUTTING PILE HEADS

8.1 Scope

This EIL specification covers procedure for cutting pile heads of cast-in-situ RCC piles.

8.2 Procedure

Head of already cast RCC piles shall be cut after 28 days of casting up to a length and elevation as shown on the drawing by chiseling taking all necessary safety precautions. Care shall be taken that pile reinforcement is not cut or damaged during chiseling operation. All debris and loose or cracked concrete in the pile shall be removed and disposed off within the plant boundary as per the directions of the Engineer-in-Charge and site shall be left clean for casting of pile caps. The surface of reinforcement bars shall be cleaned, if required by wire brushing, so that no old concrete sticks to them.

8.3 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made per pile basis for the actual number of pile heads cut.

The rate shall include supplying all tools and tackles, labour including disposal of debris, bending the pile reinforcements for proper anchorage within the pile cap etc. all complete as directed.

9.0 BUILDING-UP PILE HEADS

9.1 Scope

This EIL specification covers requirements of materials and procedure for building-up of RCC Pile Heads.

9.2 Materials

9.2.1 Concrete shall be of the same grade & EIL specification as that for the pile.

9.2.2 Reinforcement shall be of the same grade and EIL specification as that for the pile.



9.2.3 Type of cement shall be same as that used for the pile.

9.3 Procedure

Concrete in existing piles shall be chiseled off minimum upto the lap-length of the reinforcements in the pile. In cases where reinforcements are longer than the concreted piles, the top concrete of the existing piles shall be chiseled off upto a length of 800mm.

Concrete surface and reinforcement of pile shall be cleaned of any dirt, grease, debris etc. and concrete surface shall be made rough by hacking. Reinforcement shall be lapped/welded as per the direction of the Engineer-in-Charge. Neat cement slurry shall be applied on top surface of concrete and using approved formwork concreting shall be done upto the level shown on the drawing or as directed by the Engineer-in-Charge.

9.4 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made on cubic metre basis for the total quantity of concrete actually poured for achieving the level as shown on drawings.

The rate shall include supply of all materials (except reinforcement which shall be paid separately as per respective item) labour, cleaning, welding, shuttering, vibrating, finishing, curing etc. all complete. Cutting of pile heads and excavation including backfilling shall be paid separately as per respective item.

10.0 HARD CORE

10.1 Scope

This EIL specification covers the requirements of materials and procedure for laying of hard core.

10.2 Materials

Hard core shall consist of broken/crushed stones of 150mm and down size. Stones shall be sound, angular, hard and free from flakes, dust and other impurities.

10.3 Procedure

Hard core shall be laid to the grade, level and thickness as shown on the drawing. Broken stones of required height shall be vertically placed and blinded with approved murrum/sand and consolidated with roller including watering, dressing etc. However, areas inaccessible by roller may be compacted by hand rammer.

10.4 Payment

This clause shall apply to Item Rate tender only.

The hard core shall be measured on the basis of volume in cubic metres (cu.m.) of the compacted hard core laid. The rate shall include all labour, materials, consolidation by rammer/roller, watering, dressing etc. all complete.



11.0 SAND FILLING IN PLINTH/FOUNDATIONS

- 11.1 For EIL specification of sand to be used for filling, reference shall be made to EIL specification No.6-68-0002.
- 11.2 Filling shall be carried out in layers not exceeding 15cms and shall be compacted mechanically or by saturation to specified grade and level and to obtain 90 % laboratory maximum dry density or as specified in schedule of rates.
- 11.3 Compaction by flooding may be accepted at the discretion of the Engineer-in-Charge, provided the required compaction is achieved.
- 11.4 The Contractor shall not commence filling in and around any work until it has been permitted by the Engineer-in-Charge.

11.5 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made on cubic metre (cu.m.) basis of the finished compact volume. The rate shall include cost of sand for any compacted thickness, wastage if any, all handling, transport for all leads, tamping, watering, flooding, dressing etc. Any brick work required for ponding shall be paid separately under relevant item.

12.0 DAMP PROOF COURSE - (DPC)

- 12.1 All materials used for Damp Proof Course shall comply with EIL specification No. 6-68-0002.
- 12.2 The 40mm thick Damp Proof Course shall consist of plain cement concrete of grade M-20, unless otherwise specified.
- 12.3 The Damp Proof Course shall be laid at plinth level of masonry walls, flush with the floor surface and shall not be carried across doorways.
- 12.4 Before laying, the top surface of wall shall be thoroughly cleaned and watered. The D.P.C. shall be laid in layers of 20mm thickness retaining the edges by necessary formwork and shall be well tamped and troweled to smooth finish. The layer shall be cured by keeping the surface wet for 40 hours and after it has dried, two coats of hot bitumen of grade A120/S120 conforming to IS:73 shall be applied over it at the rate of 1.7 Kg./m². Over this, the second layer of 20mm thick concrete shall be laid and cured as described in case of the first layer and two coats of hot bitumen at the rate of 1.7 Kg./m² shall be applied again in a similar manner. Over this, dry sharp sand shall be sprinkled evenly before hardening of second coat of bitumen paint.

12.5 Payment

This clause shall apply to Item Rate tender only.

Payment shall be made on square metre (sq.m.) basis of the area laid. The rate shall be inclusive of formwork, curing, providing and laying bitumen, supplying and spreading sand over bitumen etc. complete.



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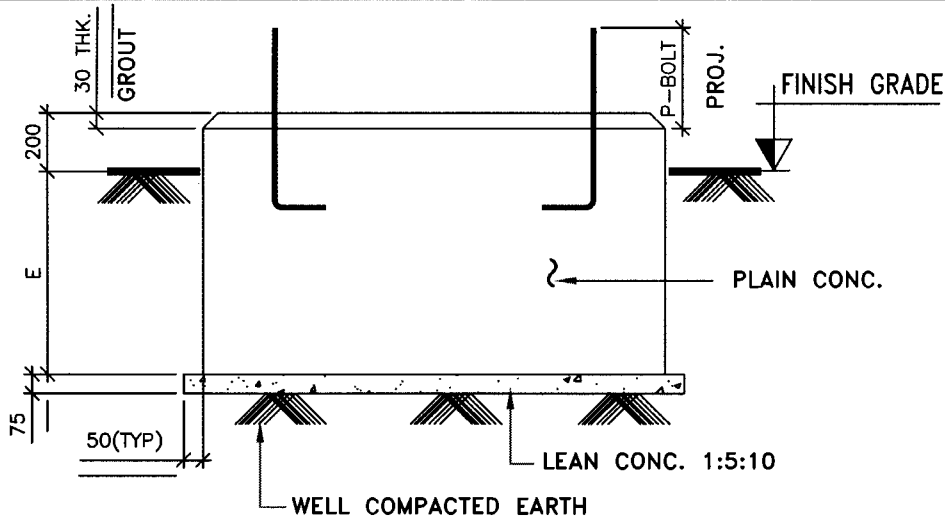
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6-68-0013

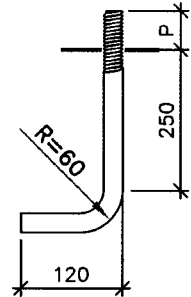
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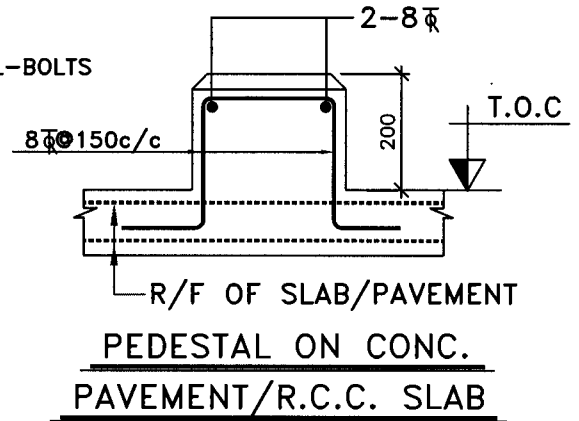
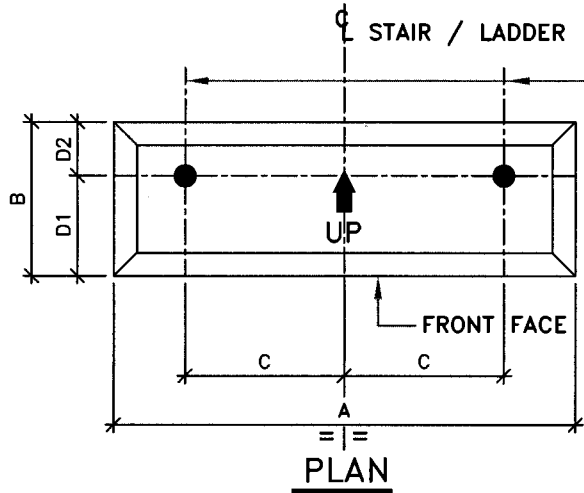
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PEDESTAL FOR UNPAVED AREA



DET. OF L-BOLT

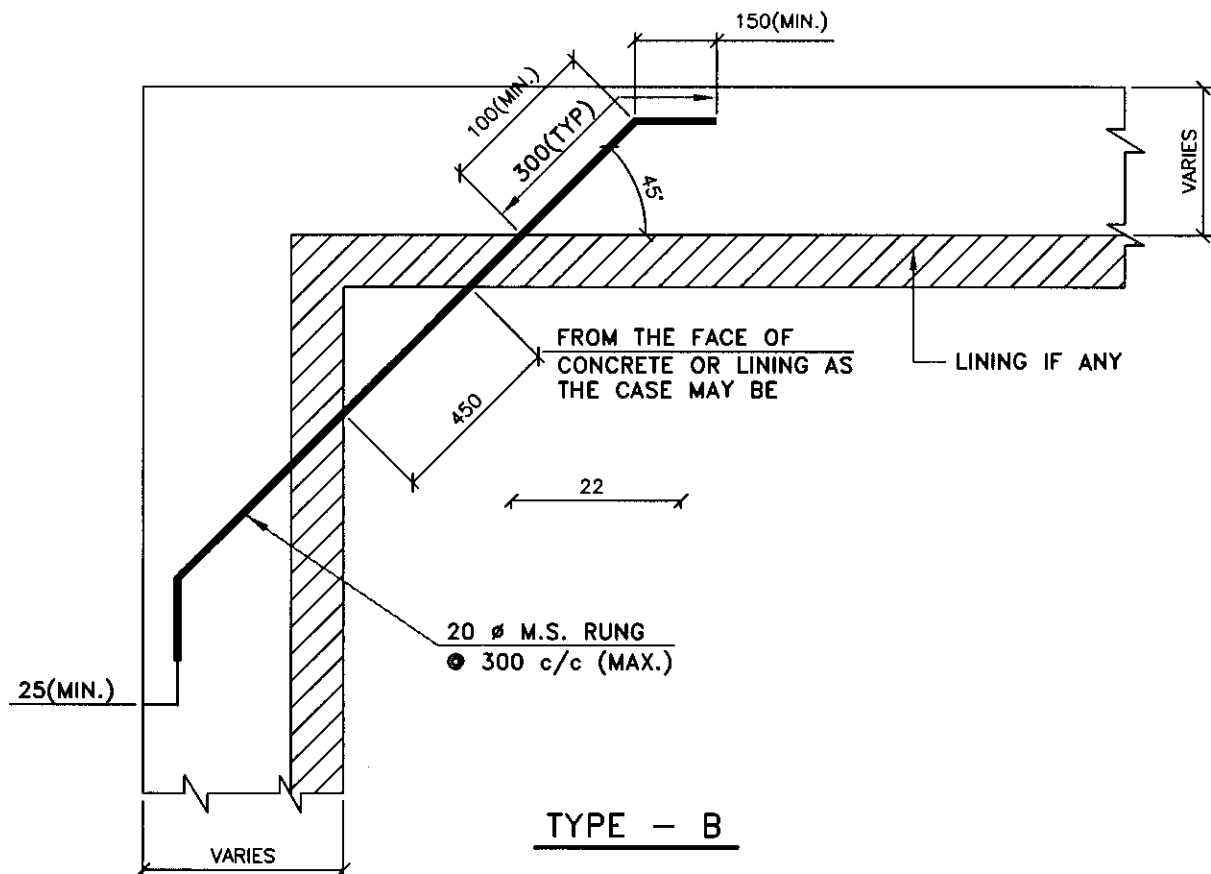


S.NO.	ITEM	WIDTH	A	B	C	D1	D2	P	E	NUT	REMARKS
1	LADDER	450	750	300	280	200	100	90	500	SINGLE	
2	STAIR	750	1100	310	421	160	150	90	600	SINGLE	FOR STRINGER BEAM MC150
3	STAIR	750	1100	355	421	255	100	90	600	SINGLE	FOR STRINGER BEAM MC200

NOTES:-

1. IN CASE OF PEDESTAL OVER PILE CAP/RCC FOUNDATION, DIMENSION E TO SUIT ACCORDINGLY BUT NOT TO EXCEED VALUES GIVEN IN ABOVE TABLE.
2. CONCRETE GRADE SHALL BE AS PER GENERAL NOTES OF THE PROJECT BUT NOT LOWER THEN M20.
3. M20 L-BOLT AS PER DETAIL GIVEN ABOVE SHALL BE PROVIDED.
4. BOLTS SHALL BE TURNED FROM MILD STEEL BARS CONFORMING TO IS:2062 GRADE-A.
5. HEXAGONAL NUTS AND WASHERS SHALL CONFORM TO IS:1363 AND IS:3138.
6. THREADING SHALL BE COARSE AND CONFORM TO IS:1367 AND IS:4218.

5	30.03.07	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	ARVIND KUMAR	V.CHATURVEDI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



5	09.10.07	REAFFIRMED AND ISSUED AS STANDARD	 VPS	 P.K. MITTAL	 VINAY KUMAR	 V. CHATURVEDI
4	19.04.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
Approved by						

GENERAL NOTES :-

1. ALL LUGS SHALL BE OF HIGH STRENGTH DEFORMED BARS OF GRADE Fe415 CONFORMING TO IS:1786 (WITH GUARANTEED WELDABILITY) AND SHALL BE CONNECTED TO METAL INSERT PLATES BY 6 mm FILLET WELDS AS SHOWN IN SKETCHES.
2. METAL INSERT PLATES SHALL BE CONFORMING TO IS:2062 (GR-A).
3. METAL INSERT PLATES MARKED ON DRAWING REFER AS UNDER

IP-(A) • (C)

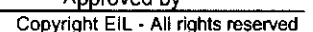
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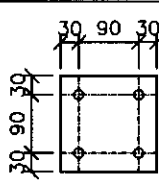
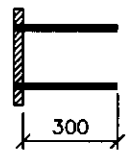
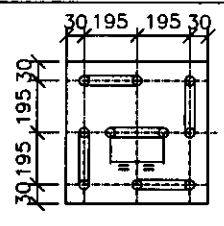
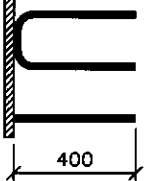
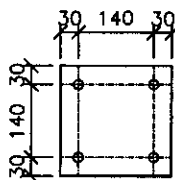
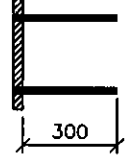
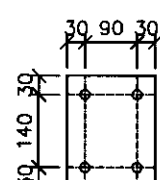
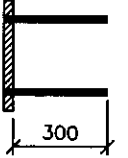
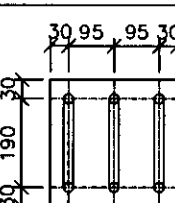
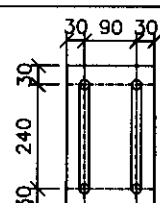
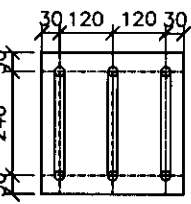
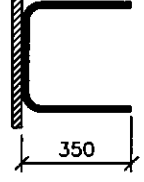
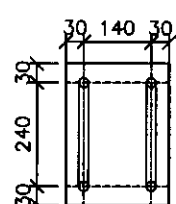
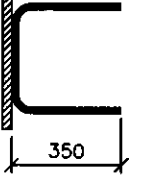
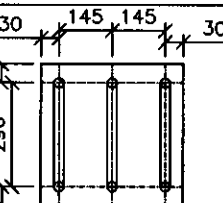
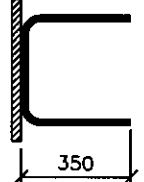
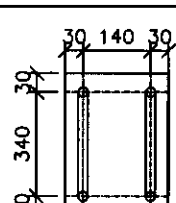
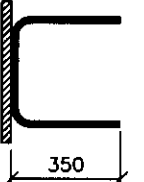
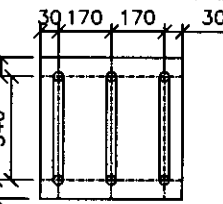
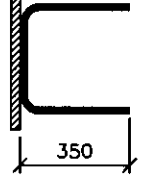
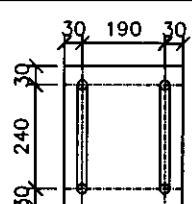
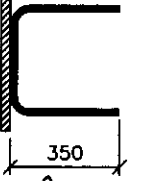
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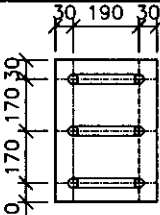
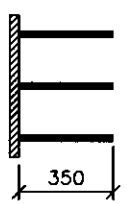
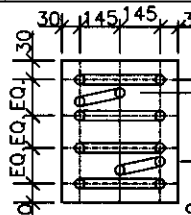
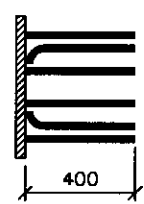
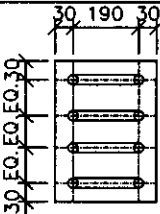
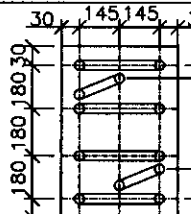
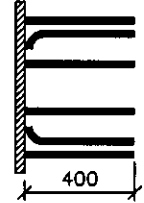
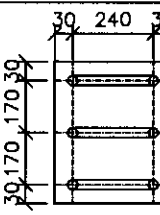
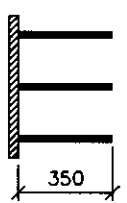
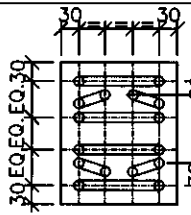
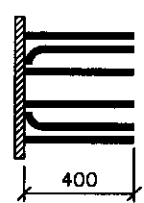
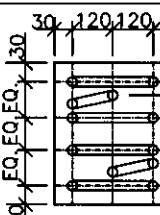
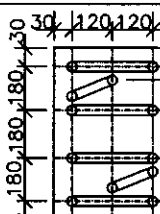
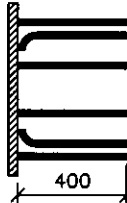
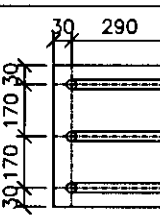
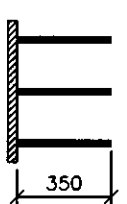
C = ELEVATION OF INSERT PLATE (TOP EDGE)

e.g IP-R9a • EL.110.300 MEANS INSERT PLATE TYPE R9a AT EL.110.300.
4. METAL INSERT PLATES SHALL BE KEPT FLUSH WITH CONCRETE SURFACE.
5. THE LONGER SIDE OF METAL INSERT PLATE SHALL BE KEPT VERTICAL UNLESS SHOWN OTHERWISE.
6. METAL INSERT PLATE ON COLUMN OR BEAM SHALL BE KEPT SYMMETRICAL ABOUT C_g OF COLUMN OR BEAM, UNLESS SHOWN OTHERWISE.

5	09.10.07	REVISED AND ISSUED AS STANDARD	 VPS	 P.K. MITTAL	 VIHAY KUMAR	 V. CHATURVEDI
4	16.04.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
						Approved by



S. NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE		S. NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE	
				PLAN	CROSS SECTION					PLAN	CROSS SECTION
1.	S1a	12	12			7.	S7a	12	12		
	S1b	16	16	<u>SIZE 150x150</u>			S7b	16	16	<u>SIZE 450x450</u>	
2.	S2a	12	12			8.	R1a	12	12		
	S2b	16	16	<u>SIZE 200x200</u>			R1b	16	16	<u>SIZE 150x200</u>	
3.	S3a	12	12			9.	R2a	12	12		
	S3b	16	16	<u>SIZE 250x250</u>			R2b	16	16	<u>SIZE 150x300</u>	
4.	S4a	12	12			10.	R3a	12	12		
	S4b	16	16	<u>SIZE 300x300</u>			R3b	16	16	<u>SIZE 200x300</u>	
5.	S5a	12	12			11.	R4a	12	12		
	S5b	16	16	<u>SIZE 350x350</u>			R4b	16	16	<u>SIZE 200x400</u>	
6.	S6a	12	12			12.	R5a	12	12		
	S6b	16	16	<u>SIZE 400x400</u>			R5b	16	16	<u>SIZE 250x300</u>	
5	09.10.07	REVISED AND REISSUED AS STANDARD									
4	16.04.01	REAFFIRMED AND ISSUED AS STANDARD				SK SAGAR	RP MEHROTRA	SC JAIN	M. IYENGAR		
Rev. No.	Date	Purpose				Prepared by	Checked by	Stds. Committee Convenor		Stds. Bureau Chairman	
Approved by											

S. NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE		S. NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE	
				PLAN	CROSS SECTION					PLAN	CROSS SECTION
13.	R6a	12	12	 SIZE 250x400		19.	R12a	12	12	 SIZE 350x500	
	R6b	16	16				R12b	16	16		
14.	R7a	12	12	 SIZE 250x500		20.	R13a	12	12	 SIZE 350x600	
	R7b	16	16				R13b	16	16		
15.	R8a	12	12	 SIZE 300x400		21.	R14a	12	12	 SIZE 400x500	
	R8b	16	16				R14b	16	16		
16.	R9a	12	12	 SIZE 300x500							
	R9b	16	16								
17.	R10a	12	12	 SIZE 300x600							
	R10b	16	16								
18.	R11a	12	12	 SIZE 350x400							
	R11b	16	16								

5 09.10.07 REAFFIRMED AND ISSUED AS STANDARD

4 16.04.01 REAFFIRMED AND ISSUED AS STANDARD

VPS

P.K.MITTAL

VINAY KUMAR

V.CHATURVEDI

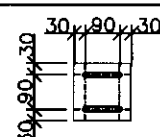
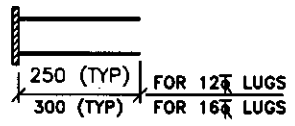
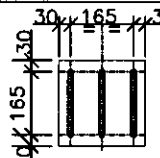
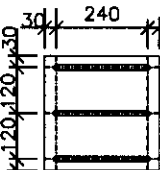
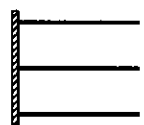
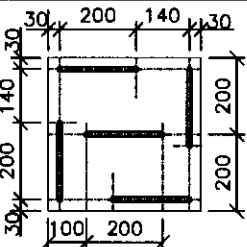
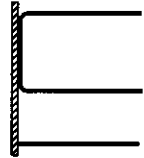
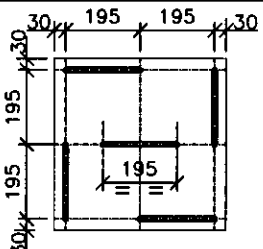
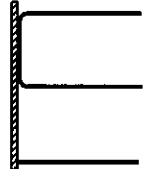
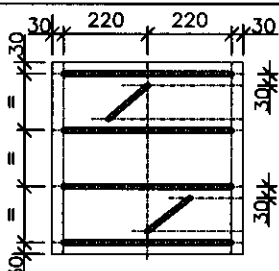
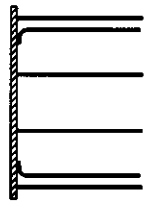
SK SAGAR
Prepared by

RP MEHROTRA
Checked by

SC JAIN
Stds. Committee
Convenor

M IYENGAR
Stds. Bureau
Chairman

Approved by

S.NO.	TYPE OF INSERT	DIA OF LUGS	THK. OF INSERT	DETAILS OF INSERT PLATE	
				PLAN	CROSS SECTION
1.	PS1	12	12	 SIZE 150x150	
	PS2	16	16		
2.	PS3	12	12	 SIZE 225x225	
	PS4	16	16		
3.	PS5	12	12	 SIZE 300x300	
	PS6	16	16		
4.	PS7	12	12	 SIZE 400x400	
	PS8	16	16		
5.	PS9	12	12	 SIZE 450x450	
	PS10	16	16		
6.	PS11	12	12	 SIZE 500x500	
	PS12	16	16		

5 09.10.07 REAFFIRMED AND ISSUED AS STANDARD

VPS

P.K.MITTAL

VINAY KUMAR

V.CHATURVEDI

4 16.04.01 REAFFIRMED AND ISSUED AS STANDARD

SK SAGAR

RP MEHROTRA

SC JAIN

M IYENGAR

Rev.
No.

Date

Purpose

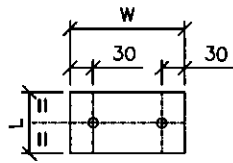
Prepared
by

Checked
by

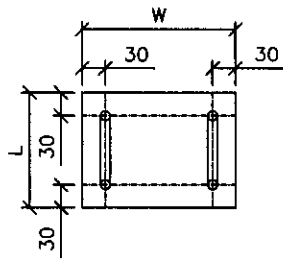
Stds. Committee
Convenor

Stds. Bureau
Chairman

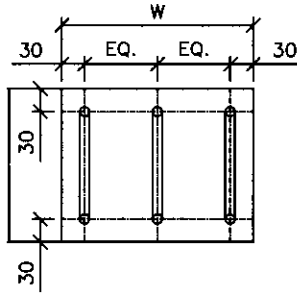
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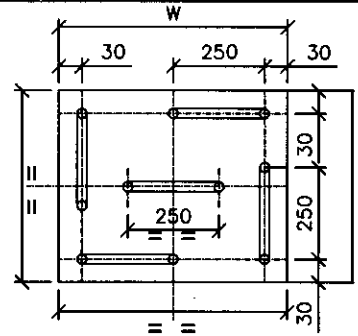
TYPE T1



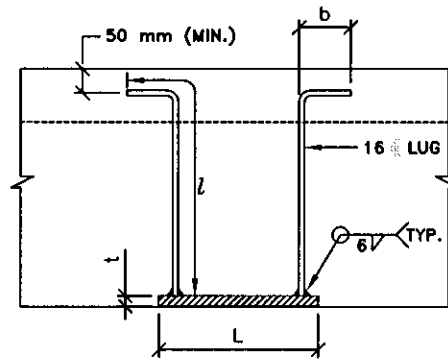
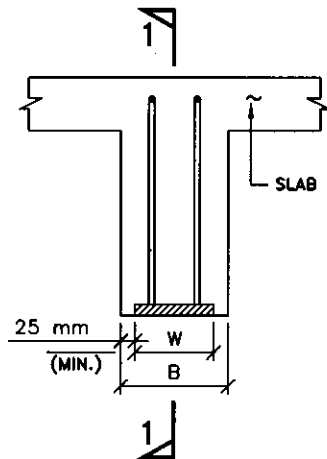
TYPE T2, T3 & T4



TYPE T5 & T6



TYPE T7



SECTION 1-1

TYPICAL FIXING DETAIL

S.NO.	TYPE OF INSERT	WIDTH OF BEAM 'B' (mm)	MAXIMUM WIDTH OF PLATE 'W' (mm)	LENGTH OF PLATE 'L' (mm)	MAXIMUM 'b' (mm)	THICKNESS OF PLATE 't' (mm)	TOTAL ANCHORAGE LENGTH 'l' (mm)
1.	T1	230	180	180	110	16	350
2.	T2	300	220	250	110	20	350
3.	T3	350	270	250	110	20	350
4.	T4	400	320	250	110	20	350
5.	T5	450	370	300	110	32	350
6.	T6	500	420	300	110	32	350
7.	T7	500	420	400	110	32	350

5 09.10.07 REAFFIRMED AND ISSUED AS STANDARD

VPS

P.K.MITTAL

VINAY KUMAR

V.CHATURVEDI

4 16.04.01 REAFFIRMED AND ISSUED AS STANDARD

SK SAGAR

RP MEHROTRA

SC JAIN

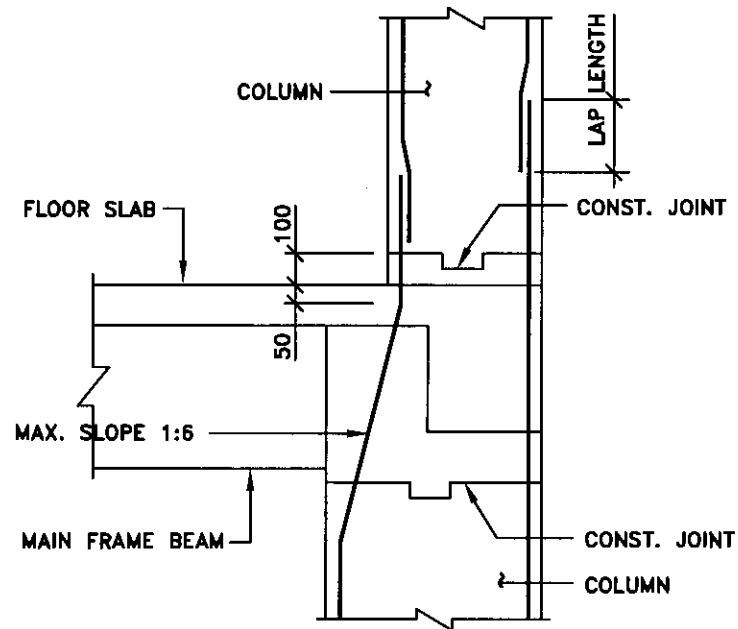
M IVENGAR

Rev. No. Date Purpose

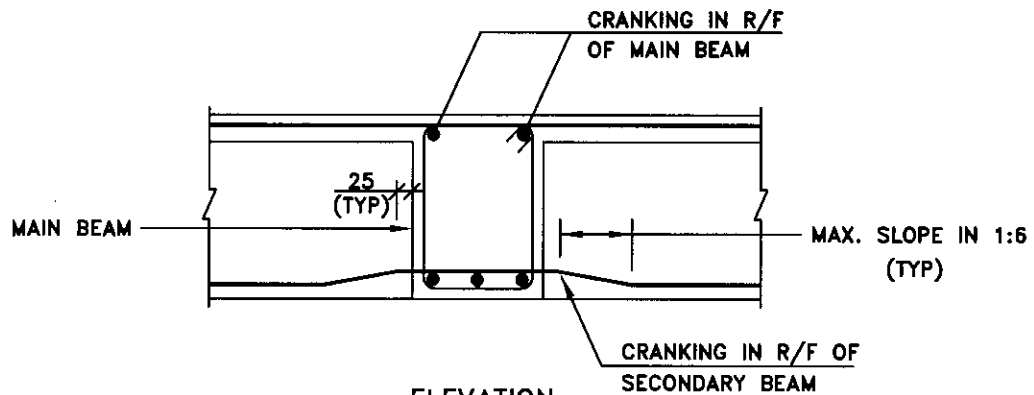
Prepared by Checked by

Stds. Committee Convenor Stds. Bureau Chairman

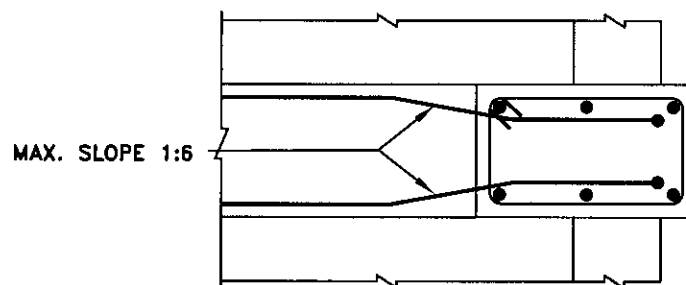
Approved by



ELEVATION
TYP. DETAIL AT BEAM COLUMN JUNCTION



ELEVATION
TYP. DETAIL AT JUNCTION OF TWO
BEAMS OF SAME DEPTH



PLAN
TYP. DETAIL AT JUNCTION OF BEAM AND
COL. OF SAME WIDTH

NOTE:

ALL DIMENSIONS ARE IN mm.

4	10.12.07	REAFFIRMED AND ISSUED AS STANDARD				
3	16.04.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman

STANDARD RE-BAR SHAPES
AND
CUT LENGTH COMPUTATION

METHOD OF MEASUREMENT OF BENDING DIMENSIONS	APPROX. TOTAL LENGTH OF BAR (L) MEASURED ALONG $\bar{C}$	SKETCH & DIMENSIONS TO BE GIVEN IN SCHEDULE	METHOD OF MEASUREMENT OF BENDING DIMENSIONS	APPROX. TOTAL LENGTH OF BAR (L) MEASURED ALONG $\bar{C}$	SKETCH & DIMENSIONS TO BE GIVEN IN SCHEDULE
	A	STRAIGHT		A+B+C+D	
	A+H			A+B+2C	
	A+2H			A+B+2C+2H	
	A+B			IF ANGLE WITH HORIZONTAL IS 45° OR LESS A+B	
	A+B+C			A+B+2H	
	WHERE C IS MORE THAN 3D A+E+C				
	A+B+C			A+B+C+D+E	
	A+B+C+2H			A+B+C+D+E	
	A+B+C+2H			A+B+D+E	
	A+B+H			A+B+C	

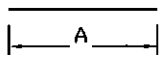
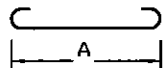
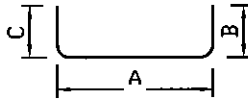
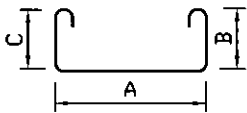
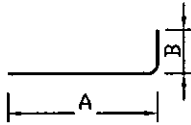
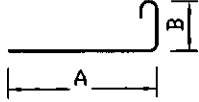
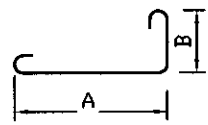
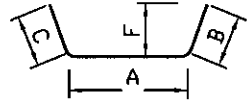
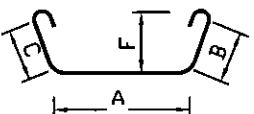
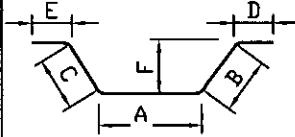
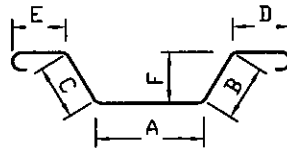
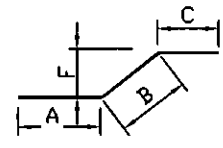
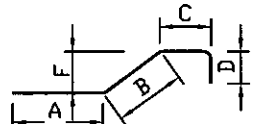
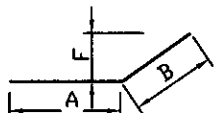
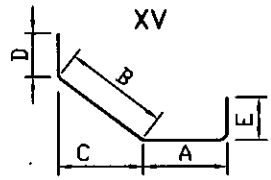
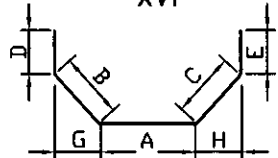
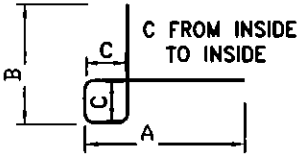
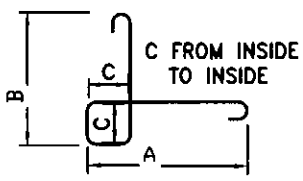
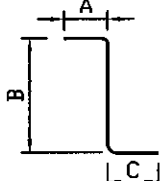
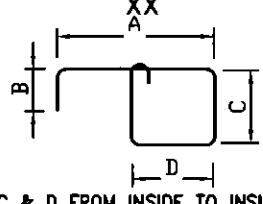
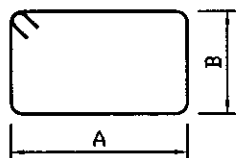
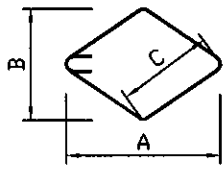
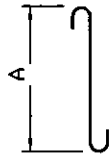
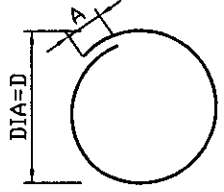
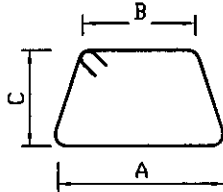
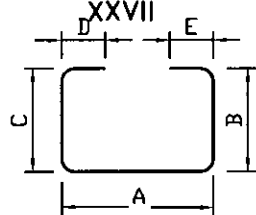
4	08-10-07	REAFFIRMED AND ISSUED AS STANDARD		P.K. MITTAL	VINAY KUMAR	V. CHATURVEDI
3	30-06-99	REAFFIRMED AND ISSUED AS STANDARD	RDD	RP MEHROTRA	SC JAIN	A SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						

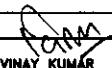
METHOD OF MEASUREMENT OF BENDING DIMENSIONS	APPROX. TOTAL LENGTH OF BAR (L) MEASURED ALONG ϵ	SKETCH & DIMENSIONS TO BE GIVEN IN SCHEDULE	METHOD OF MEASUREMENT OF BENDING DIMENSIONS	APPROX. TOTAL LENGTH OF BAR (L) MEASURED ALONG ϵ	SKETCH & DIMENSIONS TO BE GIVEN IN SCHEDULE
	$A+E+2S+2H+d$			$2(A+E)+24d$	
	$A+E+3S+2d+B+H$			$2(A+E)+20d$	
	$A+E+C+2H-D-\sqrt{C^2-D^2}$			$2A+E+28d$	
	$E+2(A-D+C+H)$			$2A+E+C+12d+B$	
	$B+2C+2H$			$2A+E+C+9d+B$	
	$2C+2E1+B+2H$			$4C+24d$	
	$2A+3D+22d$			$4C+24d$	
	$2A+3D+22d$			WHERE P IS NOT GREATER THAN $D/5$ N $\pi (D+d)+8d$ N= NUMBER OF COMPLETE AND FRACTIONAL TURNS D= INTERNAL DIA. P= PITCH OF HELIX d= SIZE OF BAR	

4	08-10-07	REAFFIRMED AND ISSUED AS STANDARD		P.K. MITTAL		VINAY KUMAR		V. CHATURVEDI
3	30-06-99	REAFFIRMED AND ISSUED AS STANDARD	RDO	RP MEHROTRA	SC JAIN	A SONI		
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman	Approved by	

METHOD OF MEASUREMENT OF BENDING DIMENSIONS	APPROX. TOTAL LENGTH OF BAR (L) MEASURED ALONG ϵ	SKETCH & DIMENSIONS TO BE GIVEN IN SCHEDULE	METHOD OF MEASUREMENT OF BENDING DIMENSIONS	APPROX. TOTAL LENGTH OF BAR (L) MEASURED ALONG ϵ	SKETCH & DIMENSIONS TO BE GIVEN IN SCHEDULE
	$A+B+2C+D$			$A+E-1/2R-d+2B$	
	$A+2H$			$A+E-1/2R-d+2H$	
				$A+E+4/3d+2H$	
	$A+2H$			$A+2B+2C-12d$	
	$\pi D+A$			$A+E-1/2R-d$	
 IF ANGLE WITH HORIZ. IS 45° OR LESS $A+B+C+H-2(R+d)$ IF ANGLE IS GREATER THAN 45° & R EXCEEDS 12d, L TO BE CALCULATED			 IF ANGLE WITH HORIZ. IS 45° OR LESS & R IS 12d OR LESS $A+E+2H$, IF ANGLE IS GREATER THAN 45° & R EXCEEDS 12d L TO BE CALCULATED		
 IF ANGLE WITH HORIZ. IS 45° OR LESS & R IS 12d OR LESS $B+C+E+2H$ OR $A+2H+C-\sqrt{C^2-D^2}$ (IF A IS SPECIFIED B OR E IS OMITTED)			 IF ANGLE WITH HORIZ. IS 45° OR LESS & R IS 12d OR LESS $B+C+1+C2+E+F+2H$ OR $A+C1+C2+2H-\sqrt{C1^2-D1^2}-\sqrt{C2^2-D2^2}$ (IF A IS SPECIFIED B, E OR F IS OMITTED)		

4	08-10-07	REAFFIRMED AND ISSUED AS STANDARD		P.K. MITTAL		VINAY KUMAR		V. CHATURVEDI
3	30-06-99	REAFFIRMED AND ISSUED AS STANDARD		RP MEHROTRA		SC JAIN		A SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman	Approved by	

I 	II 	III 	IV 
V 	VI 	VII 	VIII 
IX 	X 	XI 	XII 
XIII 	XIV 	XV 	XVI 
XVII  C FROM INSIDE TO INSIDE	XVIII  C FROM INSIDE TO INSIDE	XIX 	XX  C & D FROM INSIDE TO INSIDE
XXI  A & B FROM INSIDE TO INSIDE	XXII  C FROM INSIDE TO INSIDE	XXIII 	XXIV  DIA=D
XXV SEE NOTE 6	XXVI 	XXVII 	

4	08-10-07	REAFFIRMED AND ISSUED AS STANDARD		P.K. MITTAL		VINAY KUMAR		V.CHATURVEDI
3	30-06-99	REAFFIRMED AND ISSUED AS STANDARD	RDD	RP MEHROTRA	SC JAIN	A SONI		
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman	Approved by	

CUT LENGTH CALCULATION
FOR BARS OF DIAMETER ≤ 25 MM

BAR TYPE (REFER 7-68-0101 SHT. 4)	HIGH YIELD DEFORMED BARS	REMARKS
I	A	
II	$A+13d+13d$	
III	$A+B+C-(3d+3d)$	
IV	$A+B+C+13d+13d-(3d+3d)$	
V	$A+B-3d$	
VI	$A+B+13d-3d$	
VII	$A+B+13d+13d-3d$	
VIII	$A+B+C$	*
IX	$A+B+C+13d+13d$	*
X	$A+B+C+D+E$	*
XI	$A+B+C+D+E+13d+13d$	*
XII	$A+B+C$	*
XIII	$A+B+C+D-3d$	*
XIV	$A+B$	*
XV	$A+B+D+E-3d$	*
XVI	$A+B+C+D+E$	*
XVII	$A+B+C+C+d$	
XVIII	$A+B+C+C+13d+13d+d$	
XIX	$A+B+C-6d$	
XX	$A+B+C+C+D+13d-12d$	
XXI	$2(A+B)+10d+10d$	SEE NOTE 4
XXII	$4C+20d$	SEE NOTE 5
XXIII	$A+13d+13d$	
XXIV	$D+A$	
XXV	LUMPSUM	SEE NOTE 6
XXVI	$A+B+2\left\{\frac{(A-B)}{2}\right\}^2+C^2\right\}^{1/2}+13d$	
XXVII	$A+B+C+D+E-12d$	

4	08-10-07	REAFFIRMED AND ISSUED AS STANDARD		P.K. MITTAL		VINAY KUMAR		V. CHATURVEDI
3	30-06-99	REAFFIRMED AND ISSUED AS STANDARD	RDO	RP MEHROTRA	SC JAIN	A SONI		
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman	Approved by	

CUT LENGTH CALCULATION
 FOR BARS OF DIAMETER > 25 MM

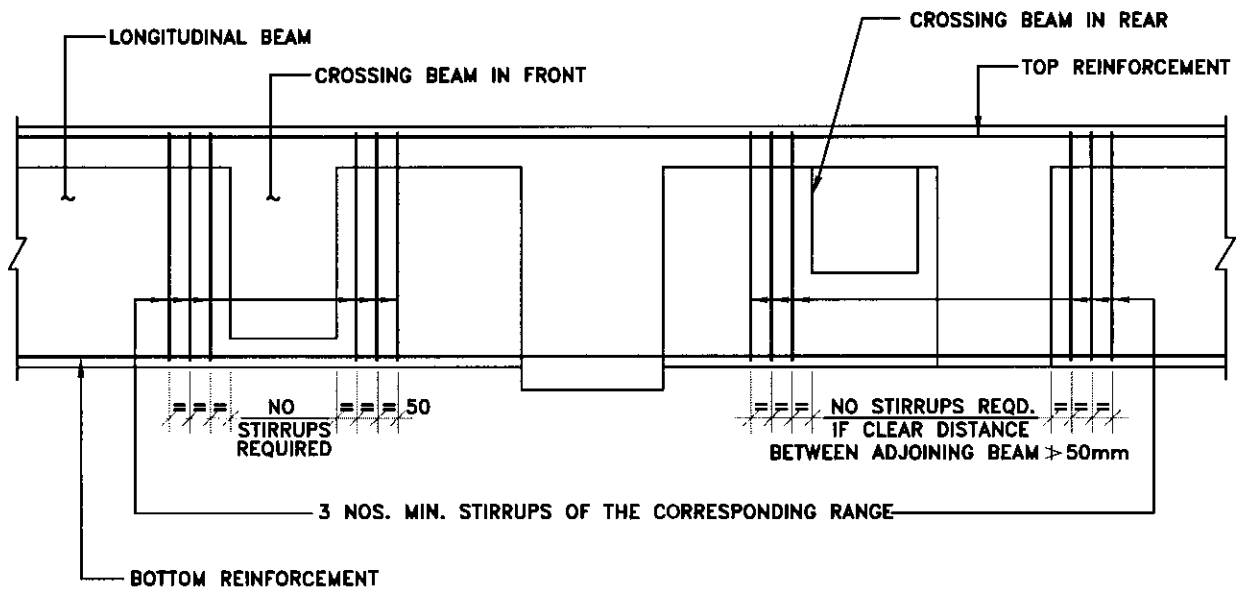
BAR TYPE	HIGH YIELD DEFORMED BARS	REMARKS
I	A	
II	A+17d+17d	
III	A+B+C-(4d+4d)	
IV	A+B+C+17d+17d-(4d+4d)	
V	A+B-4d	
VI	A+B+17d-4d	
VII	A+B+17d+17d-4d	
VIII	A+B+C	*
IX	A+B+C+17d+17d	*
X	A+B+C+D+E	*
XI	A+B+C+D+E+17d+17d	*
XII	A+B+C	*
XIII	A+B+C+D-4d	*
XIV	A+B	*
XV	A+B+D+E-4d	*
XVI	A+B+C+D+E	*
XVII	A+B+C+C+d	
XVIII	A+B+C+C+17d+17d+d	
XIX	A+B+C-4d-4d	
XX	A+B+C+C+D+17d-16d	
XXI	2(A+B)+10d+10d	SEE NOTE 4
XXII	4C+20d	SEE NOTE 5
XXIII	A+17d+17d	
XXIV	D+A	
XXV	LUMPSUM	SEE NOTE 6
XXVI	$A+B+2\left[\{(A-B)/2\}^2+C^2\}^{1/2}+17d\right]$	
XXVII	A+B+C+D+E-16d	

4	08-10-07	REAFFIRMED AND ISSUED AS STANDARD		P.K. MITTAL		VINAY KUMAR		V. CHATURVEDI
3	30-06-99	REAFFIRMED AND ISSUED AS STANDARD	RDD	RP MEHROTRA	SC JAIN	A SONI		
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman	Approved by	

NOTES: -

1. READ SHEETS 4 TO 7 IN CONJUNCTION.
2. THE COMPUTATIONS OF CUT LENGTH ARE BASED ON IS:2502-1963 EXCEPT THAT THESE SHALL BE IN MULTIPLES OF 10mm.
3. WHERE MARKED * ON SHEETS 5 & 6, IT IS ASSUMED THAT ANGLE OR BEND WITH HORIZONTAL IS 45° OR LESS.
4. HOOKS INDICATED IN SHT. 4 OF 7 FOR TYPES II, IV, VI, VII, IX, XI, XVIII, XXI, XXIII, XXVI ARE FOR DRAFTING PURPOSE ONLY. FOR 90° BEND, HOOKS ARE NOT REQUIRED, ONLY HOOK ALLOWANCE SHALL BE ADOPTED AS PER SHT. 5 & 6.
5. FOR TYPE XXII STIRRUPS IN HYD BARS, HOOKS ARE NOT REQUIRED, ONLY HOOK ALLOWANCE SHALL BE ADOPTED AS PER SHT. 5 & 6.
6. BAR TYPE XXV IS NON-STANDARD AND DETAILS IF ANY SHALL BE GIVEN IN THE R.C.C DRAWING.
7. ALL DIMENSIONS ON 7-68-0101 SHT. 4 ARE FROM OUTSIDE EDGES OF BARS UNLESS OTHERWISE MENTIONED.

4	08-10-07	REAFFIRMED AND ISSUED AS STANDARD				
3	30-06-99	REAFFIRMED AND ISSUED AS STANDARD	RDD	RP MEHROTRA	SC JAIN	A SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
						Approved by



NOTE:

ALL DIMENSIONS ARE IN mm.

3	10.12.07	REAFFIRMED AND ISSUED AS STANDARD				
2	16.04.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
						Approved by

LAP LENGTH FOR REBARS

TYPE OF REBARS	TYPE OF STRUCTURE	GRADE OF CONCRETE				TENSILE STRESS (σ_s) IN (N / mm ²)	DESIGN METHOD	REMARKS
		M 20	M 25	M 30	M 35			
HIGH STRENGTH DEFORMED BARS (IS 1786) (Fe 500) Fy 500 N/mm ²	GENERAL R.C.C STRUCTURES	57 D	50 D	50 D	40 D	435	LIMIT STATE	'D' DENOTES DIAMETER OF REBARS
	LIQUID RETAINING STRUCTURES	37 D	33 D	30 D	27 D	190	WORKING STRESS	
	CHIMNEY AND STORAGE BINS	54 D	48 D	44 D	40 D	275	WORKING STRESS	

NOTES :-

- LAP LENGTHS FOR REBARS, FULLY STRESSED TO TENSILE STRESS AT DESIGN LOAD / WORKING LOAD, HAS BEEN DERIVED FROM THE BASIC FORMULA GIVEN BELOW (REFER CLAUSE 26.2.1, IS 456:2000)

$$L_d = \frac{D\sigma_s}{4\tau_{bd}}$$

WHERE D = NOMINAL DIAMETER OF THE BARS ; L = LAP LENGTH

σ_s = TENSILE STRESS IN BARS AT DESIGN LOAD / WORKING LOAD

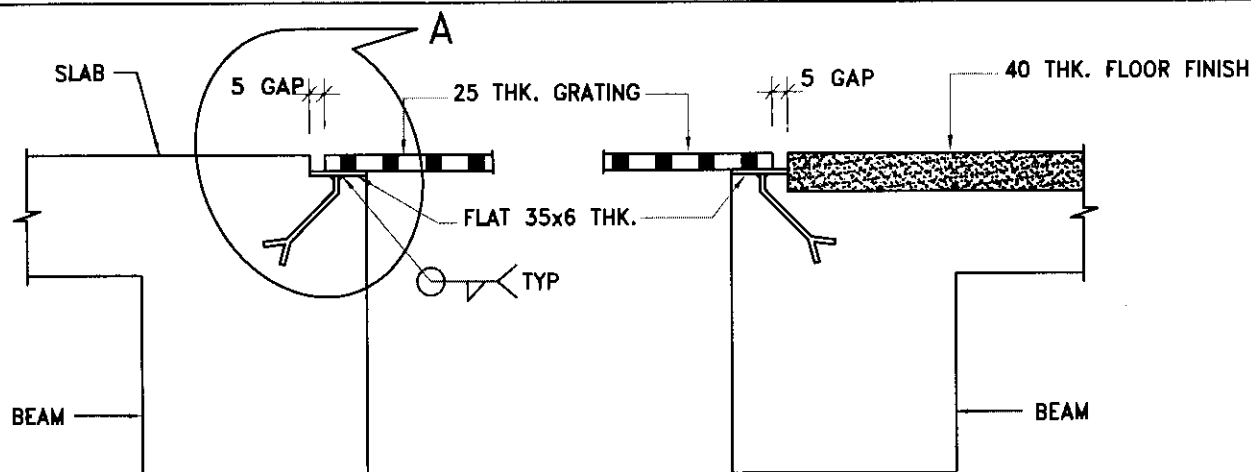
τ_{bd} = DESIGN BOND STRESS AS PER CLAUSE 26.2.1.1 FOR LIMIT STATE AND TABLE 21 FOR WORKING STRESS DESIGN.

- IS CODE REFERENCES :

LIQUID RETAINING STRUCTURE	IS 3370:1965
R.C.C CHIMNEYS	IS 4998:1992
STORAGE BINS	IS 4995:1974
GENERAL R.C.C STRUCTURES	IS 456:2000

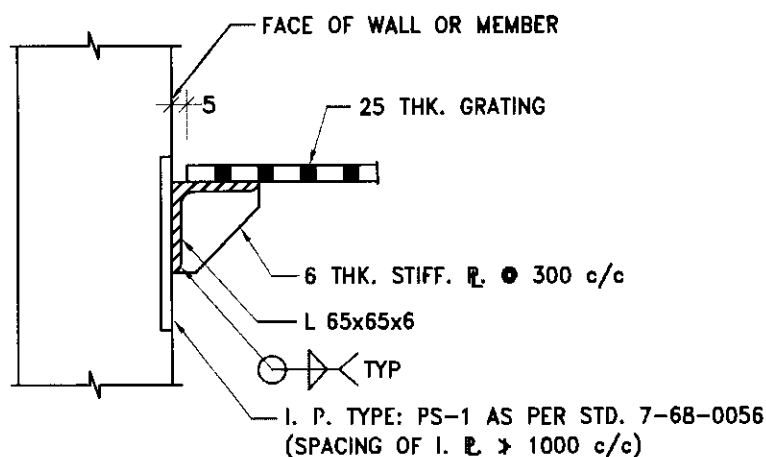
- FOR LIMIT STATE DESIGN, TENSILE STRESS AT DESIGN LOAD IN REBARS HAS BEEN ADOPTED AS $0.87f_y$.
- LAP LENGTH SHALL BE ROUNDED OFF TO NEAREST FIGURE (MULTIPLE OF 10 mm).
- LAP LENGTH FOR LIMIT STATE DESIGN HAS BEEN ROUNDED OFF TO 50D FOR GRADE M25/M30 CONCRETE.
- INCREASE IN THE VALUE OF BOND STRESS IS LIMITED TO 40 PERCENT FOR LIQUID RETAINING STRUCTURES, CHIMNEY AND STORAGE BINS.

5	02.02.10	REVISED AND ISSUED AS STANDARD	N KUMAR	P.K MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
4	10.03.03	REAFFIRMED AND ISSUED AS STANDARD	BS SHARMA	RP MEHROTRA	H MATHUR	-	SK GARYALI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	GM (E)	Stds. Bureau Chairman
Approved by							

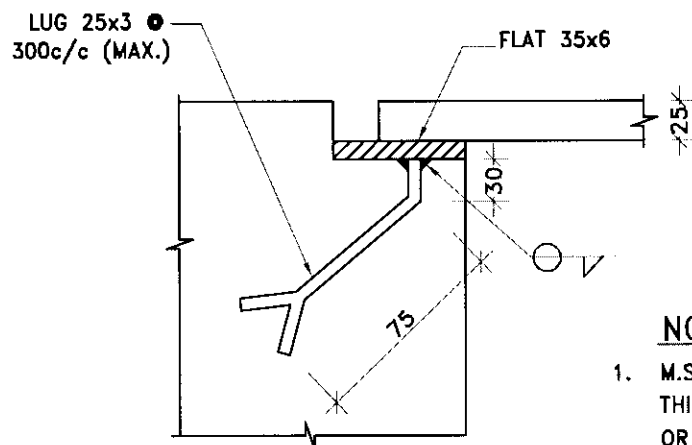


GRATING SUPPORT OVER BEAM
WITHOUT FLOOR FINISH

GRATING SUPPORT OVER BEAM
WITH FLOOR FINISH



GRATING SUPPORT ON WALL/COLUMN

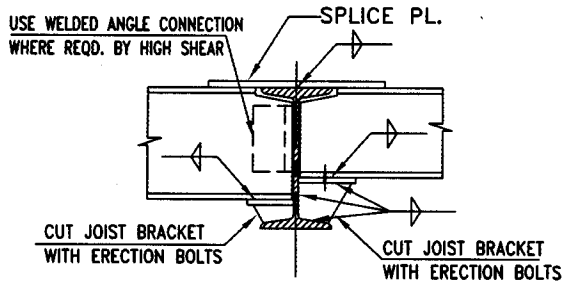


DETAIL A

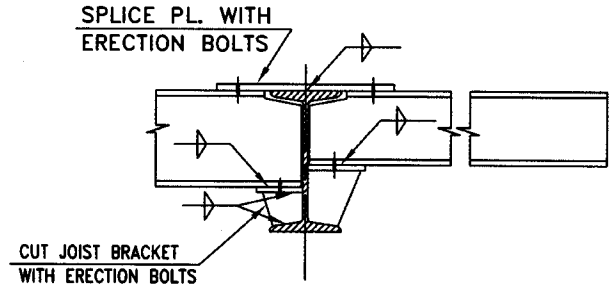
NOTES:

1. M.S. LUGS SHALL BE SUITABLY BENT IF CONCRETE THICKNESS IS LESS THAN THE LENGTH OF LUGS OR LUGS INTERFERE WITH R/F BARS.
2. ALL DIMENSIONS ARE IN mm.

5	10.12.07	REAFFIRMED AND ISSUED AS STANDARD	VPS	P.K.MITTAL	VINAY KUMAR	V.CHATURVEDI
4	16.04.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M. YENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						

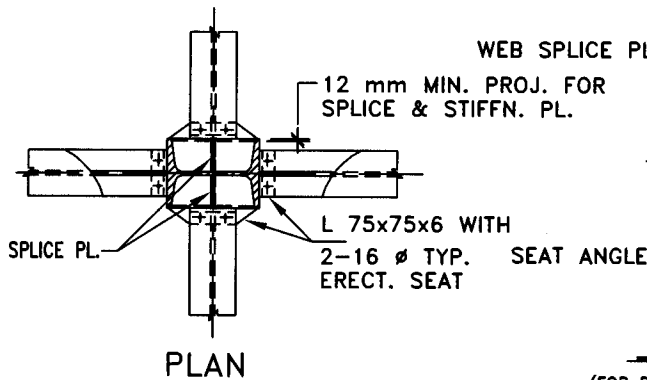


DETAIL-1

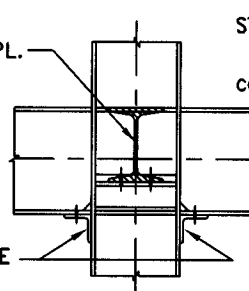


DETAIL-2

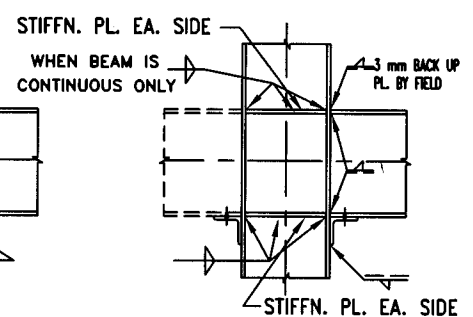
TYPICAL BEAM TO GIRDER CONNECTION



PLAN



ELEVATION - A



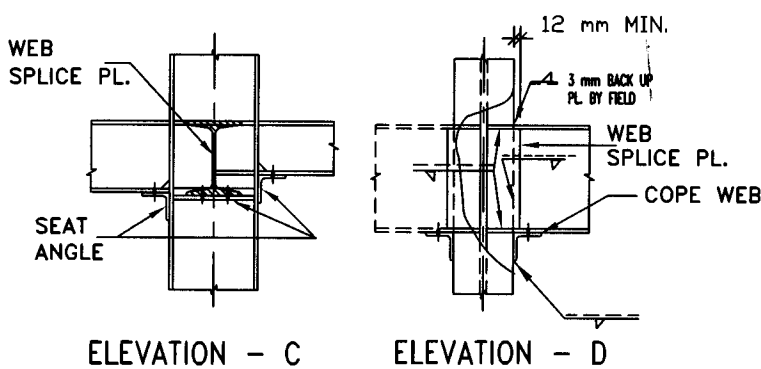
ELEVATION - B

(FOR DET. NOT SHOWN SEE ELEVATION B) (BEAM FRAMING AT 90° NOT SHOWN)

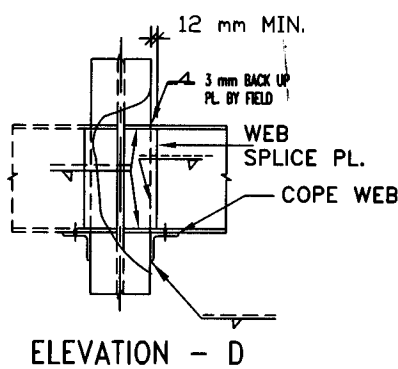
NOTES :-

(ALSO APPLICABLE TO STD. NOS. 7-68-0209 & 7-68-0212)

1. DETAILS SHOWN ARE TYPICAL ONLY AND SHALL BE USED WHEREVER DESIGN CONSIDERATIONS PERMIT IN WELDED CONTINUOUS FRAME STRUCTURE.
2. ALL MATERIAL & FABRICATION SHALL CONFORM TO IS CODE FOR FUSION WELDING IN BUILDING CONSTRUCTION.
3. OMIT ERECTION ANGLES & CLIPS WHEN WELDS ARE MADE IN SHOP.
4. ALL REINFORCING FILLET WELDS USED IN CONJUNCTION WITH V-WELDS SHALL BE 5 mm.
5. MILLED ENDS MAY BE ELIMINATED ON SMALL, LIGHTLY LOADED COLUMNS.
6. AT INTERSECTIONS, THICKNESS OF CONNECTION PLATES AND / OR STIFFENER PLATES TO BE GOVERNED BY MAX. BEAM FLANGE THICKNESS.

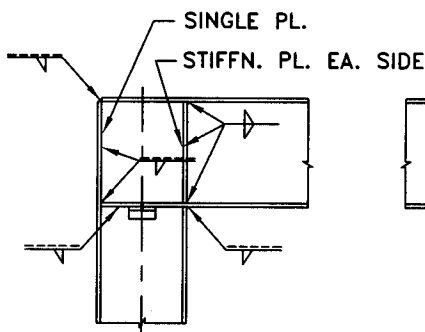


ELEVATION - C

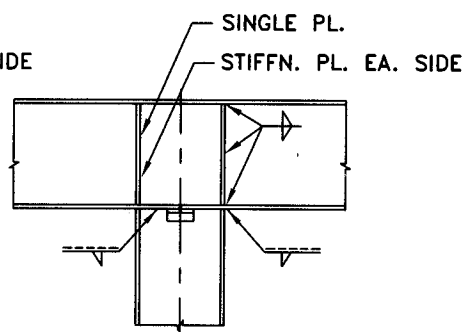


ELEVATION - D

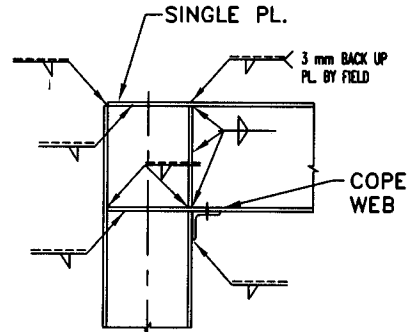
(DET. NOT SHOWN SEE ELEVATION B)



DETAIL-4



DETAIL-5



DETAIL-6

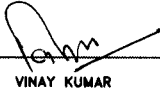
TYPICAL BEAM TO COLUMN RIGID CONNECTION

4	20.07.09	REAFFIRMED AND ISSUED AS STANDARD	N VENU KUMAR	P.K.MITTAI	VINAY KUMAR	N DUARI
3	23.04.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman

INTRODUCTION:-

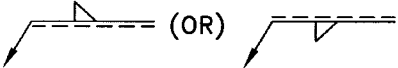
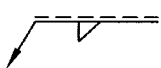
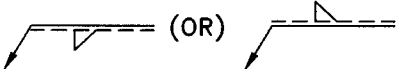
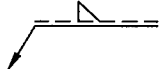
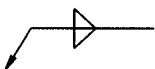
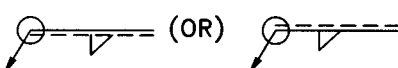
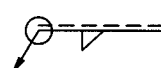
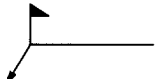
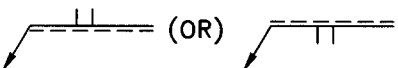
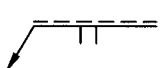
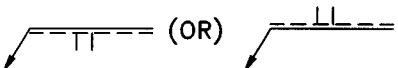
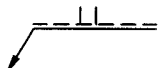
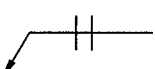
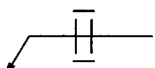
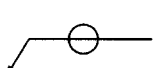
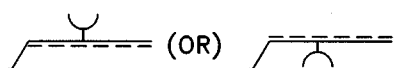
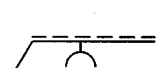
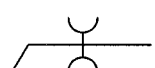
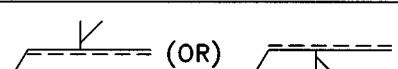
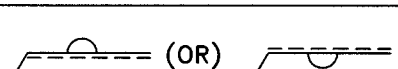
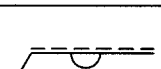
THIS STANDARD ON WELDING SYMBOLS INCORPORATES THE REQUIREMENTS OF THE BIS (BUREAU OF INDIAN STANDARD) CODE ON SCHEME OF "SYMBOLS FOR WELDING" (IS:813-1986)

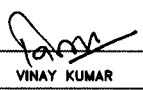
THESE WELDING SYMBOLS SHALL BE USED ON DRAWINGS FOR ALL JOBS.

4	03.11.08	REAFFIRMED AND ISSUED AS STANDARD	 VPS	 P.K. MITTAL	 VINAY KUMAR	 V. CHATURVEDI
3	24.04.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
						Approved by

STANDARD BASIC SYMBOLS FOR WELDING

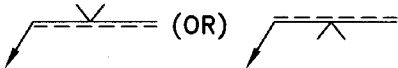
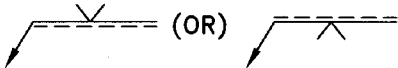
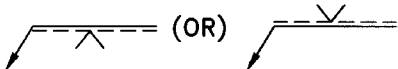
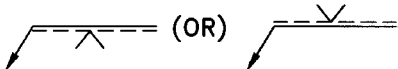
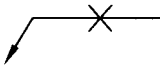
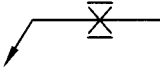
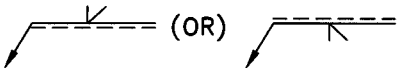
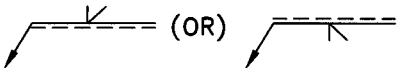
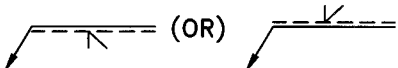
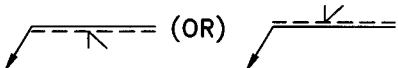
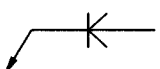
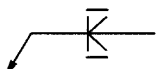
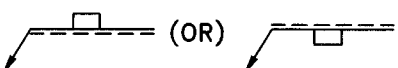
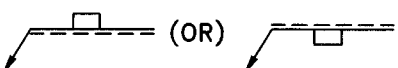
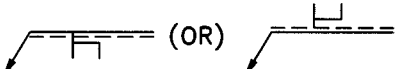
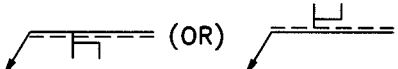
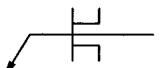
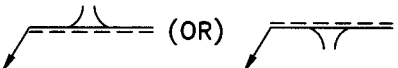
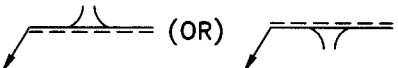
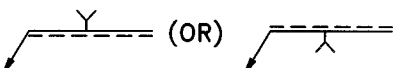
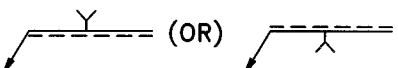
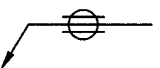
REFER IS:813-1986

S.NO.	INSTRUCTIONS	DRG. REPRESENTATION IS:813-1986
1	NEAR SIDE FILLET WELD	 (OR) 
2	FAR SIDE FILLET WELD	 (OR) 
3	BOTH SIDE FILLET WELD	
4	FILLET WELD ALL ROUND	 (OR) 
5	SITE WELD	
6	SQUARE BUTT NEAR SIDE	 (OR) 
7	SQUARE BUTT FAR SIDE	 (OR) 
8	SQUARE BUTT BOTH SIDE	
9	SQUARE BUTT BOTH SIDE GRINDING FINISH	
10	SPOT WELD	
11	SINGLE-U BUTT (NEAR SIDE)	 (OR) 
12	DOUBLE-U BUTT	
13	SINGLE BEVEL BUTT WELD WITH BROAD ROOT FACE (NEAR SIDE)	 (OR) 
14	BACKING RUN, BACK OR BACKING WELD (NEAR SIDE)	 (OR) 

4	03.11.08	REAFFIRMED AND ISSUED AS STANDARD				
3	24.04.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						

STANDARD BASIC SYMBOLS FOR WELDING

REFER IS:813-1986

S.NO.	INSTRUCTIONS	DRG. REPRESENTATION IS:813-1986
15	SINGLE-V BUTT NEAR SIDE	 (OR) 
16	SINGLE-V BUTT FAR SIDE	 (OR) 
17	DOUBLE-V BUTT	
18	DOUBLE-V BUTT GRINDING FINISH	
19	SINGLE BEVEL-BUTT NEAR SIDE	 (OR) 
20	SINGLE BEVEL-BUTT FAR SIDE	 (OR) 
21	DOUBLE BEVEL-BUTT	
22	DOUBLE BEVEL-BUTT GRINDING FINISH	
23	STITCH WELD	REFER SHEET 5 OF 6
24	PLUG OR SLOT WELD (NEAR SIDE)	 (OR) 
25	SINGLE J- BUTT (FAR SIDE)	 (OR) 
26	DOUBLE-J BUTT	
27	BUTT WELD BETWEEN PLATES WITH RAISED EDGES(NEAR SIDE)	 (OR) 
28	SINGLE-V BUTT WELD WITH BROAD ROOT FACE (NEAR SIDE)	 (OR) 
29	SEAM WELD	

4	03.11.08	REAFFIRMED AND ISSUED AS STANDARD				V. CHATURVEDI
3	24.04.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M. IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	

SUPPLEMENTARY SYMBOLS:

SHAPE OF WELD SURFACE	SYMBOL
a) FLAT (USUALLY FINISHED FLUSH)	—
b) CONVEX	
c) CONCAVE	

EXAMPLE OF APPLICATION OF SUPPLEMENTARY SYMBOLS:

SHAPE OF WELD SURFACE	SYMBOL
FLAT (FLUSH) SINGLE-V BUTT WELD	
CONVEX DOUBLE-V BUTT WELD	
CONCAVE FILLET WELD	
FLAT (FLUSH) SINGLE-V BUTT WELD WITH FLAT (FLUSH) BACKING RUN	

POSITION OF SYMBOL ACCORDING TO THE REFERENCE LINE

a) TO BE WELDED ON ARROW SIDE	b) TO BE WELDED ON OTHER SIDE	c) FOR SYMMETRIC WELDS ONLY

4	03.11.08	REAFFIRMED AND ISSUED AS STANDARD				
3	24.04.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
					Approved by	

METHOD OF INDICATING DIMENSIONS OF WELD:

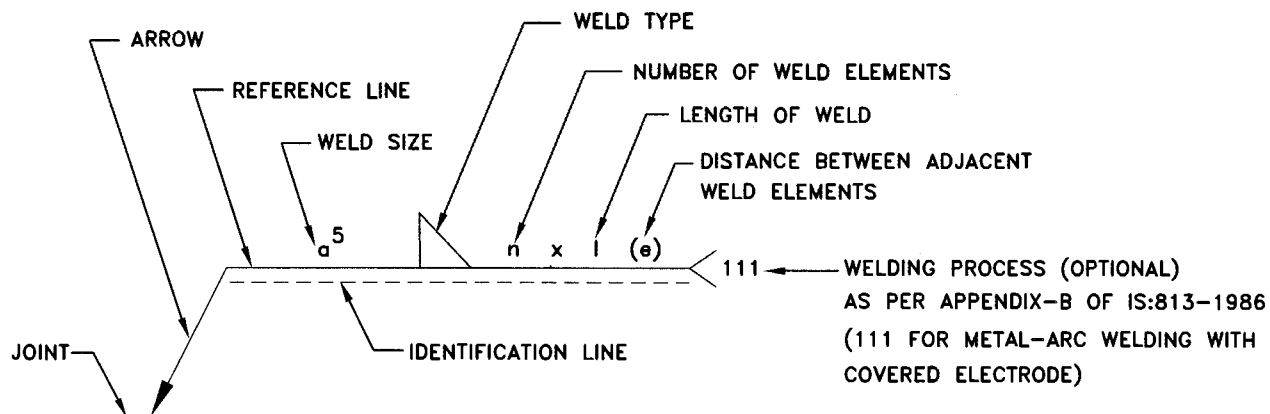
(IS:813-1986)

S.NO.	DESIGNATION OF WELDS	DEFINITION	INSCRIPTION
1	BUTT WELD		∇ $s \parallel$ ∇
2	BUTT WELD BETWEEN PLATES WITH RAISED EDGES		$s \parallel$
3	CONTINUOUS FILLET WELD		$a \triangle$ (OR) $Z \triangle$
4	INTERMITTENT FILLET WELD		$a \triangle \quad n \times l (e)$ (OR) $Z \triangle \quad n \times l (e)$
5	STAGGERED INTERMITTENT FILLET WELD		$a \triangle \quad n \times l (e)$ $a \triangle \quad n \times l (e)$ (OR) $Z \triangle \quad n \times l (e)$ $Z \triangle \quad n \times l (e)$
6	PLUG OR SLOT WELD		$C \quad n \times l (e)$
7	SEAM WELD		$C \quad n \times l (e)$
8	PLUG WELD		$d \quad n \times (e)$
9	SPOT WELD		$d \quad n \times (e)$

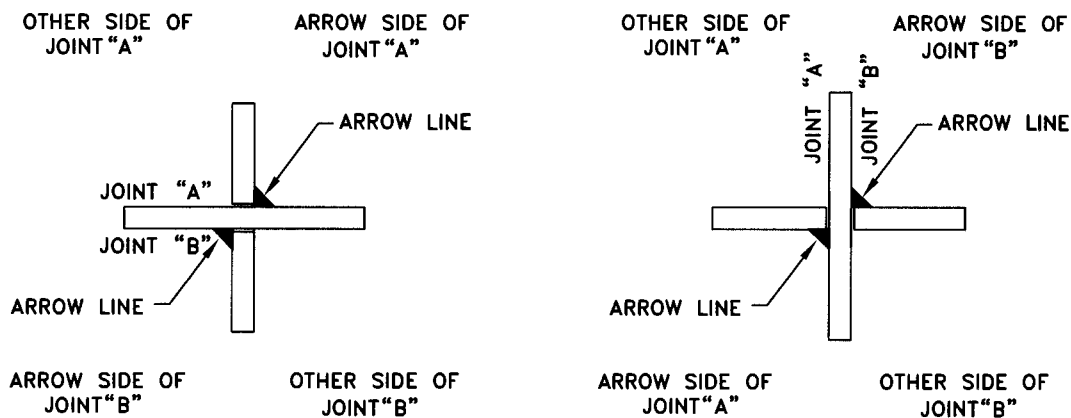
NOTE : 'n' INDICATES NUMBER OF WELD ELEMENTS

'l' INDICATES LENGTH OF WELD (WITHOUT END CRATERS)

4	03.11.08	REAFFIRMED AND ISSUED AS STANDARD	 SK SAGAR	 RP MEHROTRA	 SC JAIN	 M IYENGAR
3	24.04.01	REAFFIRMED AND ISSUED AS STANDARD	 P.K. MITTAL	 VINAY KUMAR	 V. CHATURVEDI	
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman



STANDARD REPRESENTATION OF WELDS IN DRAWINGS



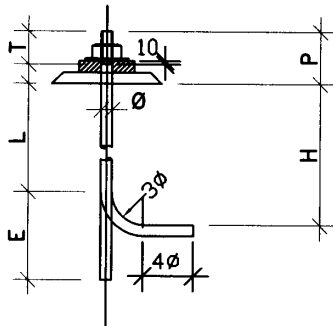
POSITION OF WELDING SYMBOL ACCORDING TO THE REFERENCE LINE

4	03.11.08	REAFFIRMED AND ISSUED AS STANDARD	<i>VPS</i>	<i>P.K.MITTAL</i>	<i>VINAY KUMAR</i>	<i>V. CHATURVEDI</i>
3	24.04.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman

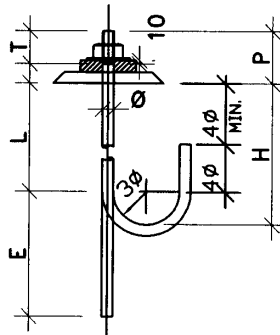
GRADE OF CONC.	BOLT TYPE	DIMENSIONS MM		BOLT DIA (ϕ) IN MM											
				10	12	16	18	20	22	24	27	30	33	36	39
M20	I & III	L		250	300	450	450	550	600	650	750	850	950	1000	1100
		E		95	115	155	170	190	210	230	255	285	315	345	370
		H	TYPE-I	280	336	498	504	610	666	722	831	940	1049	1108	1217
			TYPE-III	430	486	648	654	910	966	1022	1281	1390	1499	1558	1667
	II & IV	L		200	200	300	350	400	450	450	550	600	700	700	800
		E		150	180	240	270	300	330	380	405	450	495	540	585
		H	TYPE-II	230	236	348	404	460	516	522	631	690	799	808	917
			TYPE-IV	380	386	498	554	760	816	822	1081	1140	1249	1258	1367
M25	I & III	L		200	250	400	400	450	550	550	650	700	800	850	950
		E		95	115	155	170	190	210	230	255	285	315	345	370
		H	TYPE-I	230	286	448	454	510	616	622	731	790	899	958	1067
			TYPE-III	380	436	598	604	810	916	922	1181	1240	1349	1408	1517
	II & IV	L		150	150	250	250	300	350	350	450	500	550	600	650
		E		150	180	240	270	300	330	360	405	450	495	540	585
		H	TYPE-II	180	186	298	304	360	416	422	531	590	649	708	767
			TYPE-IV	330	336	440	454	660	716	722	981	1040	1099	1158	1217
M30	I & III	L		180	220	315	335	390	445	470	550	600	680	735	815
		E		95	115	155	170	190	210	230	255	285	315	345	370
		H	TYPE-I	210	260	365	390	450	515	545	635	690	780	845	935
			TYPE-III	360	410	515	540	750	815	845	1085	1140	1230	1295	1385
	II & IV	L		150	150	200	200	250	275	300	350	375	425	450	500
		E		150	180	240	270	300	330	360	405	450	495	540	585
		H	TYPE-II	180	190	250	255	310	345	375	435	465	525	560	620
			TYPE-IV	330	340	400	405	610	645	675	885	915	975	1010	1070

6	26.03.09	REVISED AND ISSUED AS STANDARD	VPS	P.K. MITTAL	VINAYKUMAR	N. DUARI
5	09.06.08	REVISED AND ISSUED AS STANDARD	SPJ	P.K. MITTAL	VINAYKUMAR	V. CHATURVEDI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman

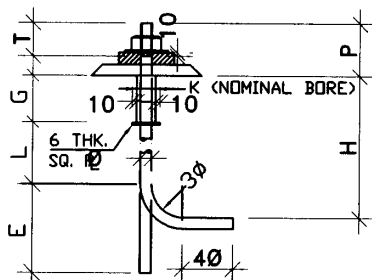
GRADE OF CONC.	BOLT TYPE	DIMENSIONS MM	BOLT DIA (ϕ) IN MM											
			10	12	16	18	20	22	24	27	30	33	36	39
M35	I & III	L	160	190	275	295	340	390	410	480	525	595	640	710
		E	95	115	155	170	190	210	230	255	285	315	345	370
		H	TYPE-I	190	230	325	350	400	460	485	565	615	695	750
			TYPE-III	340	380	475	500	700	760	785	1015	1065	1145	1280
	II & IV	L	150	150	150	150	180	225	225	275	300	350	350	400
		E	150	180	240	270	300	330	360	405	450	495	540	585
		H	TYPE-II	180	190	200	205	240	290	300	360	390	450	460
			TYPE-IV	330	340	350	355	540	590	600	810	840	900	970
M40	I & III	L	150	170	240	255	300	340	360	425	460	525	565	625
		E	95	115	155	170	190	210	230	255	285	315	345	370
		H	TYPE-I	180	210	290	310	360	410	435	510	550	625	675
			TYPE-III	330	360	440	460	660	710	735	960	1000	1075	1195
	II & IV	L	150	150	150	150	175	200	200	225	250	275	300	325
		E	150	180	240	270	300	330	360	405	450	495	540	585
		H	TYPE-II	180	190	200	205	235	270	275	310	340	375	410
			TYPE-IV	330	340	350	355	535	570	575	760	790	825	860



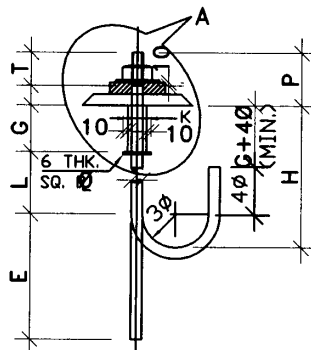
TYPE - I



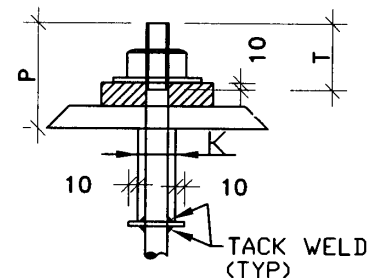
TYPE - II



TYPE - III



TYPE - IV



**DETAIL-A
(TYP)**

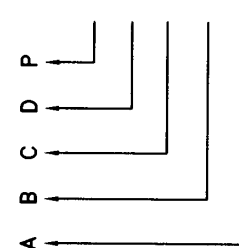
6	26.03.09	REVISED AND ISSUED AS STANDARD	<i>VPS</i>	<i>P.K.MITTAL</i>	<i>VINAYKUMAR</i>	<i>N. DUARI</i>
5	09.06.08	REVISED AND ISSUED AS STANDARD	SPJ	P.K.MITTAL	VINAYKUMAR	V.CHATURVEDI
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman

GRADE OF CONC.	BOLT TYPE	DIMENSIONS MM		BOLT DIA (ϕ) IN MM															
				SLEEVE	THREADED (T) LENGTH	G	H	W	t3	L	L	C	G	H	W	t3	L	L	C
M20,M25, M30,M35 & M40	III & IV			G															
				K															
	I TO IV IX & XII			SINGLE NUT															
				DOUBLE NUT															
M20 & M25	V																		
	V & VI																		
	VII																		
	VIII																		
M30	V																		
	V & VI																		
	VII																		
	VIII																		

6	26.03.09	REVISED AND ISSUED AS STANDARD	VPS	P.K.MITTAL	VINAYKUMAR	N. DUARI
5	09.06.08	REVISED AND ISSUED AS STANDARD	SPJ	P.K.MITTAL	VINAYKUMAR	V.CHATURVEDI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman

GRADE OF CONC.	BOLT TYPE	DIMENSIONS MM	BOLT DIA (ϕ) IN MM															
			10	12	16	18	20	22	24	27	30	33	36	39	42	45	48	52
M35 & M40	V	G	150	150	150	200	300	300	300	450	450	450	450	450	500	550	600	600
		H	210	225	235	290	400	410	415	580	585	600	610	625	690	745	805	825
	V & VI	W	80	80	90	100	100	100	100	110	110	140	160	200	210	220	230	260
		t3	10	12	16	16	20	20	20	25	25	28	32	36	36	36	40	45
	VII	L					250	275	300	350	400	450	550	675	775	875	900	975
M20, M25, M30, M35, & M40	VIII	L											300	350	400	450	500	550
		C											125	160	160	160	185	185
	V & VI	E	50	60	70	75	80	90	95	105	110	120	130	140	150	155	165	180
		K	50	50	50	50	50	80	80	80	80	80	80	100	100	100	100	125
	VII & VIII	THREADED (T) LENGTH	40	45	55	60	60	65	70	75	80	90	95	100	105	110	120	125
		DOUBLE NUT	50	60	70	75	80	90	95	105	110	120	130	140	150	155	165	180
	VII	t3					16	16	16	16	16	16	16	16	16	16	20	20
	VIII	t3											16	20	20	20	25	25
	VII & VIII	G	150	150	150	150	300	300	300	450	450	450	450	450	450	450	450	450
		L	80	100	150	170	200											
M20&25	XII	L	185	220	310	335	385	435	460	535	590	660	720					
M30		L	150	150	200	225	250	275	300	350	375	425	450					
M35&M40		L	150	150	175	200	225	250	275	300	350	375	400					

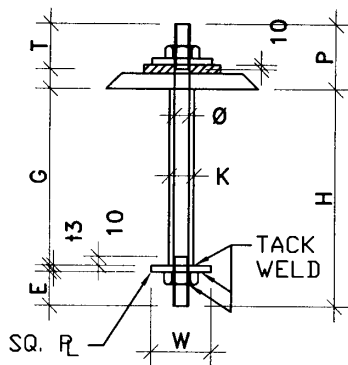
NOTES :-

- BOLTS SHALL BE MARKED ON THE DRAWING AS UNDER :
- 

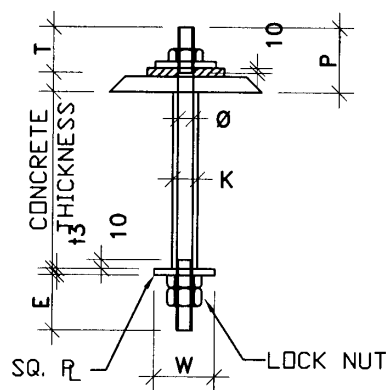
PROJECTION ABOVE CONCRETE
SINGLE NUT (N1) OR DOUBLE NUT (N2)
DIAMETER OF BOLT
TYPE OF BOLT
NO OF BOLTS

e.g. 6-IV-M27-N1-200
- BOLTS SHALL BE TURNED FROM M.S. ROUNDS CONFORMING TO IS:2062 GR-A.
- NUTS AND WASHERS SHALL CONFORM TO IS:1363 AND IS:3138.
- THREADING SHALL BE COARSE CONFORMING TO IS:1367 AND IS:4218.
- ANCHOR BOLTS SHALL BE SET ACCURATELY AND HELD IN POSITION BY TEMPLATE BEFORE CONCRETING.
- 6 THK. SQ. PLATE AT THE BOTTOM OF SLEEVE SHALL BE TACK WELDED WITH BOLT AND SLEEVE FOR BOLT TYPE III, IV, VII AND VIII.
- SLEEVE SHALL BE M.S. TUBES (MEDIUM) AS PER IS:1239.
- REFER DESIGN DRAWINGS FOR PROJECTION (P) OF BOLT ABOVE TOP OF ROUGH CONCRETE AND NUMBER (A) OF BOLTS.
- ANCHOR BOLTS SHALL BE TEMPERED BEFORE MACHINING IF MADE BY FORGING. THE FORGING TEMPERATURE SHALL BE ABOVE 900° C BUT LOWER THAN SUPER HEATING TEMPERATURE.

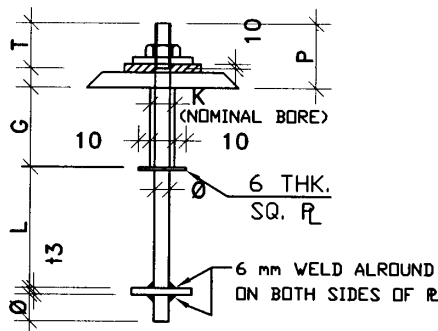
6	26.03.09	REVISED AND ISSUED AS STANDARD	SPJ	P.K.MITTAL	VINAYKUMAR	V.CHATURVEDI
5	09.06.08	REVISED AND ISSUED AS STANDARD	SPJ	P.K.MITTAL	VINAYKUMAR	V.CHATURVEDI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman



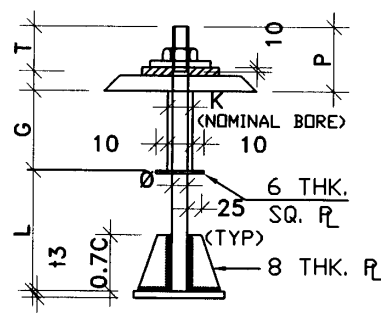
TYPE - V



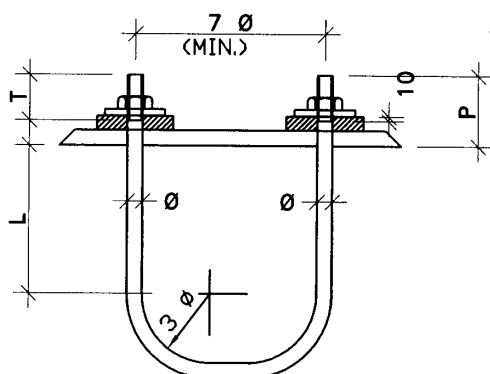
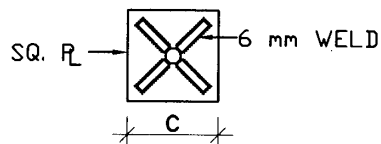
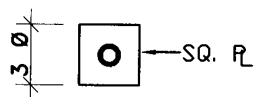
TYPE - VI



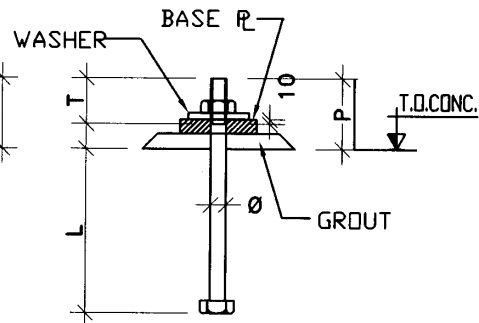
TYPE - VII



TYPE - VIII



TYPE - IX

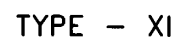


TYPE - XII

6	26.03.09	REVISED AND ISSUED AS STANDARD	VPS	P.K.MITTAL	VINAYKUMAR	N. DUARI
5	09.06.08	REVISED AND ISSUED AS STANDARD	SPJ	P.K.MITTAL	VINAYKUMAR	V.CHATURVEDI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman

GRADE OF CONC.	BOLT TYPE	DIMENSIONS MM	BOLT DIA (ϕ) IN MM																	
			20	22	24	27	30	33	36	39	42	45	48	52	56	60	64	68	72	
			150	160	180	200	220	240	260	280	300									
M20, M25, M30, M35 & M40	X	a	150	160	180	200	220	240	260	280	300									
		b	250	290	310	330	370	390	460	480	500									
		L	600	700	800	900	1000	1100	1200	1300	1400									
		E	220	220	240	270	300	330	360	390	420									
		H	640	744	848	954	1060	1166	1272	1378	1484									
		ISA	100x100 X10	130X130X10	150X150X12	200X200X16														
		THREADED LENGTH (T)	60	65	70	75	80	90	95	100	105									
		DOUBLE NUT	80	90	95	105	110	120	130	140	150									
		h			18		20		25		30		30		30		30		30	
		k			18		22		25		30		35		40		50		55	
	XI	c			24		30		36		42		48		56		64		72	
		q			65		75		85		95		110		125		140		155	
		r			1.6		1.6		2.0		2.0		2.0		3.0		3.0		4.0	
		f			140		150		170		190		210		220		240		260	
		e			30		35		42		50		58		65		75		85	
		L			800		1000		1200		1400		1600		1800		2000		2200	
		ISMC			75x40		75x40		100x50		125x65		150x75		150x75		175x75		175x75	
		THREADED LENGTH (T)			70		80		95		105		120		135		150		165	
		SINGLE NUT																		
		DOUBLE NUT			95		110		130		150		165		190		215		240	

6	26.03.09	REVISED AND ISSUED AS STANDARD	<i>VPS</i>	<i>P.K.MITTAL</i>	<i>VINAYKUMAR</i>	<i>N. DUARI</i>
5	09.06.08	REVISED AND ISSUED AS STANDARD	SPJ	P.K.MITTAL	VINAYKUMAR	V.CHATURVEDI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						

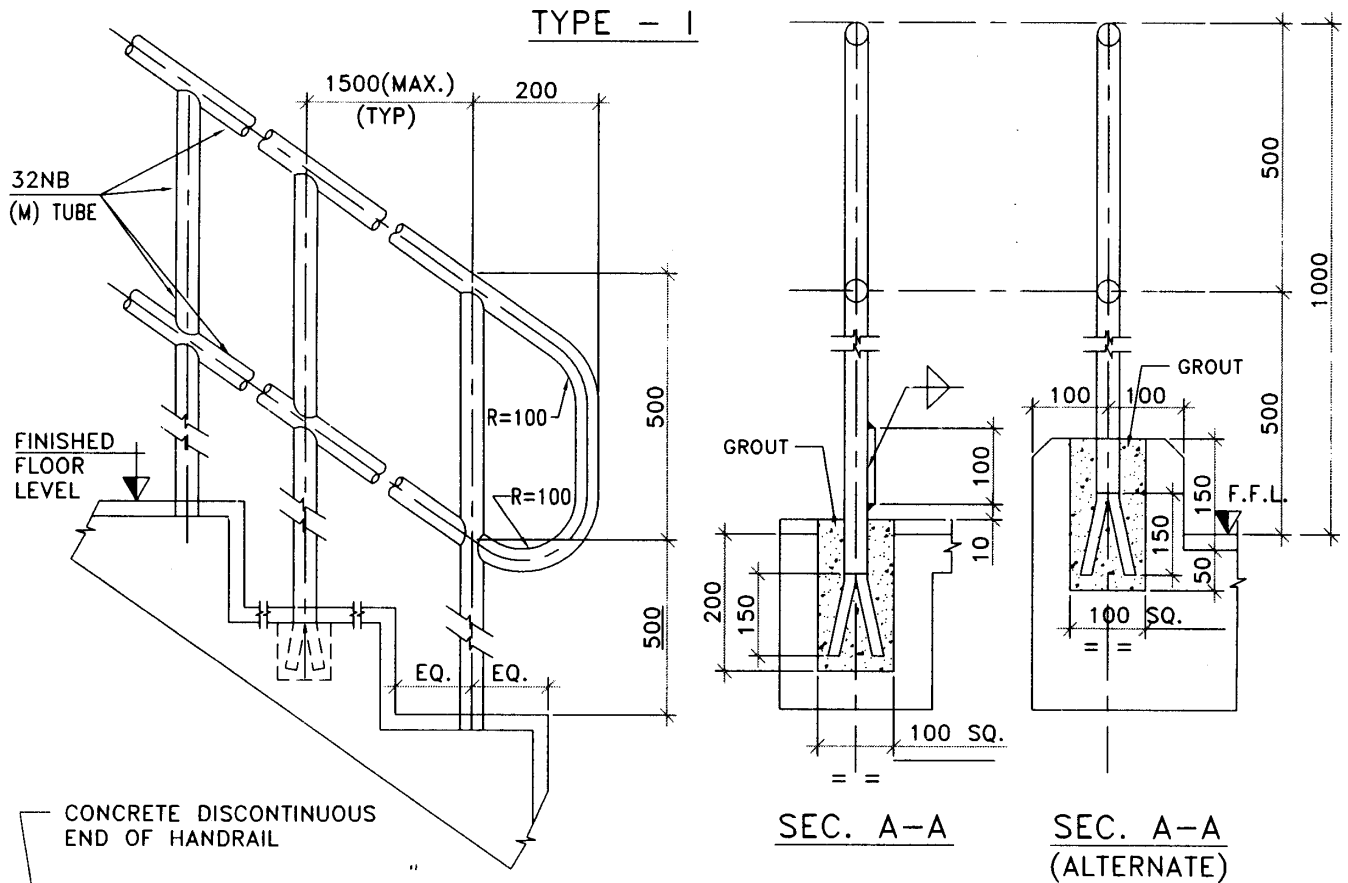


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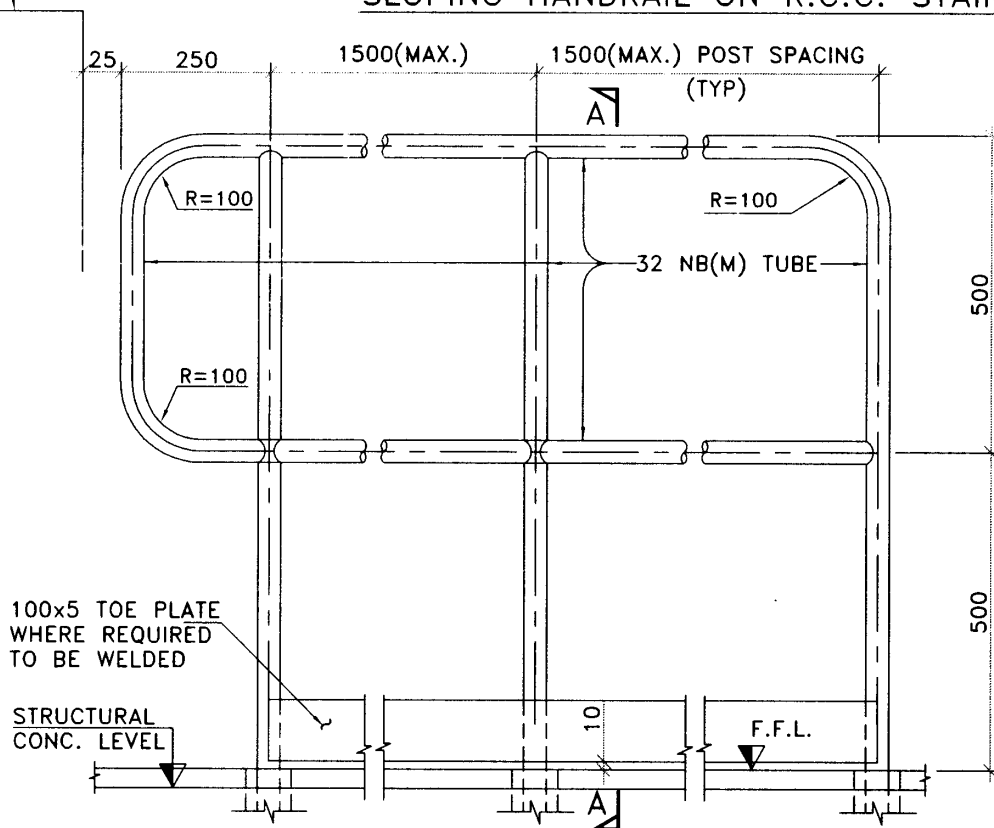
NOTES:-

1. ALL HANDRAILS AND UPRIGHT SHALL BE AS PER RESPECTIVE TYPE.
2. ALL FILLET WELDS OF 3mm (MINIMUM) THICKNESS SHALL BE CONTINUOUS UNLESS NOTED OTHERWISE.
3. JOINTS IN HANDRAILS SHALL BE PROVIDED AT SUITABLE LOCATIONS, WELDED AND GROUND FLUSH.
4. FOR ADDITIONAL TYPE OF UPRIGHT FIXING DETAILS REFER EIL STD. 7-68-0061.
5. ALL M.S. TUBES SHALL CONFORM TO IS:1239.
6. BOTTOM 150mm OF ALL UPRIGHT MEMBER EMBEDDED IN CONCRETE SHALL BE CUT AND ENDS SPLAYED OUT.
7. FABRICATION OF TOP RAIL, INTERMEDIATE FLAT AND TOE PLATE SHALL ONLY BE STARTING AFTER TAKING ACTUAL DIMENSIONS AT SITE.
8. ADJUSTMENT IN SPACING OF VERTICAL POST SHALL BE DONE AT EITHER END OF PLATFORM.
9. FOR INSERT PLATE REFER EIL STD. 7-68-0056.

6	29.01.2010	REVISED & ISSUED AS STANDARD	V.P. SINGH	PK MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
5	15.06.2004	REAFFIRMED & ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	ARVIND KUMAR	SK GARYALI	
Rev. No.	Date	Purpose	Prepared by	Checked by	Sds. Committee Convenor	Sds. Bureau Chairman	Approved by



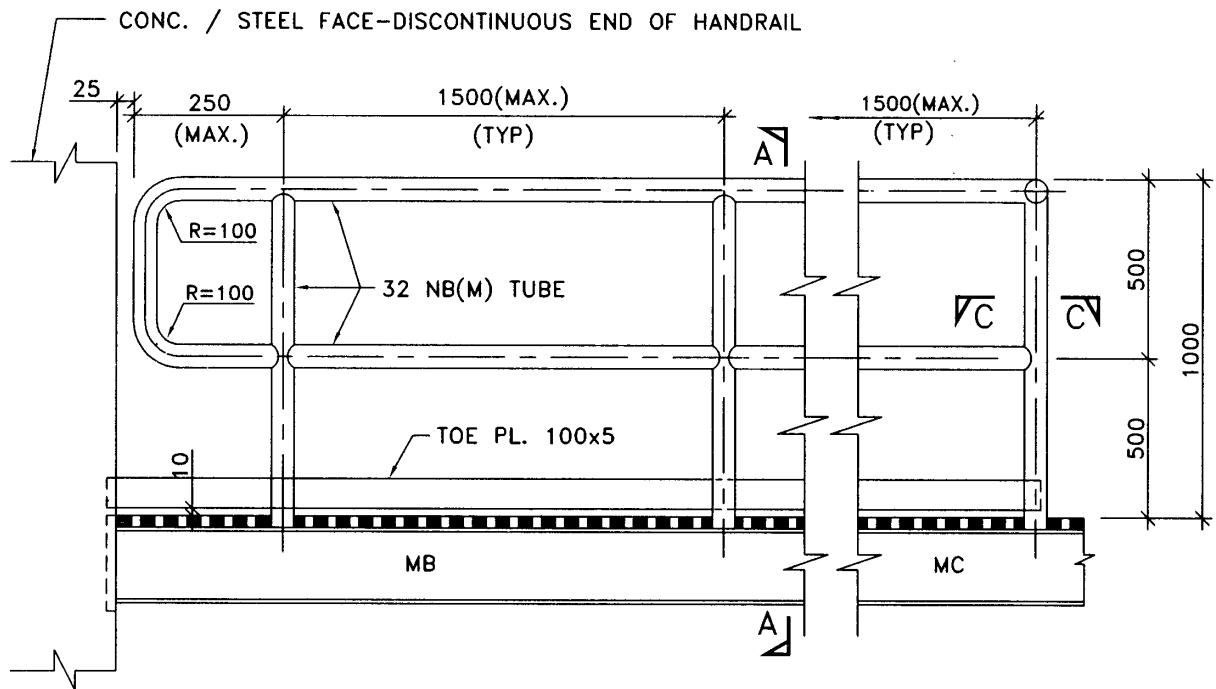
SLOPING HANDRAIL ON R.C.C. STAIR



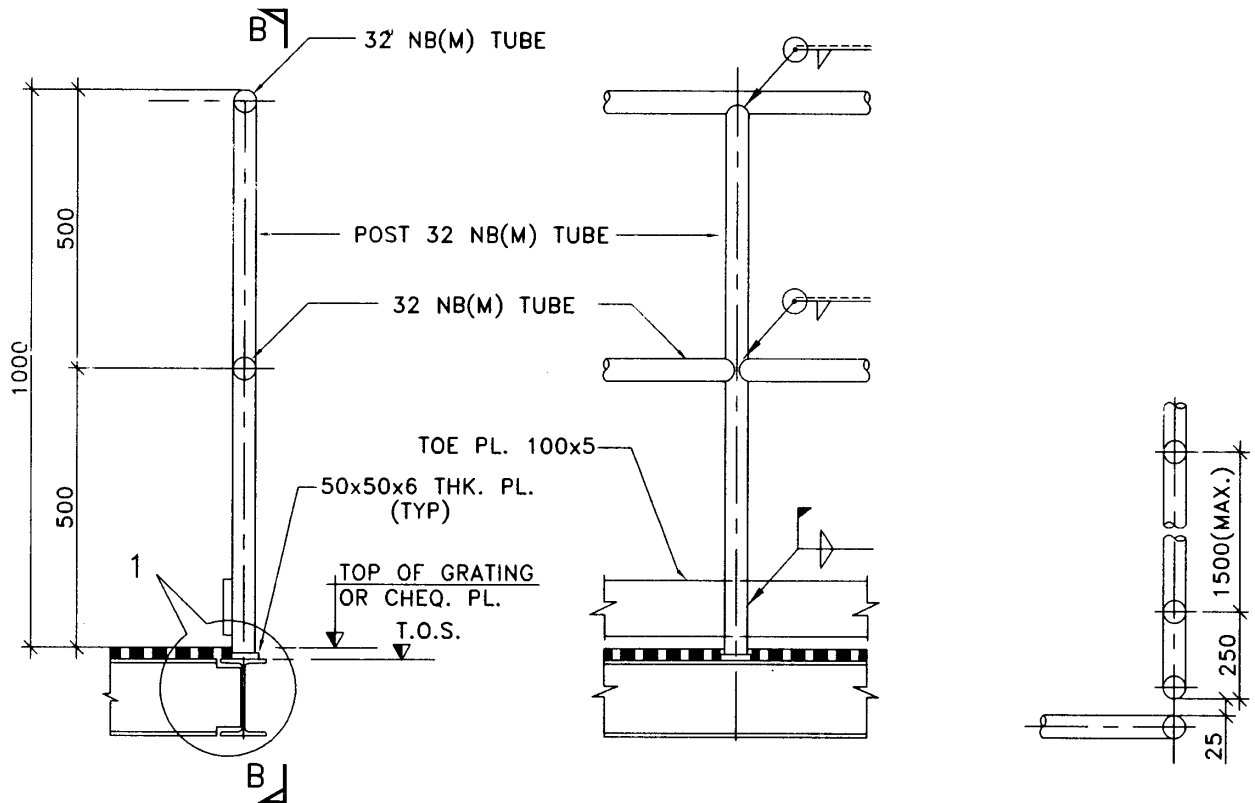
HORIZONTAL HANDRAIL ON R.C.C. PLATFORM

6	29.01.2010	REVISED & ISSUED AS STANDARD	V.P. SINGH	PK MITTAL	S. CHATURVEDI	VINAY KUMAR	N DUARI
5	15.06.2004	REAFFIRMED & ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	ARVIND KUMAR	SK GARYAL	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman	Approved by

TYPE - II



HORIZONTAL HANDRAIL ON STEEL PLATFORM



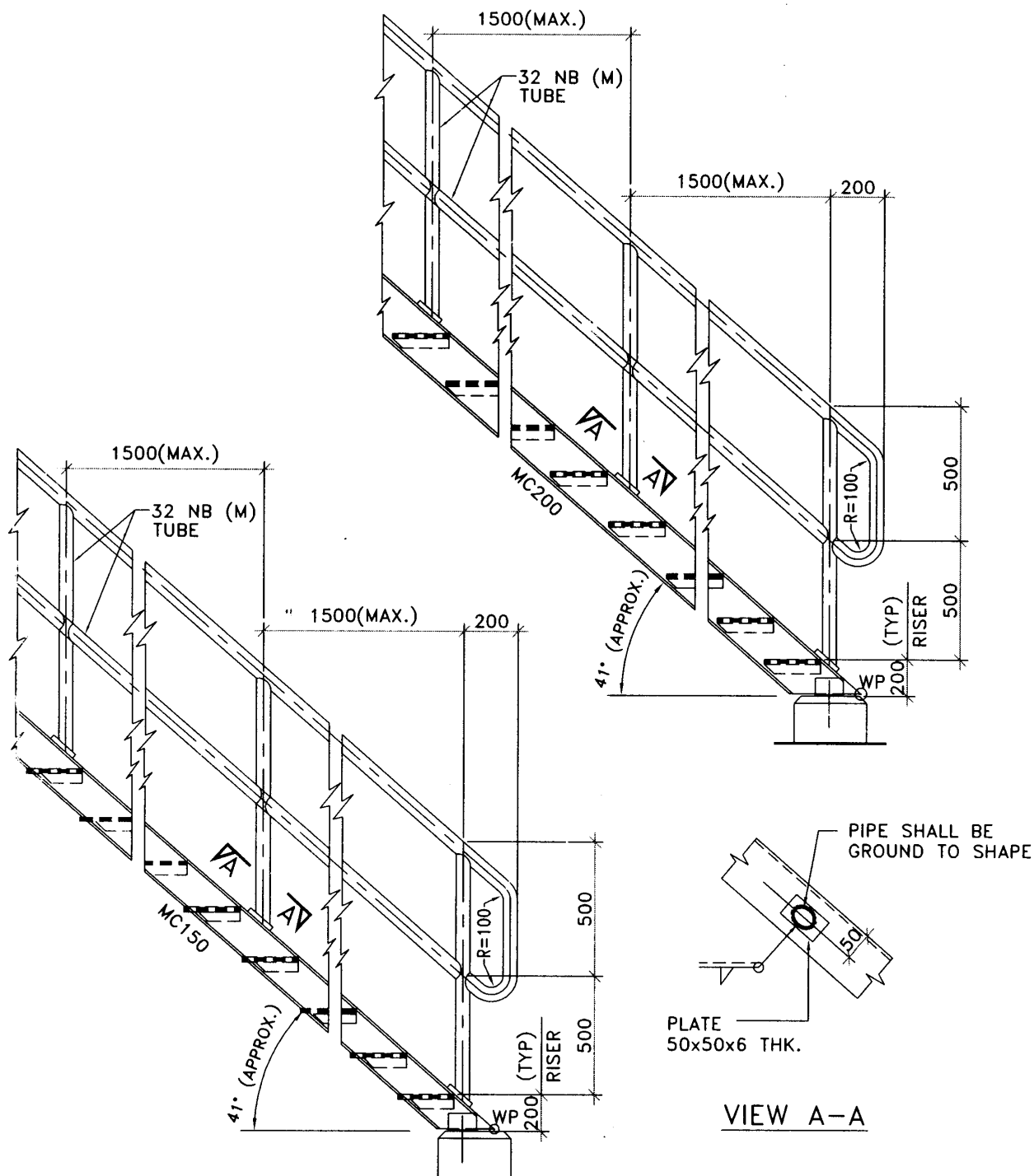
SECTION A-A
(FOR DETAIL ① REFER PAGE 8 OF 8)

VIEW B-B

VIEW C-C
(AT CORNER)

6	29.01.2010	REVISED & ISSUED AS STANDARD	V.P.SINGH	PK MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
5	15.06.2004	REAFFIRMED & ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	ARVIND KUMAR	SK GARYALI	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman	Approved by

TYPE - II



SLOPING HANDRAIL ON STEEL STAIR
WHEREVER HIGHER SIZE OF STRINGER BEAMS
ARE REQUIRED AS PER DESIGN SIMILAR G.A.
BE FOLLOWED FOR THE SAME.

6	29.01.2010	REVISED & ISSUED AS STANDARD	V.P. SINGH	PK MITTAL	S. CHATURVEDI	VINAY KUMAR	N DUARI
5	15.06.2004	REAFFIRMED & ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	ARVIND KUMAR	SK GARYALI	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman	Approved by

120

22.5 75

WALL

100

R=100

VIEW B-B

100

HANDRAIL

R=100

3mm MIN. CONTINUOUS FILLET WELD

WALL

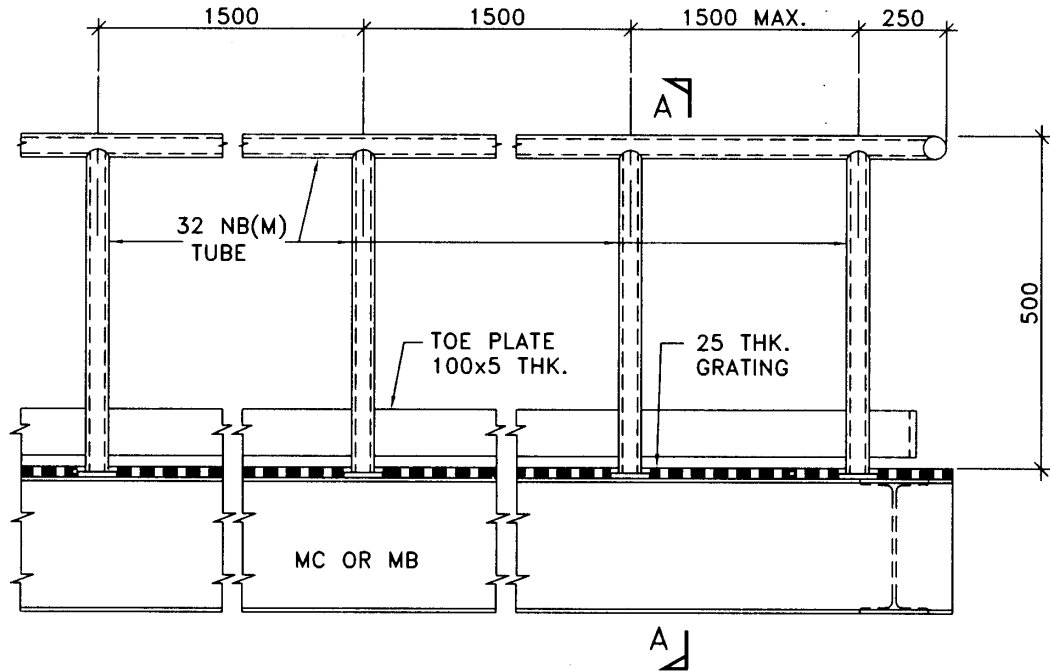
16 ϕ EXPANSION FASTENERS

120 ϕ -8 THK. WALL PLATE

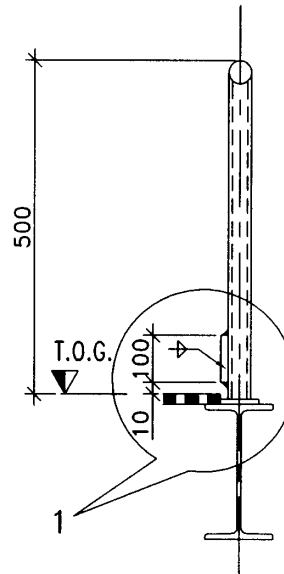
VIEW A-A

6	29.01.2010	REVISED & ISSUED AS STANDARD	V.P.SINGH	PK MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
5	15.06.2004	REAFFIRMED & ISSUED AS STANDARD	SK GAGAR	RP MEHROTRA	ARVIND KUMAR	SK GARYALI	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman	
Approved by							

TYPE - IV



HANDRAIL ON HORIZONTAL PLATFORM (STEEL)



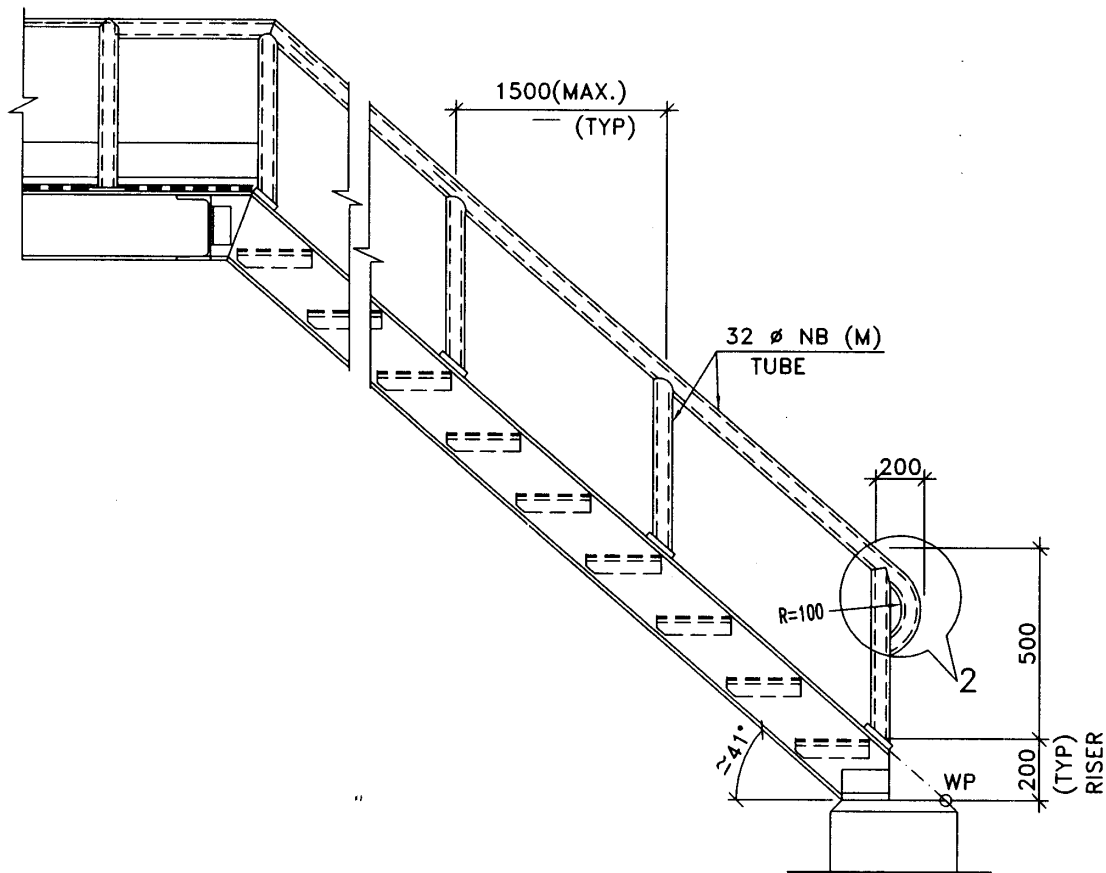
SEC. A-A

NOTE : HANDRAIL TYPE-IV SHALL BE USED OVER PIPE CROSS OVER AND LOW LEVEL PLATFORMS SUCH AS FOR VALVE OPERATION ETC. AS MENTIONED IN STD 7-68-0562 & 0563.

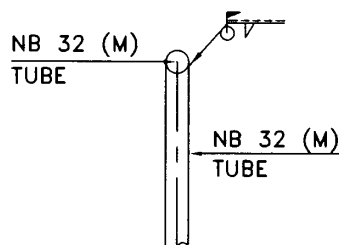
(FOR DETAILS ① REFER PAGE 8 OF 8)

6	29.01.2010	REVISED & ISSUED AS STANDARD	V.P.SINGH	PK MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
5	15.06.2004	REAFFIRMED & ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	ARVIND KUMAR	SK GARYALI	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman	Approved by

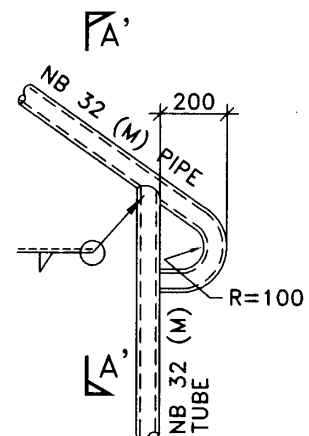
TYPE - IV



SLOPING HALF HANDRAIL ON STEEL STAIR

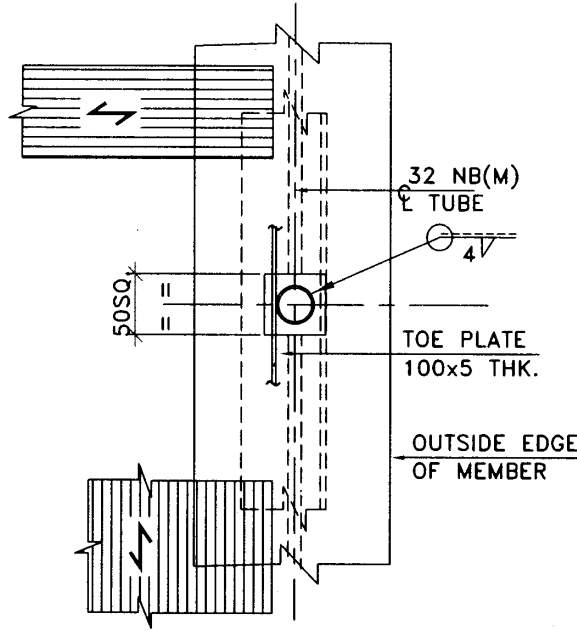


SEC. A'-A'

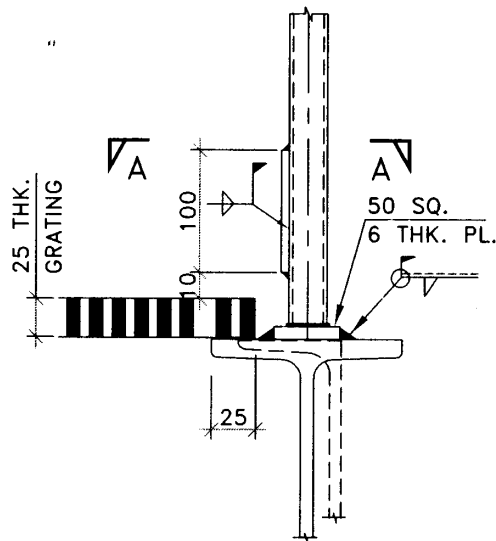


DETAIL - 2

6	29.01.2010	REVISED & ISSUED AS STANDARD	V.P. SINGH	PK MITTAL	S. CHATURVEDI	VINAY KUMAR	N DUARI
5	15.06.2004	REAFFIRMED & ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	ARVIND KUMAR	SK GARYALI	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman	Approved by



VIEW A-A

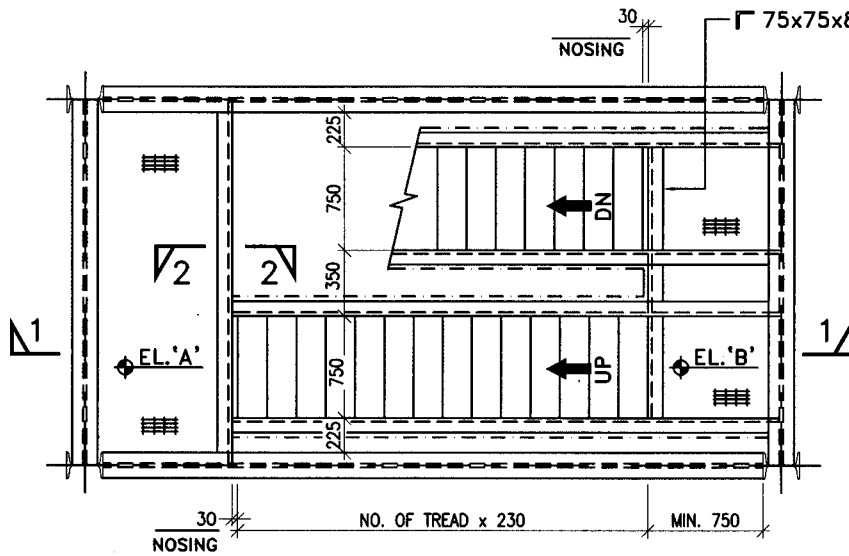


DETAIL - ①

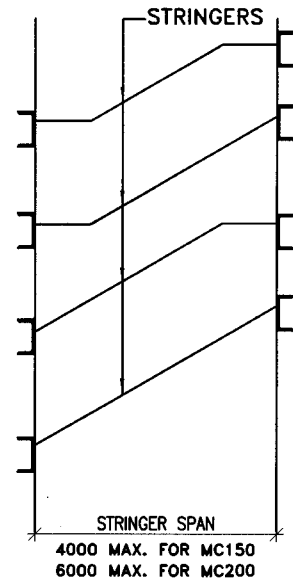
CONNECTION DETAILS (FOR TYPE I, II, III, IV)

NOTE : CHEQUERED PLATES / GRATINGS SHALL BE SUITABLY NOTCHED TO ACCOMMODATE THE TUBE IN CASE OF BEAM MC100 OR MC125.

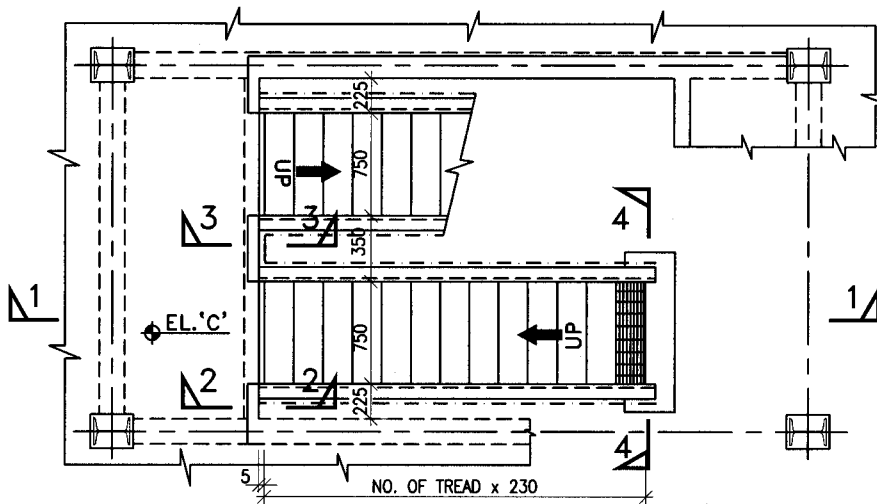
6	29.01.2010	REVISED & ISSUED AS STANDARD	V.P.SINGH	PK MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
5	15.06.2004	REAFFIRMED & ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	ARVIND KUMAR	SK GARYALI	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman	Approved by



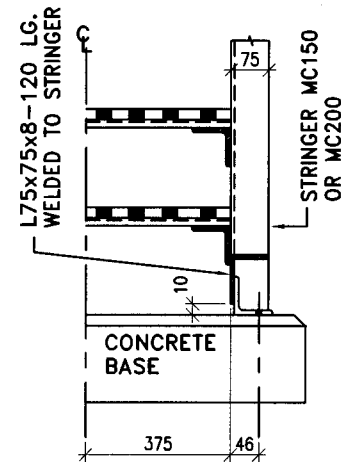
PLAN AT EL. 'A'



MAX. STRINGER SPAN
BETWEEN SUPPORTS



PLAN AT EL. 'C'

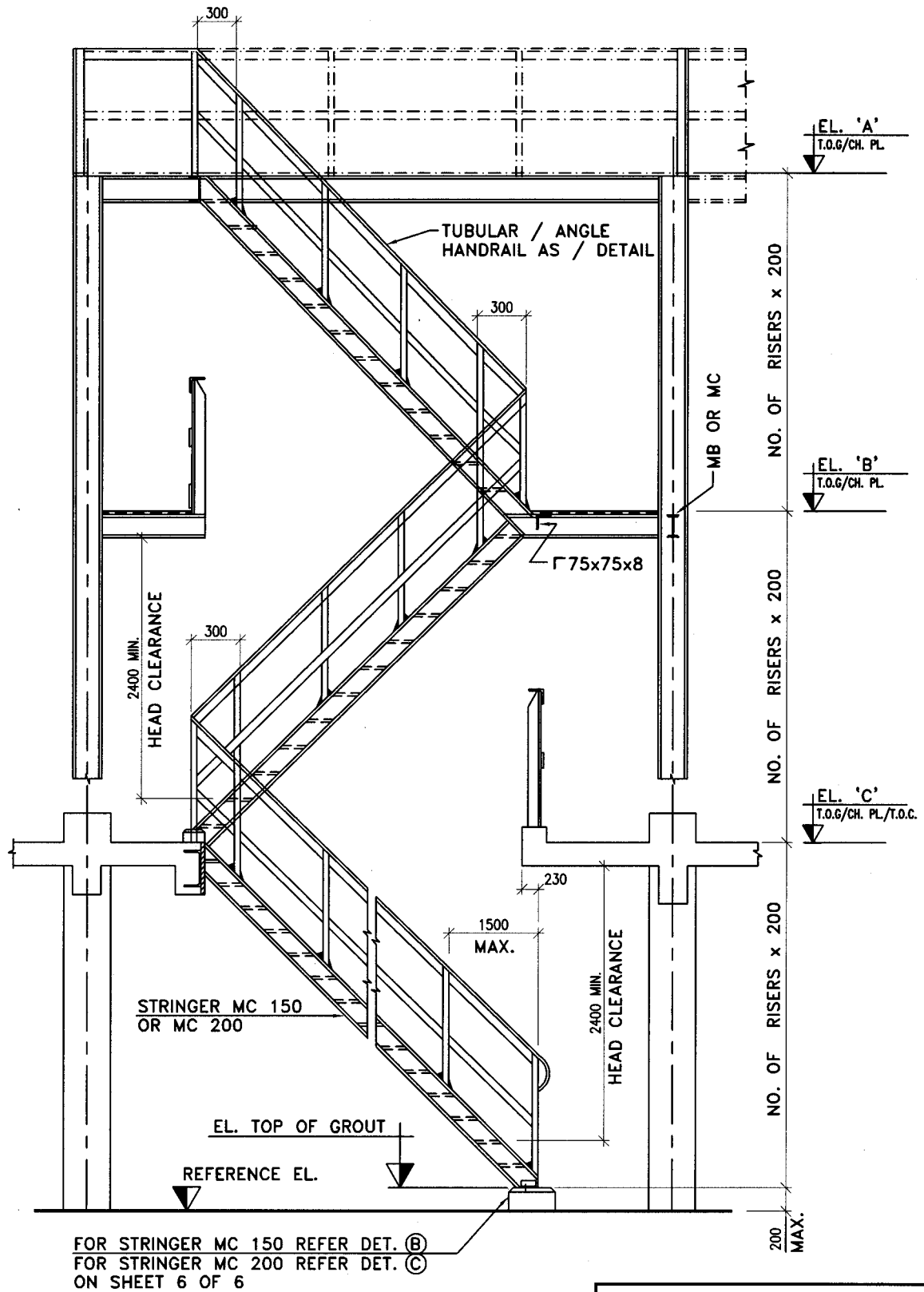


SECTION 4-4

NOTES :-

1. FOR STAIRWAY USE GRATING TYPE-III OR CHEQUERED PLATE IN TREADS WITH NOSING AS SPECIFIED.
2. FOR CONNECTION DETAILS REFER SHEETS 3, 4, 5 AND 6.
3. STRUCTURAL FLOORING : CHEQ. PLATE OR GRATING AS PER STANDARD NO. 7-68-0561.
4. STRINGER TO BE MC150 FOR RISES UPTO 4.0 m EXCEPT IN OFFICE BUILDING, WARE HOUSES AND WORKSHOPS, WHERE IT WILL BE AS PER DESIGN.
5. FOR DETAIL OF INSERT PLATE 'R1a' REFER EIL STD. NO. 7-68-0056.

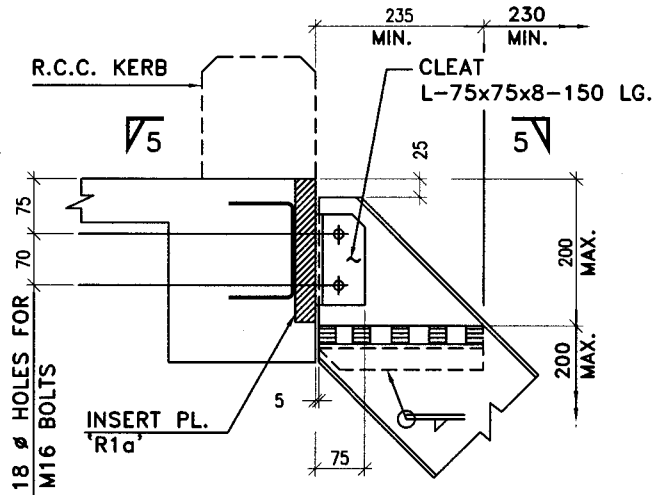
5	09.06.08	REAFFIRMED AND ISSUED AS STANDARD	SP Joshi	P.K. MITTAL	VINAYKUMAR	V. CHATURVEDI
4	11.07.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



SECTION 1-1

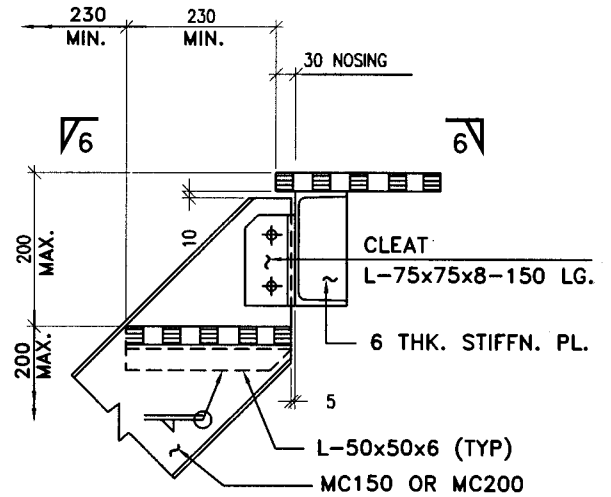
MAXIMUM RISER IS 200 HOWEVER IT MAY BE REDUCED AND ADJUSTED AS REQUIRED.

5	09.06.08	REAFFIRMED AND ISSUED AS STANDARD	SP JOSHI	P.K. MITTAL	VINAY KUMAR	V. CHATURVEDI
4	11.07.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



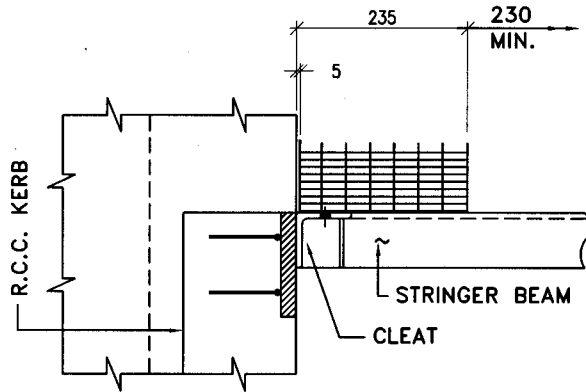
SECTION 2-2

(CONNECTION WITH CONCRETE BEAM)

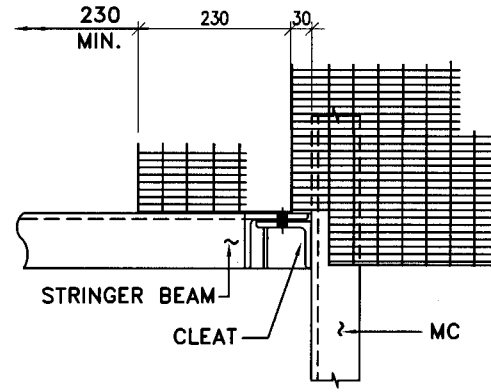


SECTION 2-2

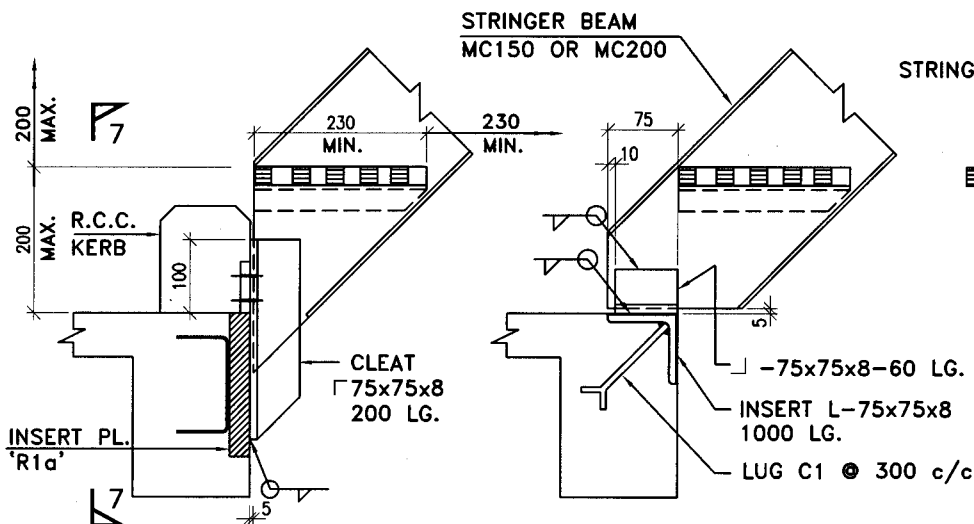
(CONNECTION WITH STEEL BEAM MC)



VIEW 5-5

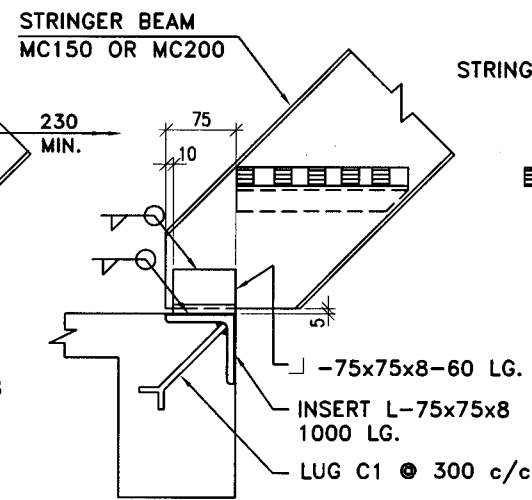


VIEW 6-6



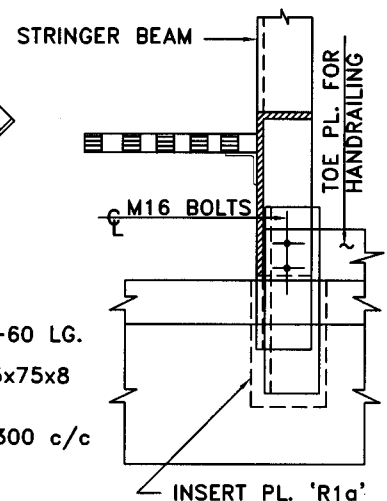
SECTION 3-3

(CONNECTION WITH CONCRETE BEAM)



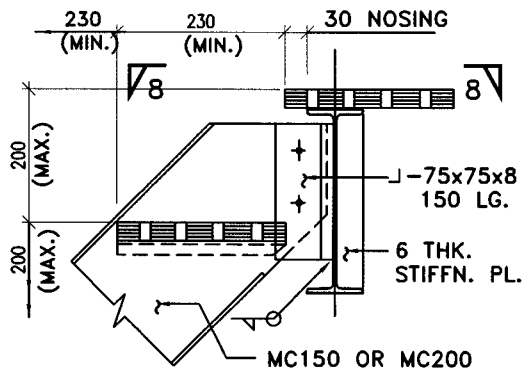
SECTION 3-3 (ALT.)

(CONNECTION WITH CONCRETE BEAM)
(R.C.C. KERB NOT SHOWN FOR CLARITY)



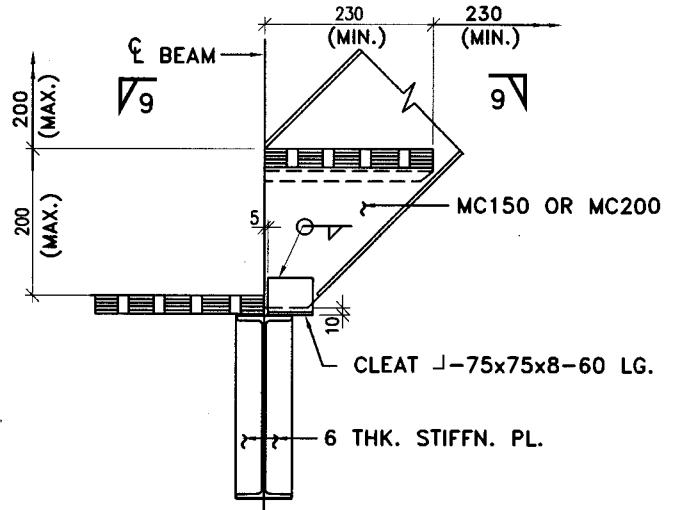
VIEW 7-7

5	09.06.08	REAFFIRMED AND ISSUED AS STANDARD	SP.JOSHI	P.K.MITTAL	VINAYKUMAR	V.CHATURVEDI
4	11.07.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman



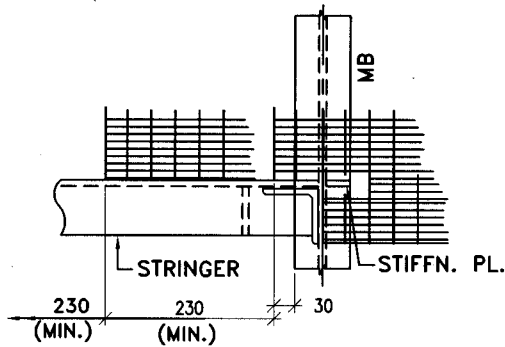
SECTION 2-2

(CONNECTION WITH STEEL BEAM ISMB)

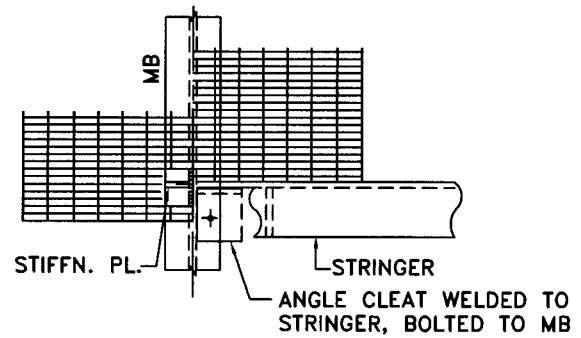


SECTION 3-3

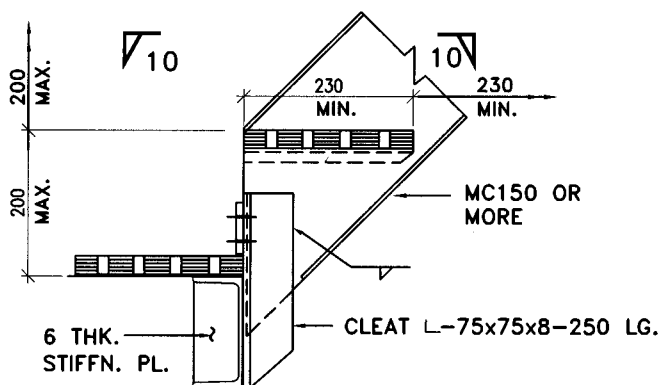
(CONNECTION WITH STEEL BEAM ISMB)



VIEW 8-8

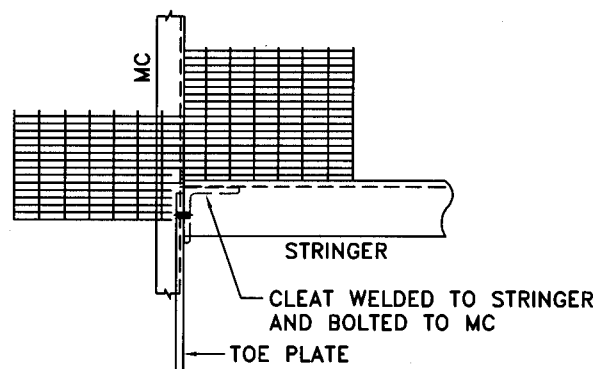


VIEW 9-9



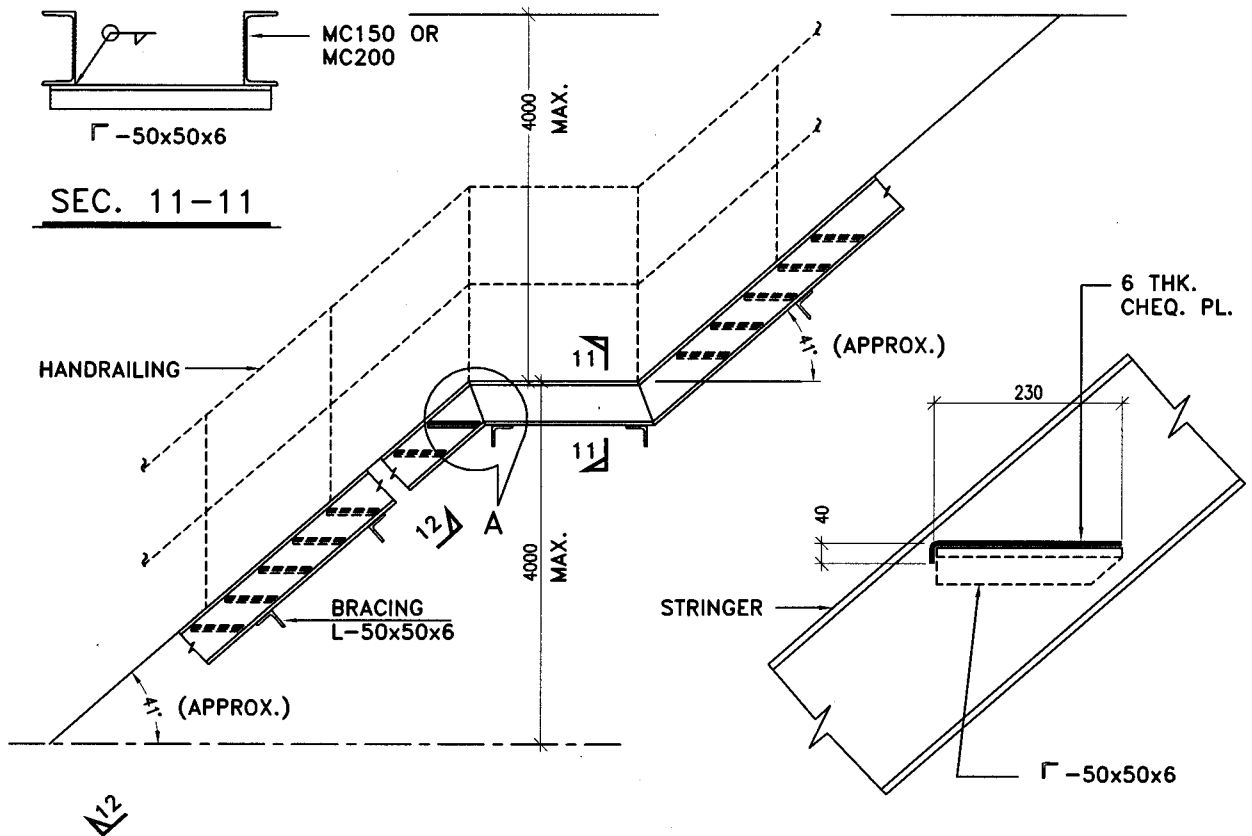
SECTION 3-3

(CONNECTION WITH STEEL BEAM ISMC)

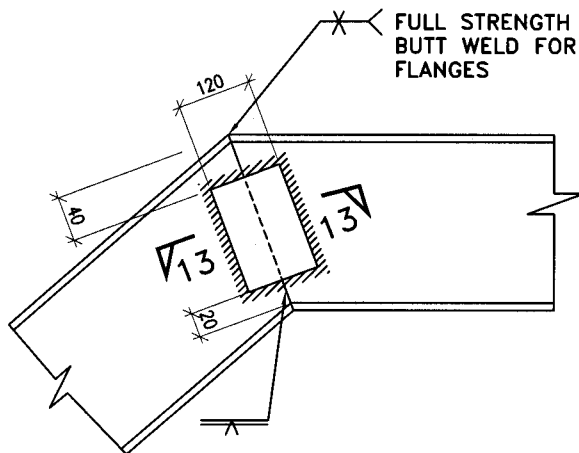


VIEW 10-10

5	09.06.08	REAFFIRMED AND ISSUED AS STANDARD	SP. Joshi	P.K. MITTAL	VINAY KUMAR	V. CHATURVEDI
4	11.07.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M. IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						

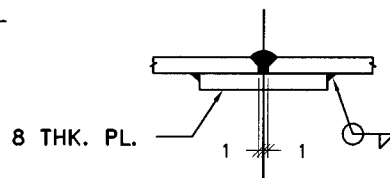


TYP. DET. OF CHEQ. PL. STEP

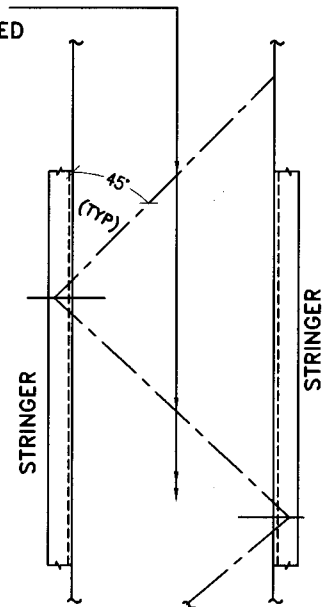


DETAIL - A

L-50x50x6 STIFFENING BRACING TO BE PROVIDED FOR STAIR WITH MORE THAN 20 RISER

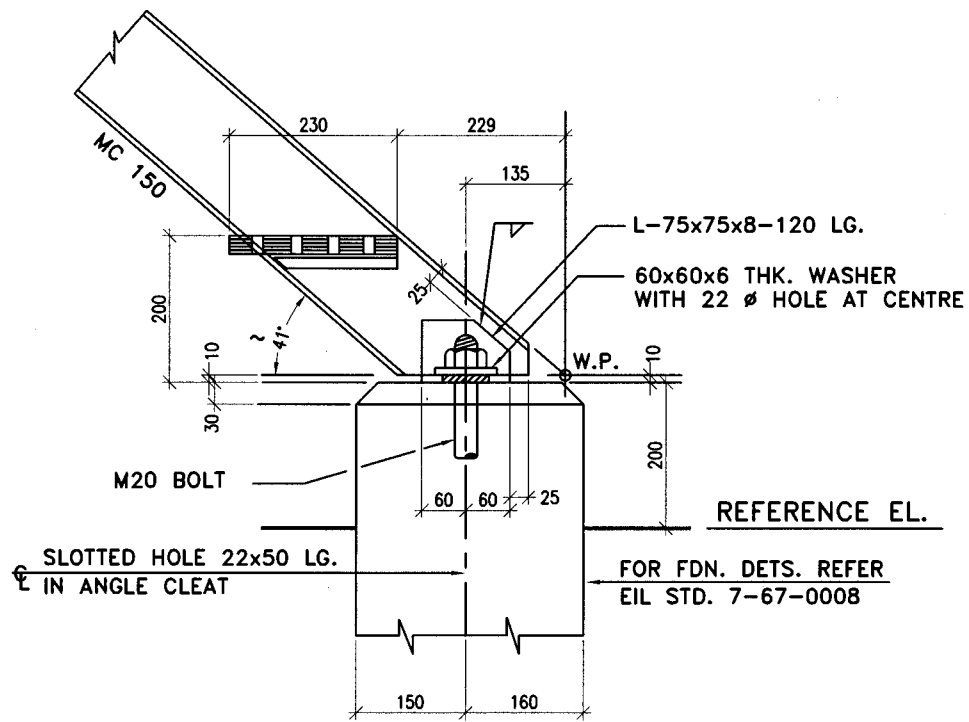


SEC. 13-13

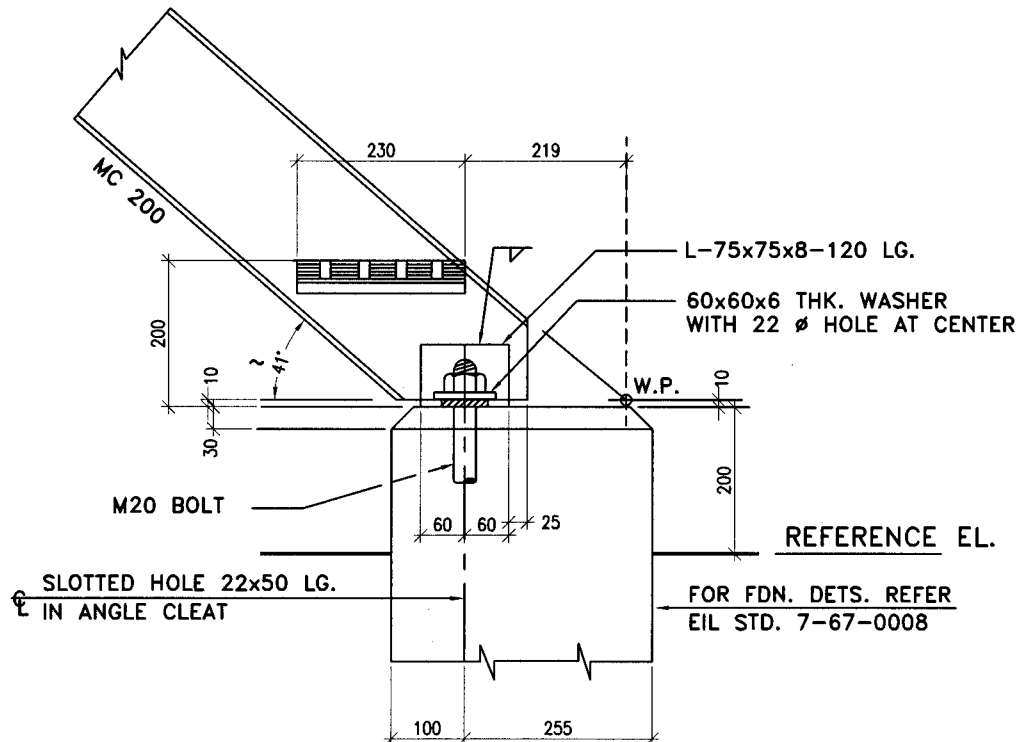


VIEW 12-12

5	09.06.08	REAFFIRMED AND ISSUED AS STANDARD	SPJoshi	P.K.MITTAL	VINAYKUMAR	V.CHATURVEDI
4	11.07.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						



DETAIL - B

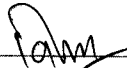


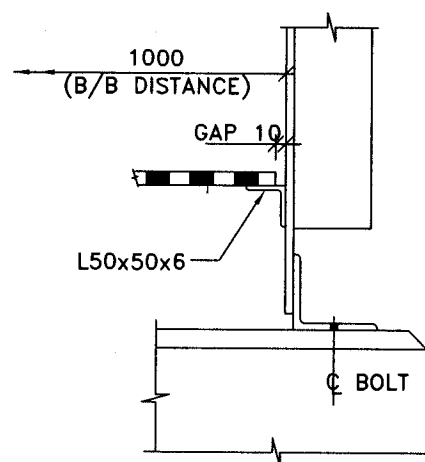
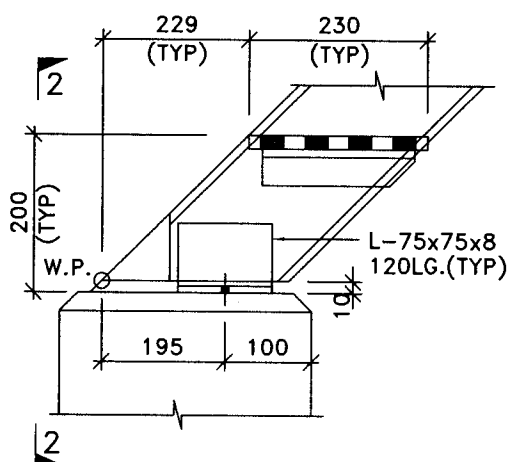
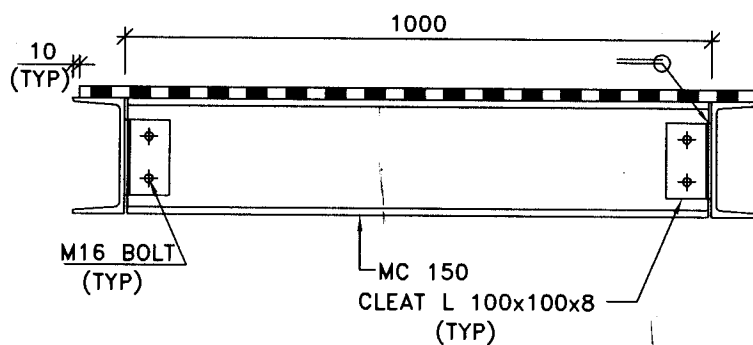
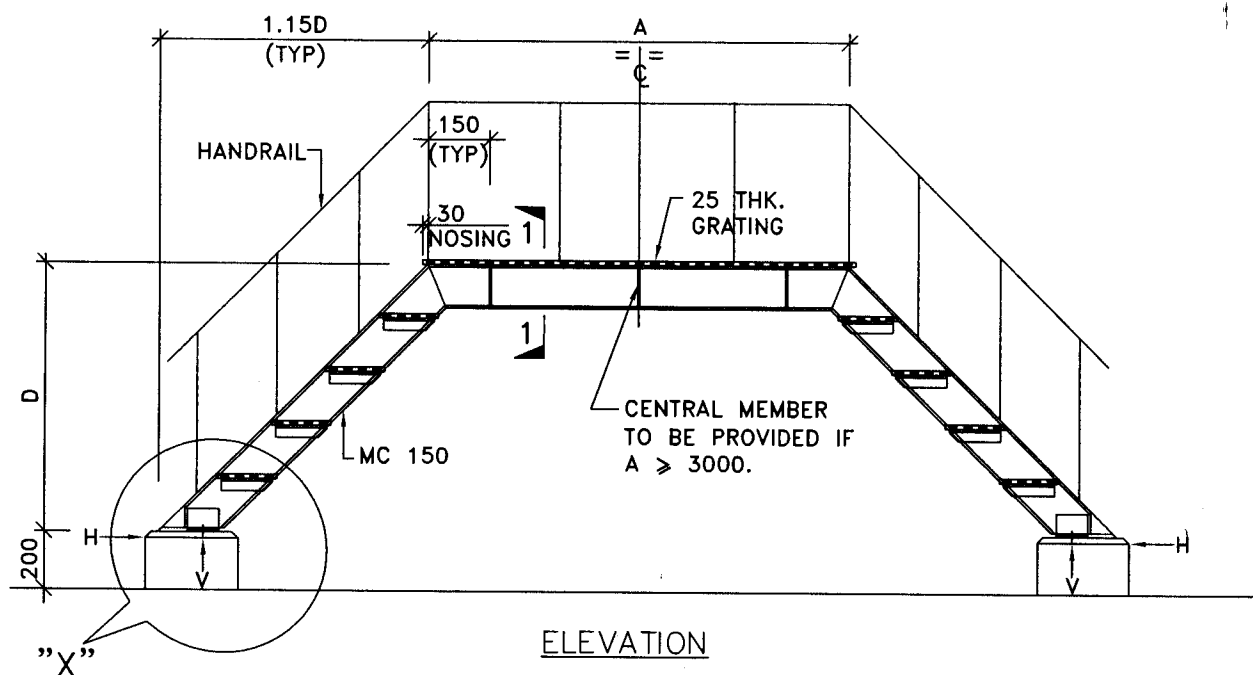
DETAIL - C

5	09.06.08	REAFFIRMED AND ISSUED AS STANDARD	SP Joshi	P.K. MITTAL	VINAYKUMAR	VINAYKUMAR
4	11.07.01	REAFFIRMED AND ISSUED AS STANDARD	SK SAGAR	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						

NOTES :-

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. THE LOADING CONSIDERED ARE :-
 - a) LIVE LOAD = 2.0 kN/m² ON CROSSOVERS.
 - b) SELF WEIGHT OF MEMBER INCLUDING GRATINGS.
3. ALL STRUCTURAL STEEL SHALL CONFORM TO IS:2062 GRADE-A.
4. REINFORCEMENT BARS SHALL BE HIGH YIELD STRENGTH DEFORMED BARS OF GRADE Fe500 CONFORMING TO IS:1786.
5. CONCRETE AND STEEL WORKS SHALL BE AS PER GENERAL NOTES FOR THE PROJECT.
6. LOCATION AND ORIENTATION OF PLATFORMS SHALL BE AS PER PIPING GAD.
7. STAIRCASE DETAIL SHALL BE AS PER EIL STANDARD NO. 7-68-0506.
8. STAIRCASE ON EACH SIDE OF CROSSOVER SHALL HAVE INCLINATION OF 41° TO HORIZONTAL, WITH RISERS NOT EXCEEDING 200mm.
9. GRATING SHALL BE TYPE-I AS PER EIL STANDARD NO. 7-68-0697.
10. UPTO H >= 2000 HANDRAIL SHALL BE TYPE-IV AS PER EIL STD. NO. 7-68-0501, HANDRAIL FOR OTHER PLATFORMS SHALL BE TYPE-VII. TOP RAIL OF HANDRAIL SHALL BE 32 NB (M) PIPE.
11. GUSSET PLATES SHALL BE 8mm THICK, UNLESS NOTED OTHERWISE.
12. ANCHOR BOLTS SHALL BE AS PER EIL STANDARD 7-68-0417.
13. PIPE SLEEPERS HAVE BEEN ASSUMED TO BE 500mm (MAXIMUM) ABOVE GRADE AND WITH A MAXIMUM LENGTH OF 5000mm SYMMETRICALLY LOCATED WITH RESPECT TO CENTRE LINE, THUS REQUIRING SINGLE SPAN CROSSOVERS.
14. VARYING CROSSOVER LENGTHS AGAINST HEIGHT OF 1000, 1600, 2000 AND 2500 ABOVE THE PEDESTAL HAVE BEEN TABULATED IN SHT.3 OF 4 OF THIS STANDARD.
15. TABULATED HORIZONTAL AND VERTICAL FORCES 'H AND V' ON THE FOUNDATION MAY BE USED FOR DESIGN OF FOOTING, SINCE SOIL RECOMMENDATION VARY FOR DIFFERENT SITES, HOWEVER, A STANDARD FOUNDATION DETAIL GIVEN IN SHEET 4 OF 4 MAY BE ADOPTED FOR MINIMUM SOIL BEARING CAPACITY OF 5T/m² AT FOUNDATION LEVEL.

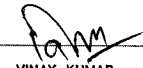
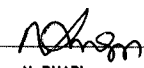
3	20.07.09	REAFFIRMED AND ISSUED AS STANDARD	 GAUTAM SANKER	 P.K. MITTAL	 VINAY KUMAR	 N. DUARI
2	11.07.01	REAFFIRMED AND ISSUED AS STANDARD	A. LAL	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman
Approved by						

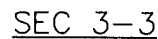


3.	20.07.09	REAFFIRMED AND ISSUED AS STANDARD	GAUTAM SANKER	P.K.MITTAI	VINAY KUMAR	N DUARI
2	12.07.01	REAFFIRMED AND ISSUED AS STANDARD	A. LAL	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman

DESIGN FORCES IN VERTICAL AND HORIZONTAL
DIRECTION, FOR PIPE SLEEPER CROSSOVERS.

SL. NO.	LENGTH A, mm	HEIGHT D, mm	FORCES AT TOP OF FDN, TONNE	
			V	H
1	1000	1000	0.38	0.35
2	1500	1000	0.38	0.35
3	2000	1000	0.38	0.35
4	2500	1000	0.49	0.56
5	3000	1000	0.49	0.56
6	3500	1000	0.49	0.56
7	1000	1600	0.52	0.42
8	1500	1600	0.52	0.42
9	2000	1600	0.52	0.42
10	2500	1600	0.62	0.59
11	3000	1600	0.62	0.59
12	3500	1600	0.62	0.59
13	1000	2000	0.61	0.48
14	1500	2000	0.61	0.48
15	2000	2000	0.61	0.48
16	2500	2000	0.72	0.64
17	3000	2000	0.72	0.64
18	3500	2000	0.72	0.64
19	3000	2500	0.83	0.70

3	20.07.09	REAFFIRMED AND ISSUED AS STANDARD	 GAUTAM SANKER	 P.K. MITTAL	 VINAY KUMAR	 N. DUARI
2	12.07.01	REAFFIRMED AND ISSUED AS STANDARD	A. LAL	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman



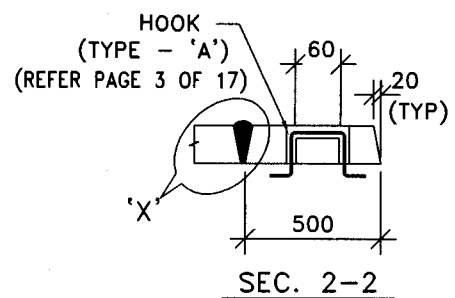
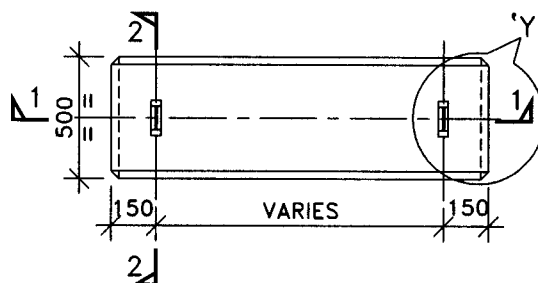
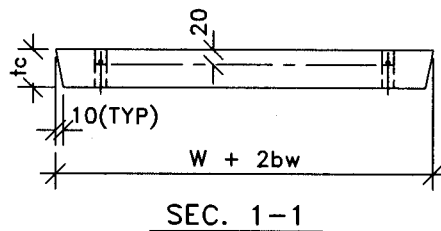
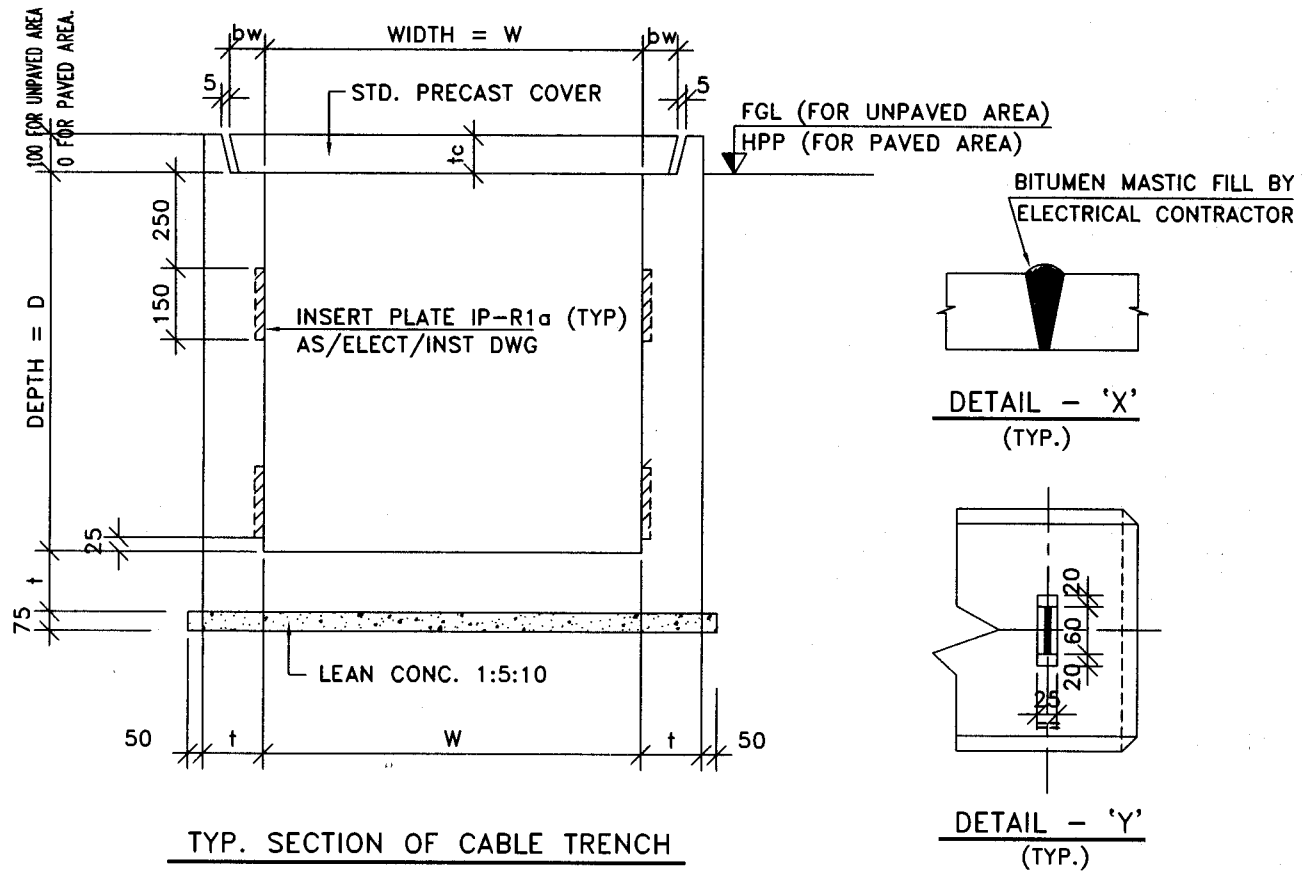
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NOTES :-

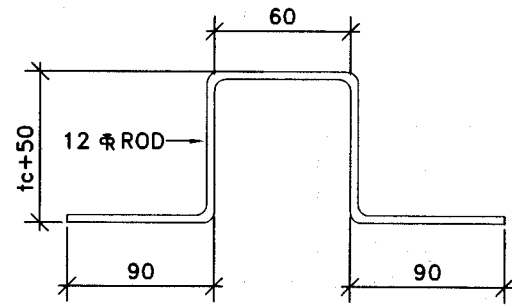
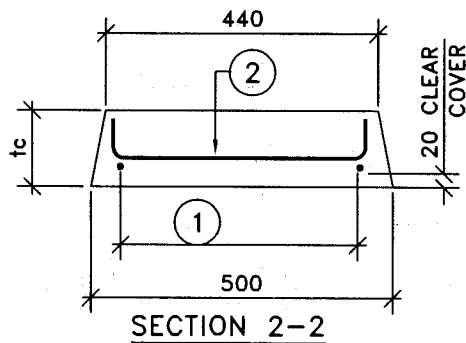
1. THIS STANDARD IS BASED ON FOLLOWING PRINCIPLES OF LAYING CABLES IN THE PLANT AREA
 - a) UNIT AREA - CABLES IN RCC TRENCH/BRICK MASONRY TO BE FILLED WITH SAND AND COVERED WITH PRECAST RCC SLABS.
 - b) INSIDE BUILDING - CABLES IN RCC TRENCH TO BE COVERED WITH CHEQUERED PLATE/RCC COVERS.
 - c) OFFSITE AREA - AS PER PROJECT SPECIFIC REQUIREMENT.
2. RELEVANT DRAWINGS WHICH WILL BE ISSUED FOR CONSTRUCTION SHALL BE REFERRED FOR, THE FOLLOWING IN BUILDINGS :
 - a) LAYOUT AND SIZE OF THE CABLE TRENCH BY ELECTRICAL/INSTRUMENTATION DEPTS.
 - b) TYPE OF COVER REQUIRED i.e. PRECAST RCC/CHEQD PLATE ELECTRICAL/INSTRUMENTATION.
 - c) INSERT PLATE REQUIREMENT BY ELECTRICAL/INSTRUMENTATION DEPTS.
 - d) LAYOUT AND SIZE OF OPENING FOR PANELS (SHEET 15 OF 17) AS PER ELECTRICAL EQUIPMENT LAYOUT DRAWING FOR BUILDINGS ONLY.
3. RELEVANT GENERAL CIVIL DRAWINGS SHALL BE REFERRED FOR THE TRENCHES IN UNIT & OFFSITE AREA.
4. CONCRETE FOR PRECAST COVER AND CABLE TRENCH SHALL BE AS PER GRADE OF CONCRETE FOR THE PROJECT BUT NOT LESS THAN M20.
5. THIS STANDARD IS NOT APPLICABLE FOR CABLE TRENCH / COVERS AT ROAD CROSSING.
6. STRUCTURAL STEEL FOR CABLE SUPPORTS INCLUDING INSERT PLATES IS IN SCOPE OF CIVIL CONTRACTOR.
7. ALL OTHER STRUCTURAL STEEL WORKS SHALL BE UNDER THE SCOPE OF ELECTRICAL CONTRACTOR INCLUDING CHEQUERED PLATE.

PRECAST COVERS DESIGNED FOR 10 T. HYDRA

3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN	A.SONI	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	GM(E)	Stds. Bureau Chairman

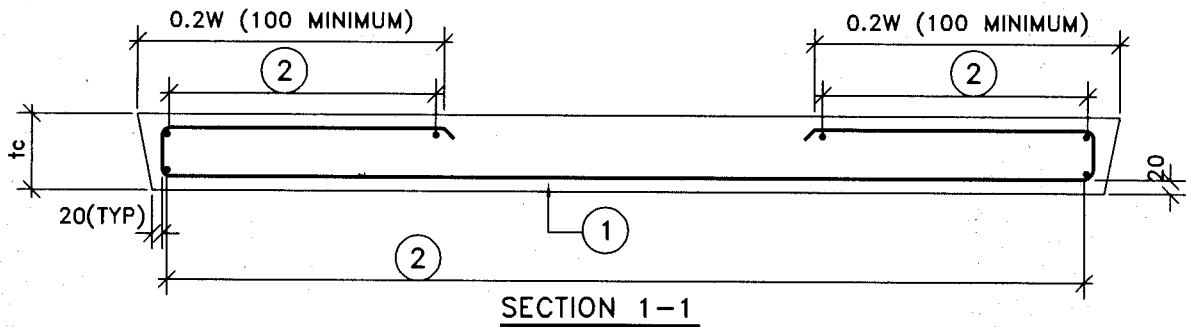


3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN	A.SONI	
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	GM(E)	Stds. Bureau Chairman
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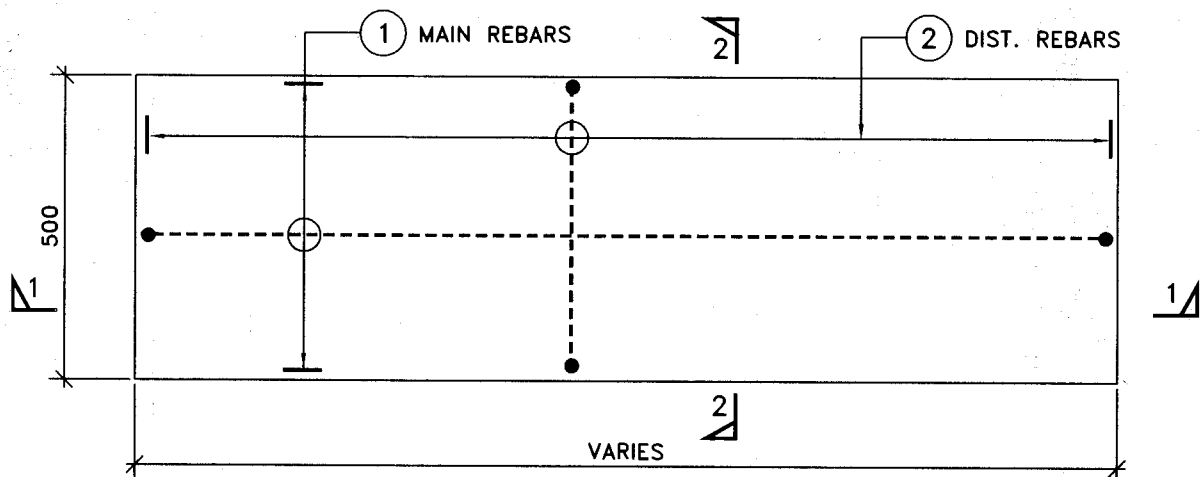


HOOK TYPE 'A'
(REFER SHT.2 OF 17)

TYP. DETAIL OF HOOK

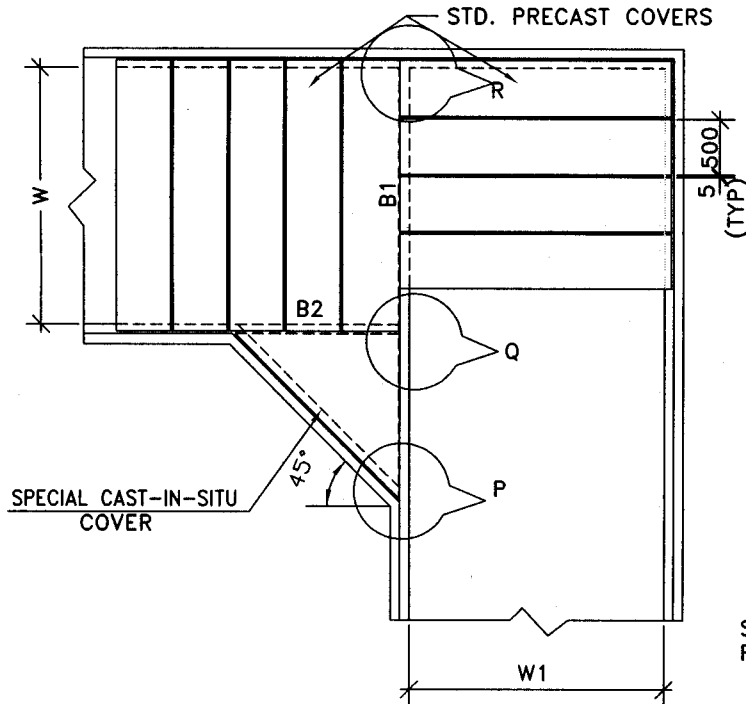


SECTION 1-1

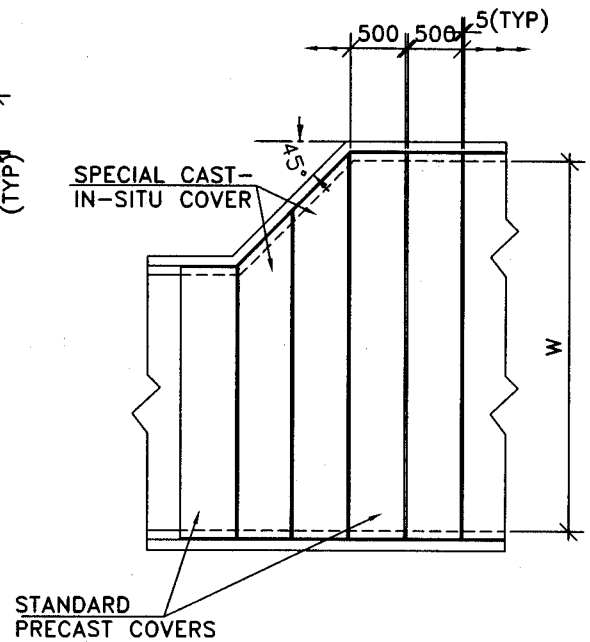


PLAN
(STANDARD PRECAST COVER)

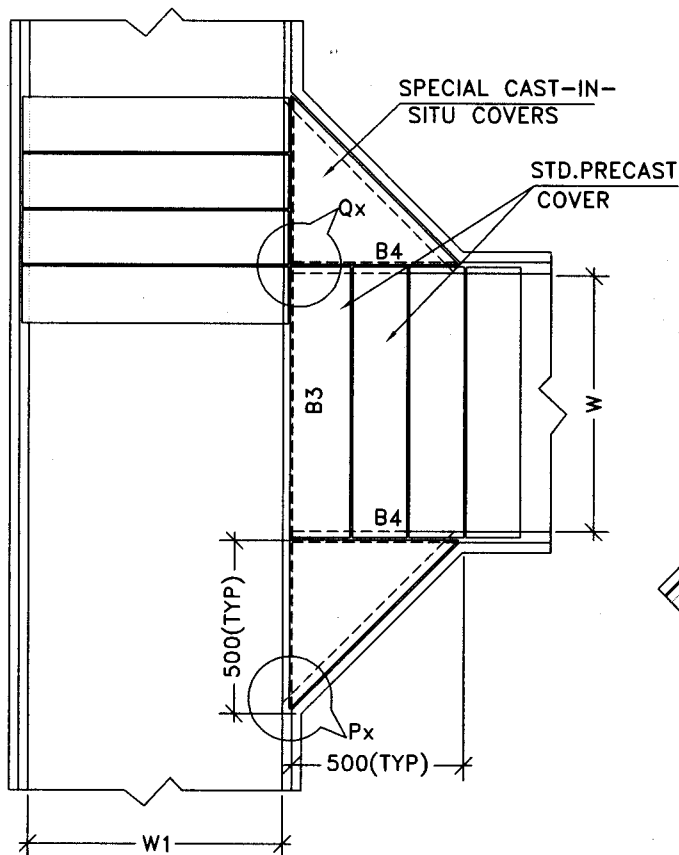
3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	S.CHATURVEDI	VINAY KUMAR	N. DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN	A.SONI	
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	GM(E)	Std. Bureau Chairman
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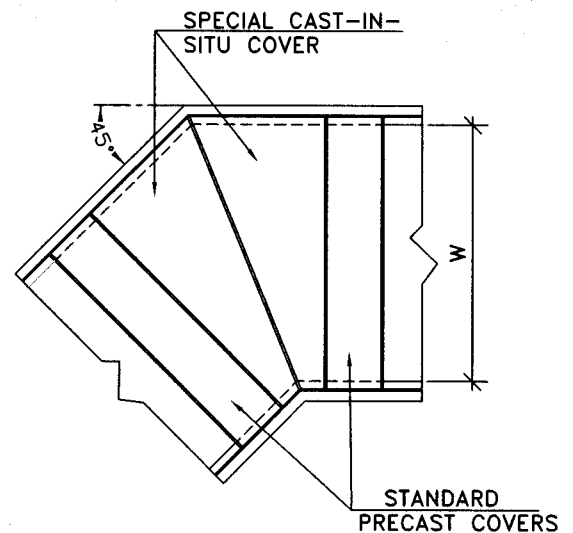
JUNCTION TYPE - I



JUNCTION TYPE - III



JUNCTION TYPE - II



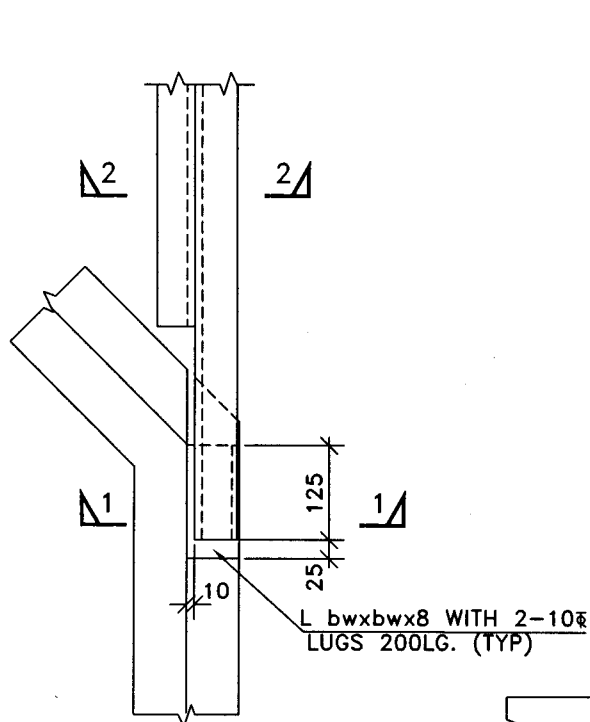
JUNCTION TYPE - IV

NOTES :

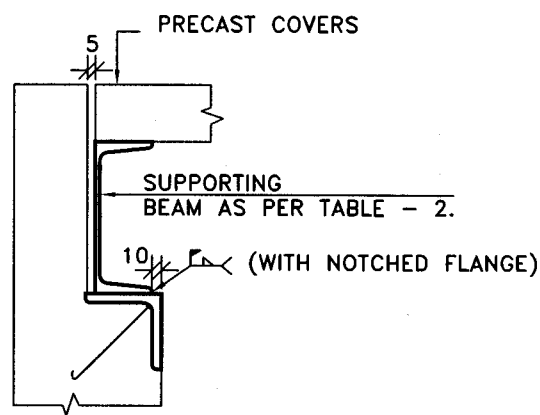
1. FOR DETAILS P, Q, Px, Qx & R REFER SHT. 6 OF 17.
2. FOR DETAIL OF BEAMS B1 TO B4 REF. TABLE 2.

SPECIAL CAST-IN-SITU COVERS

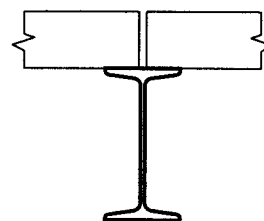
3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN		A.SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	GM(E)	Stds. Bureau Chairman



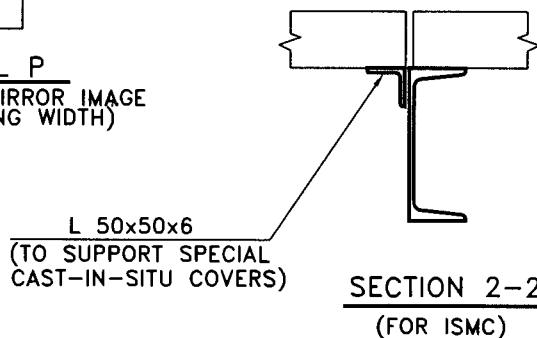
DETAIL P
DETAIL Px - MIRROR IMAGE
(bw=BEARING WIDTH)



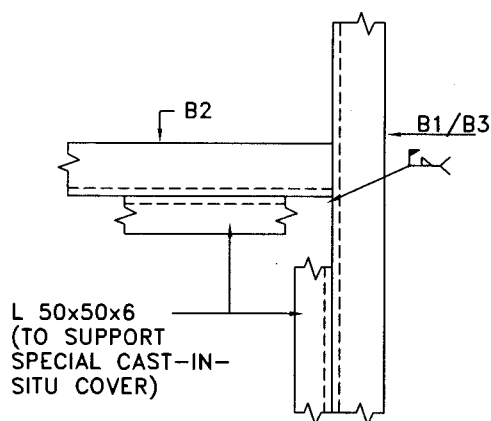
SECTION 1-1



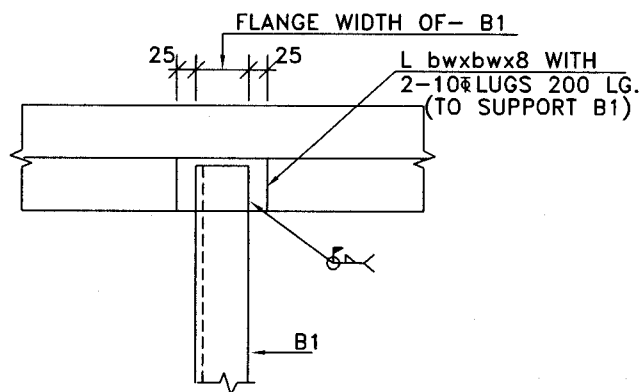
SECTION 2-2
(FOR ISMB)



SECTION 2-2
(FOR ISMC)



DETAIL Q
DETAIL Qx - MIRROR IMAGE



DETAIL R
(bw=BEARING WIDTH)

SUPPORTING MEMBERS

(FOR LOCATION OF DET. P, Q, Px, Qx & R REF. SHT. 5 OF 17)

3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN		A.SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	GM(E)	Std. Bureau Chairman

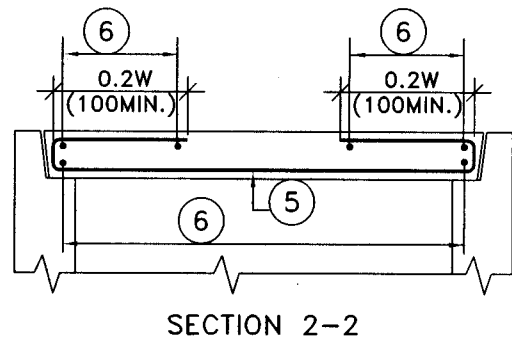
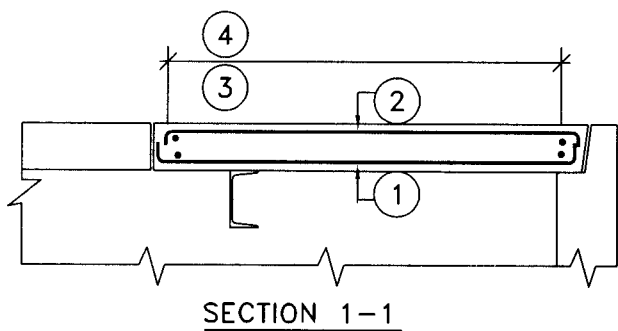
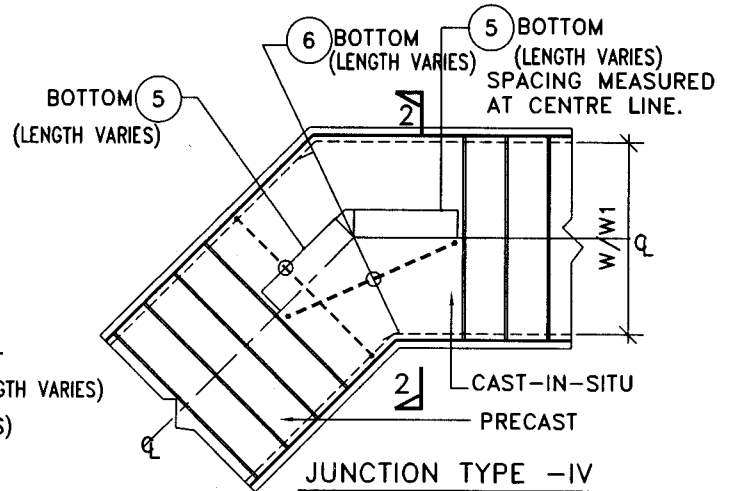
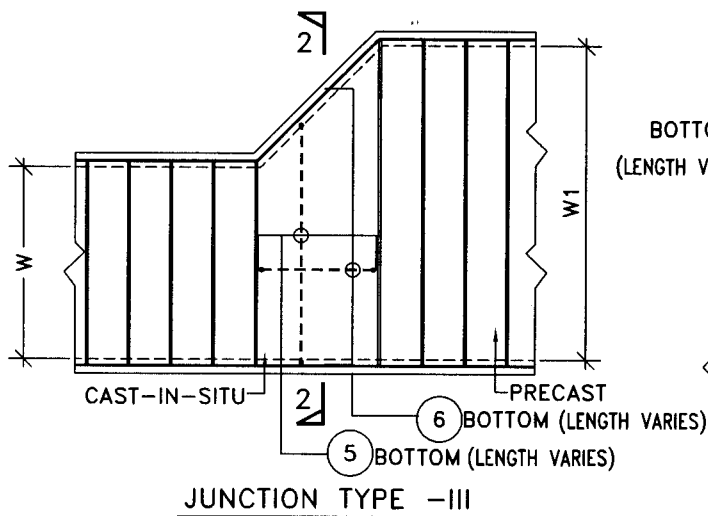
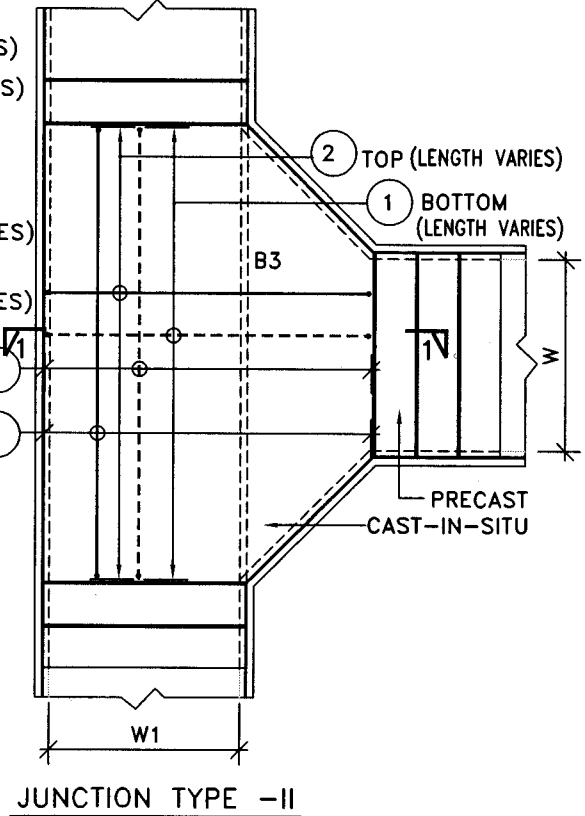
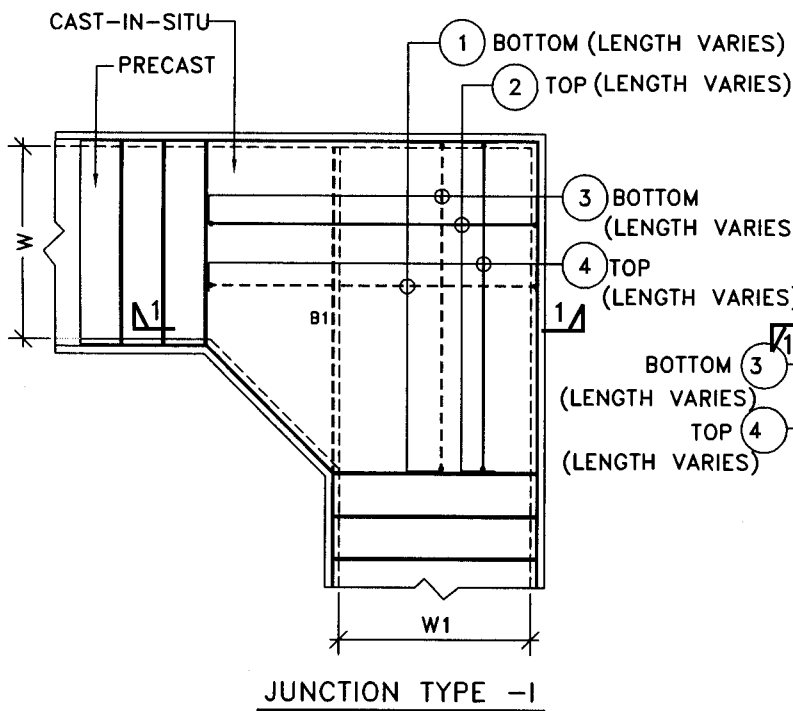
TABLE-2: DETAIL OF SUPPORTING MEMBERS B1, B2, B3 & B4 AT JUNCTIONS

S.NO.	CLEAR WIDTH OF MAIN TRENCH W	JUNCTION TYPE - I				JUNCTION TYPE - II			
		SUPPORTING MEMBER B1		SUPPORTING MEMBER B2		SUPPORTING MEMBER B3		SUPPORTING MEMBER B4	
		SIZE	LENGTH	SIZE	LENGTH	SIZE	LENGTH	SIZE	LENGTH
1.	300	MC 150	1020	MC 125	625	MC 200	1650	MC 125	625
2.	500	MC 150	1220	MC 125	625	MC 200	1850	MC 125	625
3.	750	MC 200	1470	MC 125	625	MC 250	2100	MC 125	625
4.	1000	MC 200	1720	MC 125	625	MC 250	2350	MC 125	625
5.	1250	MC 250	1970	MC 125	625	MC 300	2600	MC 125	625
6.	1500	MC 250	2270	MC 125	625	MC 300	2900	MC 125	625
7.	2000	MB 250	2770	MC 125	625	MC 300	3400	MC 125	625

NOTE

THE SUPPORTING MEMBERS ARE DESIGNED FOR COVER WT. PLUS A POINT LOAD OF 5000 kg. AT MID SPAN.

3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN	A.SONI	
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DETAIL OF CAST-IN-SITU COVERS

(FOR DETS OF R/F BARS ① TO ⑥ REFER TABLE-3 SHT 9 OF 17)

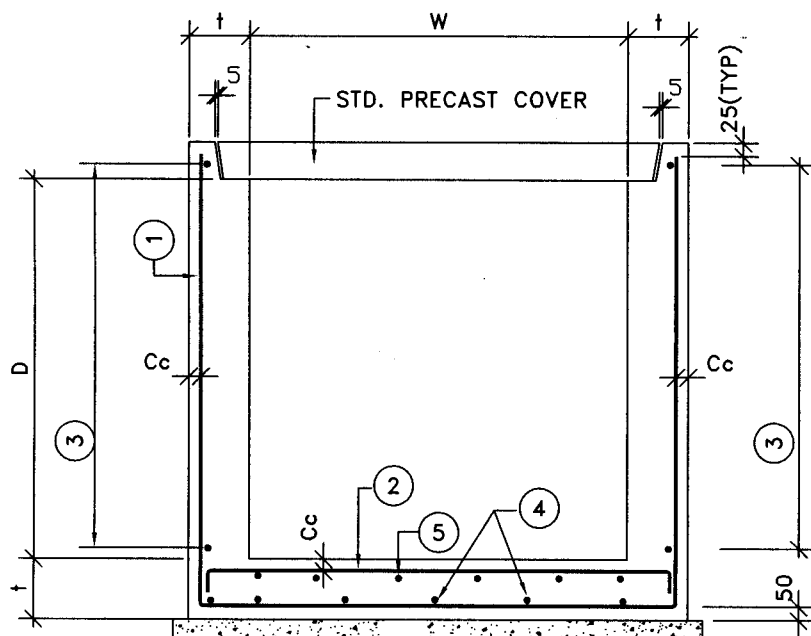
3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN	A.SONI	
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TABLE - 3:

S.NO.	CLEAR WIDTH OF TRENCH W1 (mm)	tc (mm)	REINFORCEMENT DETAIL FOR CAST-IN-SITU COVERS					
			JUNCTION TYPE I & II				JUNCTION TYPE III & IV	
			BAR MARK (1)	BAR MARK (2)	BAR MARK (3)	BAR MARK (4)	BAR MARK (5)	BAR MARK (6)
1.	300	150	8 Φ 120c/c	—	8 Φ 150c/c	—	8 Φ 120c/c	8 Φ 150c/c
2.	500	150	8 Φ 100c/c	—	8 Φ 150c/c	—	8 Φ 120c/c	8 Φ 150c/c
3.	750	200	10 Φ 150c/c	8 Φ 150c/c	8 Φ 150c/c	8 Φ 150c/c	10 Φ 200c/c	8 Φ 150c/c
4.	1000	200	12 Φ 120c/c	8 Φ 150c/c	8 Φ 200c/c	8 Φ 200c/c	10 Φ 200c/c	8 Φ 200c/c
5.	1250	250	12 Φ 150c/c	8 Φ 150c/c	8 Φ 200c/c	8 Φ 200c/c	12 Φ 200c/c	8 Φ 200c/c
6.	1500	250	12 Φ 200c/c	8 Φ 150c/c	8 Φ 200c/c	8 Φ 200c/c	12 Φ 200c/c	8 Φ 200c/c
7.	2000	250	16 Φ 200c/c	8 Φ 150c/c	8 Φ 200c/c	8 Φ 200c/c	12 Φ 150c/c	8 Φ 200c/c

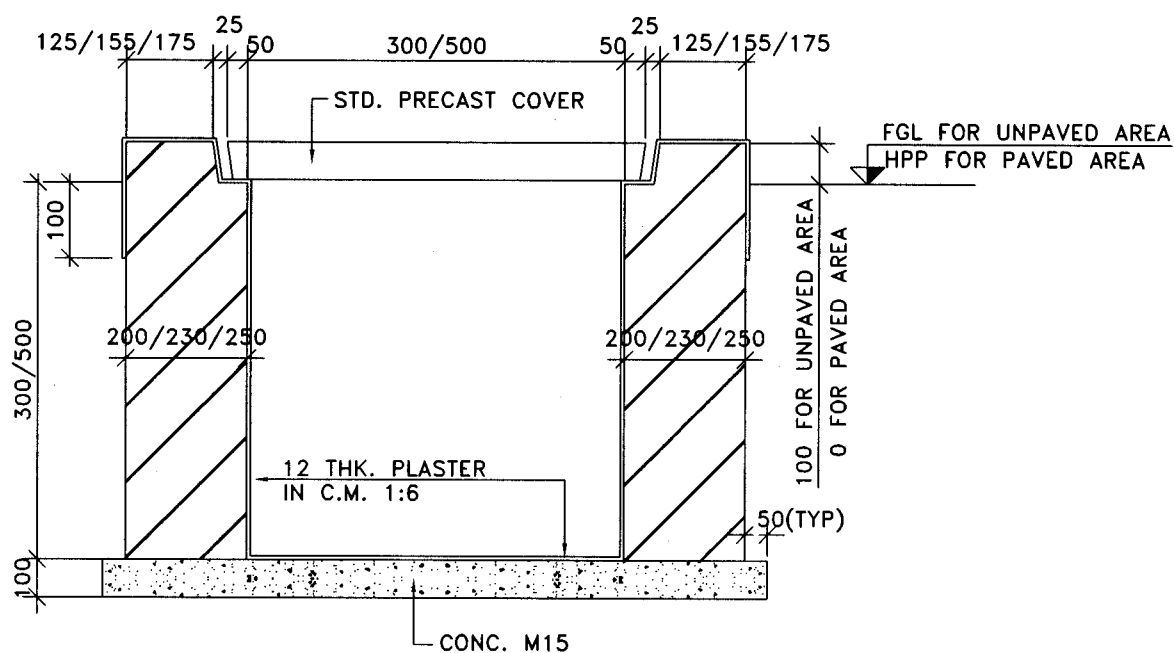
- NOTES :-**
1. THE CAST-IN-SITU COVERS ARE DESIGNED FOR POINT LOAD OF 5000 kg ACTING AT MID SPAN.
 2. FOR CONNECTION DETAIL AND SIZES OF B1 & B3 REFER SHT. 6 OF 17 AND 7 OF 17.
 3. REINFORCEMENT BARS SHALL CONFORM TO IS: 1786 OF GRADE Fe-500 TMT.
 4. GRADE OF CONC. SHALL BE MINIMUM M20 OR AS PER GENERAL NOTES OF OF THE PROJECT.
 5. FOR LOCATION OF BAR MARKS (1) TO (6) REFER SHT. 8 OF 17.

3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN	A.SONI	
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	GM(E) Std. Bureau Chairman	Approved by



CABLE TRENCH SECTION WITH R.C.C.

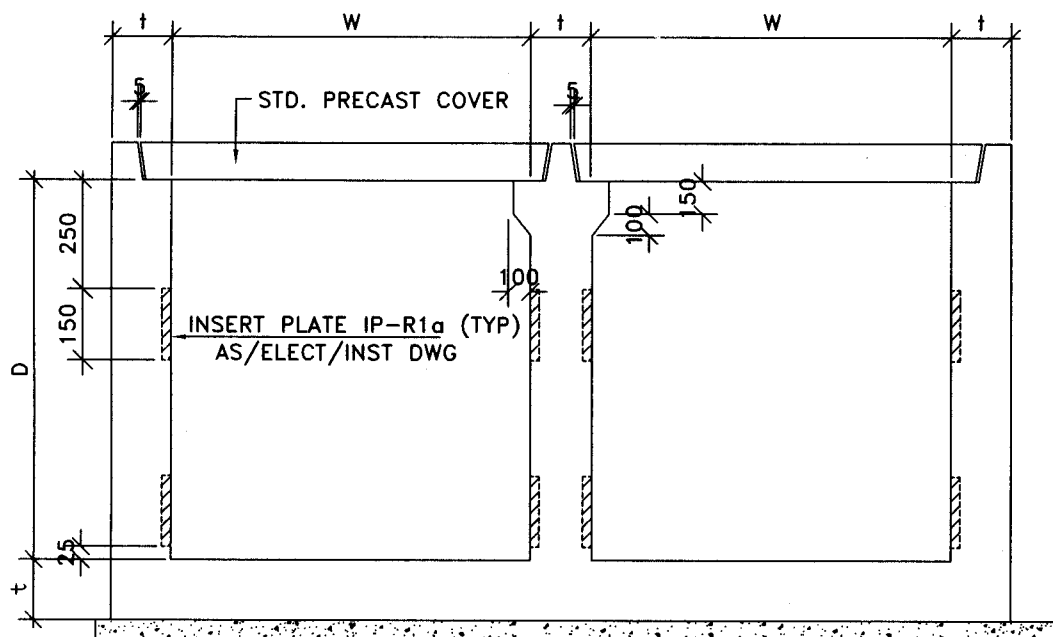
(FOR DETS OF R/F BARS ① TO ⑥ REFER TABLE-4 SHT 12 OF 17)



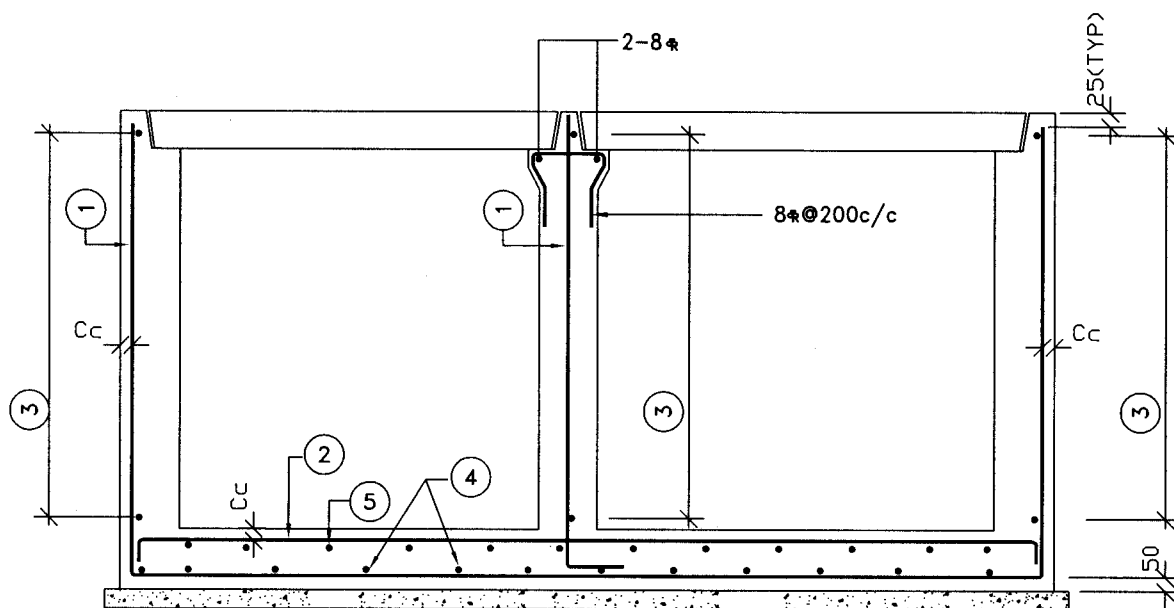
CABLE TRENCH SECTION WITH BRICK MASONRY

(IN C.M. 1:6)

3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P. SINGH	P.K. MITTAL	S. CHATURVEDI	VINAY KUMAR	N. DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN		A. SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	GM(E)	Std. Bureau Chairman
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CABLE TRENCH SECTION WITH PARTITION



CABLE TRENCH SECTION WITH PARTITION

(FOR DETS OF R/F BARS ① TO ⑤ REFER TABLE-4 SHT 12 OF 17)

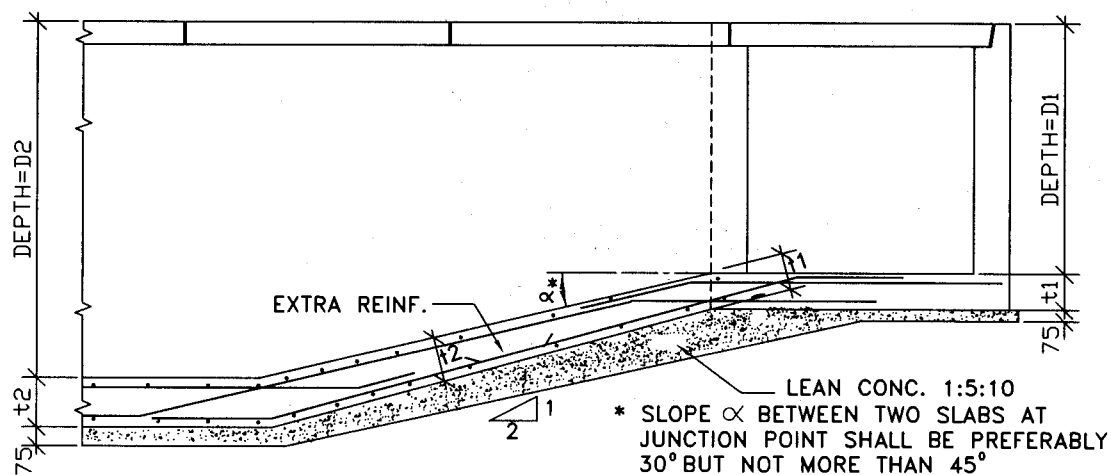
3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN		A.SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	GM(E)	Stds. Bureau Chairman
Approved by							

TABLE- 4: DETAIL OF CABLE TRENCH REINFORCEMENT

S.NO.	WORKING DIMENSIONS				R/F CONFORMING TO IS: 1786 GRADE Fe-500(TMT).					APPROX. QUANTITIES PER METRE LENGTH.			
	DEPTH D (mm)	WIDTH W (mm)	THICK- NESS t (mm)	CLEAR COVER Cc (mm)	BAR MARK (REF. SHT. 10 OF 17)					LEAN CONC. 1:5:10 (m ³)	CONC. (m ³)	REBARS (kg)	SHUTTERING (m ²)
					(1)	(2)	(3)	(4)	(5)				
1.	1500	2000	200	40	12#-200C/C.	12#-175C/C.	8#-250C/C.	8#-300C/C.	8#-300C/C.	0.180	1.08	56.0	6.3
2.		1500	200	40	12#-200C/C.	10#-175C/C.	8#-250C/C.	8#-300C/C.	8#-300C/C.	0.143	0.98	44.0	6.3
3.		1250	200	40	12#-200C/C.	8#-175C/C.	8#-250C/C.	8#-300C/C.	8#-300C/C.	0.124	0.93	40.0	6.3
4.		1000	200	40	12#-200C/C.	8#-250C/C.	8#-250C/C.	8#-300C/C.	8#-300C/C.	0.105	0.88	36.0	6.3
5.	1250	2000	150	40	10#-150C/C.	12#-150C/C.	8#-250C/C.	8#-300C/C.	8#-300C/C.	0.180	0.72	49.0	5.3
6.		1500	150	40	10#-150C/C.	12#-150C/C.	8#-300C/C.	8#-300C/C.	8#-300C/C.	0.139	0.65	43.0	5.25
7.		1250	150	40	10#-150C/C.	10#-150C/C.	8#-300C/C.	8#-300C/C.	8#-300C/C.	0.120	0.61	37.0	5.25
8.		1000	150	40	10#-150C/C.	10#-200C/C.	8#-300C/C.	8#-300C/C.	8#-300C/C.	0.101	0.57	32.0	5.25
9.	1000	2000	150	40	10#-150C/C.	12#-150C/C.	8#-250C/C.	8#-300C/C.	8#-300C/C.	0.180	0.65	49.0	4.3
10.		1500	125	40	10#-150C/C.	12#-150C/C.	8#-300C/C.	8#-300C/C.	8#-300C/C.	0.139	0.47	36.0	4.25
11.		1250	125	40	10#-150C/C.	8#-150C/C.	8#-300C/C.	8#-300C/C.	8#-300C/C.	0.116	0.44	29.0	4.2
12.		1000	125	40	10#-150C/C.	8#-200C/C.	8#-300C/C.	8#-300C/C.	8#-300C/C.	0.098	0.41	26.0	4.2
13.	750	750	100	40	8#-200C/C.	8#-150C/C.	8#-300C/C.	8#-300C/C.	8#-300C/C.	0.079	0.25	19.0	3.2
14.	500	500	100	40	8#-200C/C.		8#-300C/C.	8#-300C/C.		0.060	0.15	5.60	2.2
15.	300	500	100	40	8#-200C/C.		8#-300C/C.	8#-300C/C.		0.048	0.11	4.70	1.4
16.	300	300	100	40	8#-200C/C.		8#-300C/C.	8#-300C/C.		0.045	0.09	3.80	1.4

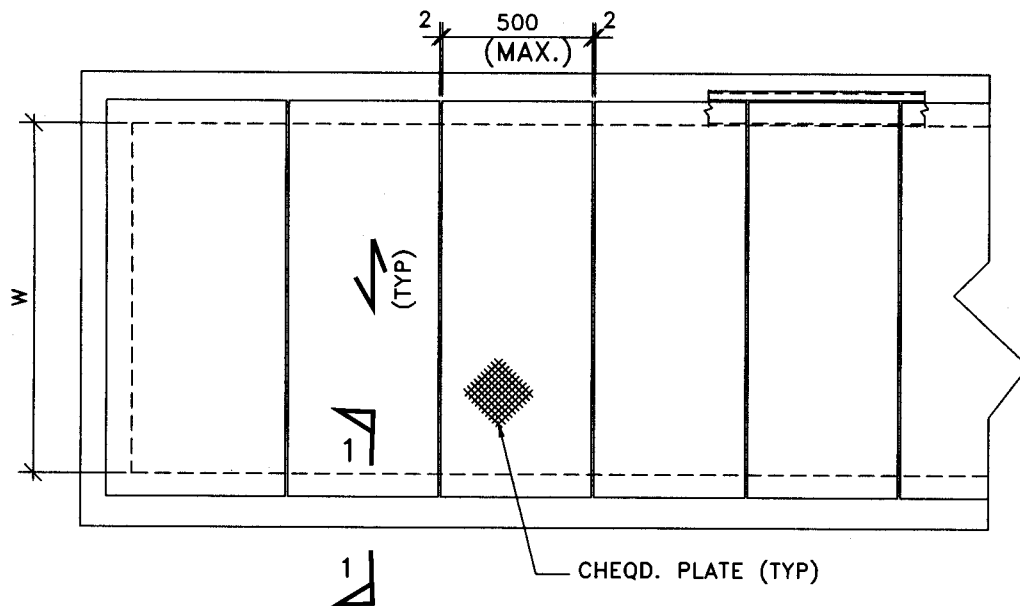
- NOTES- 1. R.C.C. CABLE TRENCHES ARE DESIGNED FOR A SURCHARGE LOAD OF 10.0 T HYDRA.
2. THE QUANTITIES GIVEN IN THIS TABLE ARE FOR ESTIMATION PURPOSE ONLY.
3. PREFERABLY THE DEPTH OF CABLE TRENCH SHALL NOT BE MORE THAN THE WIDTH.
4. TRENCH OF DEPTH 300,500MM IN BRICK MASONRY WHEREVER SPECIFIED

3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
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Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	GM(E)	Stds. Bureau Chairman
Approved by							

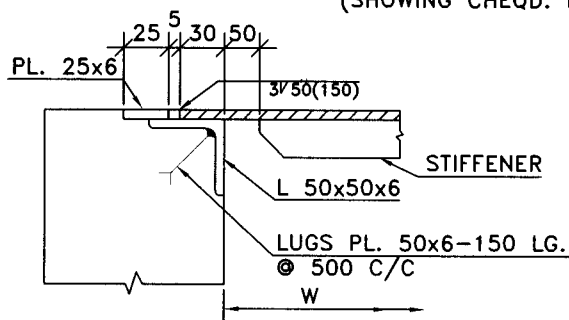


**TYPICAL DETAIL AT JUNCTION FOR
DIFFERENT DEPTHS OF TRENCH.**
(R/F DETAIL OF TRENCH IN SLOPE SHALL BE BASED ON DEPTH D2).

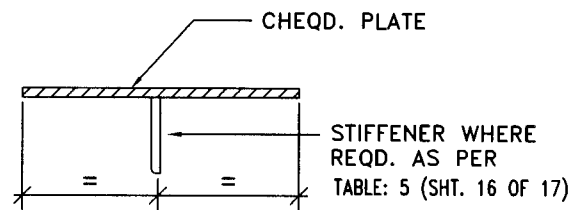
3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P. SINGH	P.K. MITTAL	S. CHATURVEDI	VINAY KUMAR	N. DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN		A. SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	GM(E)	Std. Bureau Chairman
						Approved by	



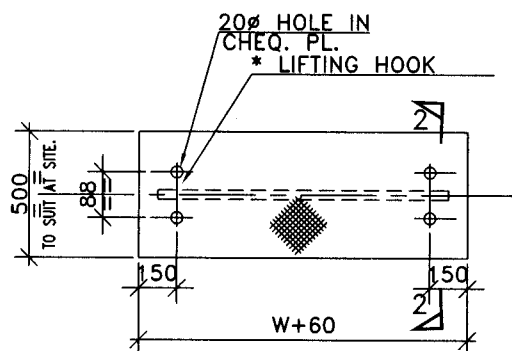
TYPICAL TRENCH PLAN
(SHOWING CHEQD. PLATE)



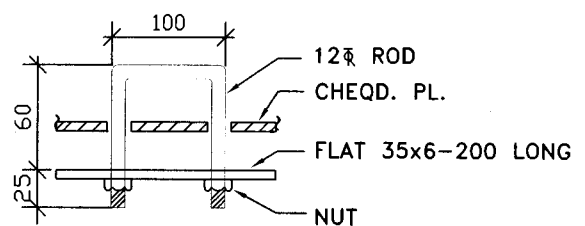
SECTION 1-1



SECTION 2-2



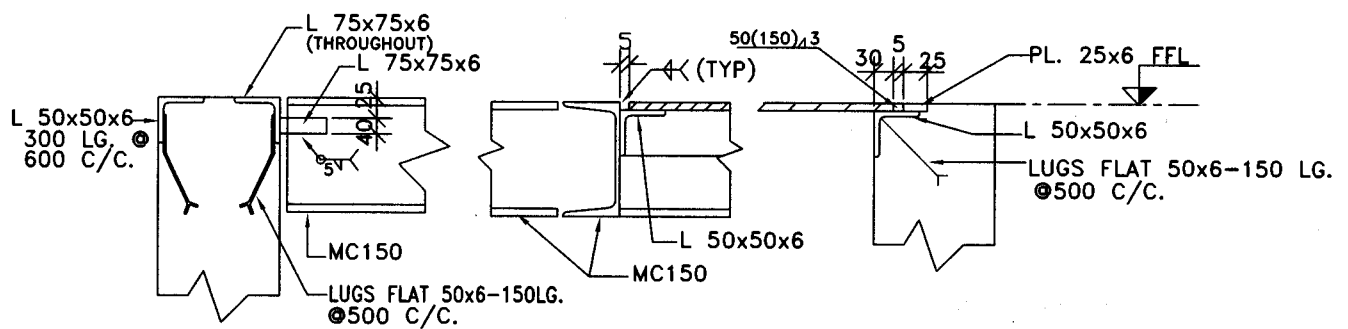
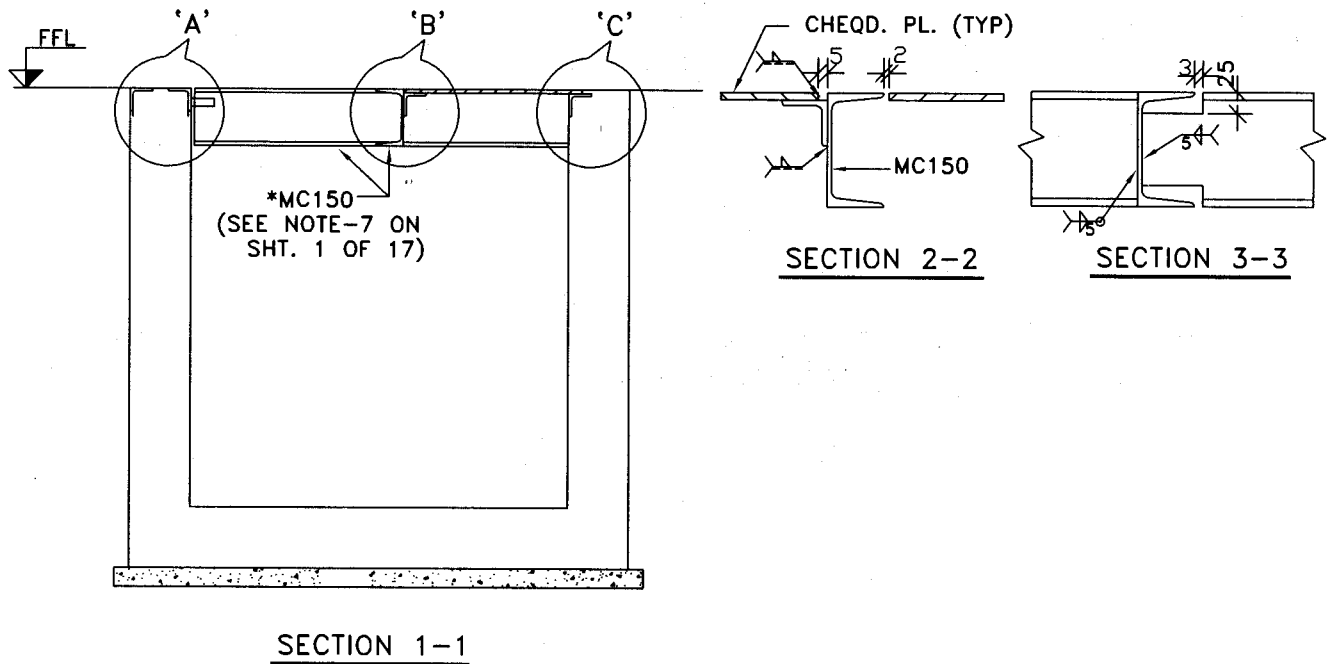
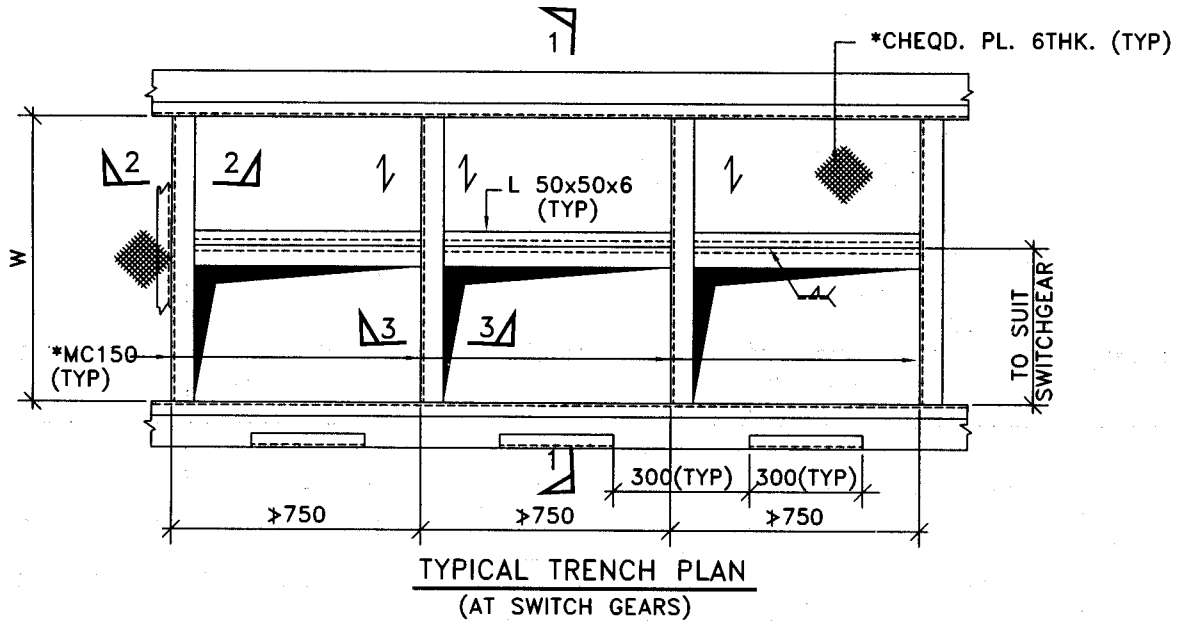
TYP. CHEQD. PLATE DETAIL
(SHOWING CHEQD. PLATE)



TYP. LIFTING HOOK DETAIL

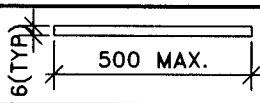
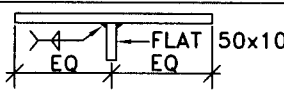
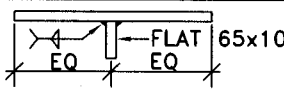
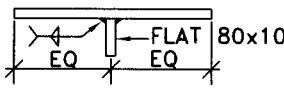
* ONE HOOK FOR SPAN UPTO 500
TWO HOOKS FOR SPAN ABOVE 500.

3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN		A.SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	GM(E)	Std. Bureau Chairman
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Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	GM(E)	Std. Bureau Chairman
3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN		A.SONI

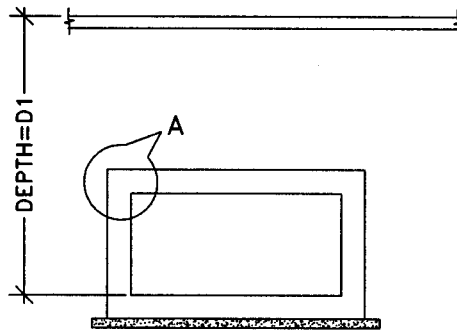
TABLE- 5: DETAIL OF CHEQUERED PLATE COVER

S.NO.	TYPE	SECTION	SECTION PROPERTIES FOR 500mm WIDE PLATE			RECOMMENDED SPAN (W) mm
			WT. kg/m	$I = \text{cm}^4$	$Z_{\text{min}} = \text{cm}^3$	
1.	I		23.55	0.90	3.00	$W < 500$
2.	II		27.45	44.90	9.16	$500 < W \leq 1250$
3.	III		28.62	91.00	14.76	$1250 < W \leq 1500$
4.	IV		29.79	160.30	21.66	$1500 < W \leq 2000$

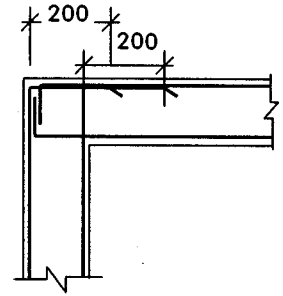
NOTE-

THE DESIGN IS BASED ON A LIVE LOAD OF 500 Kg/m^2 AND.
MAXIMUM ALLOWABLE DEFLECTION = $W/200$ ($W = \text{SPAN}$)

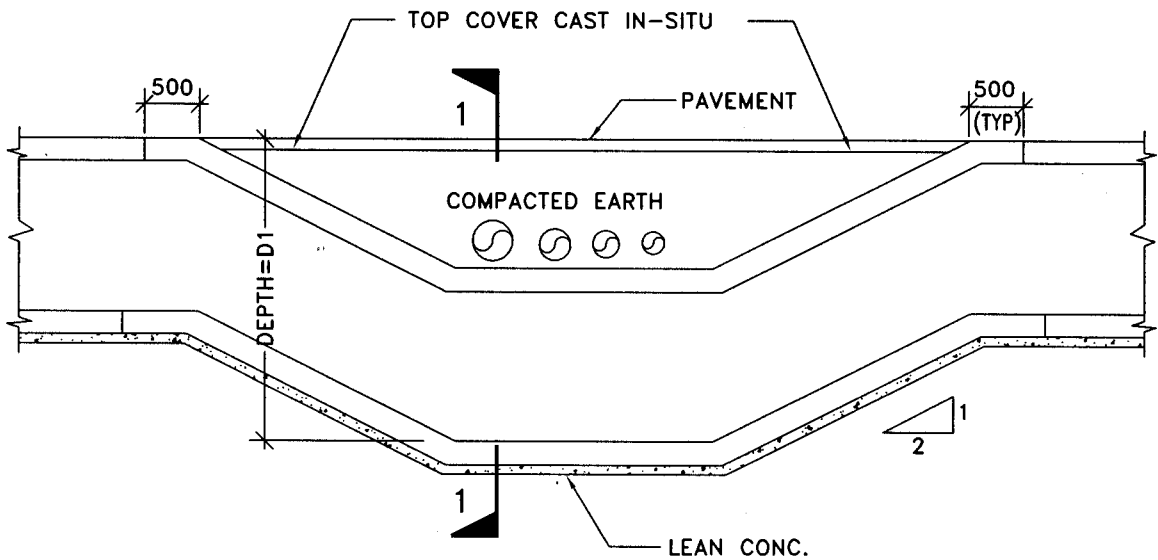
3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITTAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN	A.SONI	
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	GM(E)	Std. Bureau Chairman
Approved by							



SECTION 1-1



DET. A

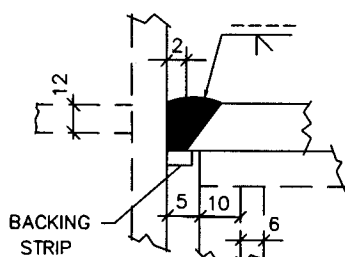


TYPICAL DETAIL AT JUNCTION FOR
DIFFERENT DEPTHS OF TRENCH.

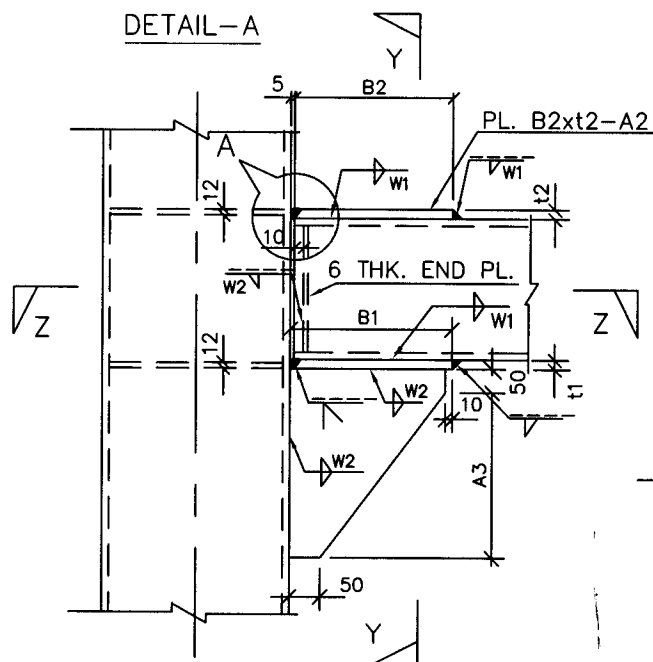
NOTES : -

- (1) TOP COVER FOR THE INDICATED PORTION SHALL BE CAST IN SITU. RC DET'S FOR THE COVER SLAB SHALL BE SAME AS THE PRECAST COVERS OF SAME SPAN. EXCEPT THE CORNER DETAIL WHICH IS SHOWN HERE.
- (2) RC DETAILS FOR THE TRENCH WALL / BASE SHALL BE BASED ON DEPTH "D1".

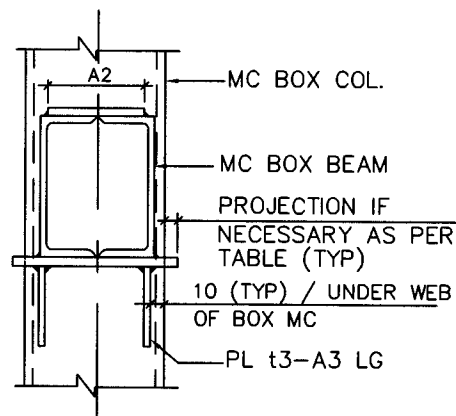
3	16.04.10	REVISED AND ISSUED AS STANDARD	V.P.SINGH	P.K.MITAL	S.CHATURVEDI	VINAY KUMAR	N DUARI
2	31.07.97	REAFFIRMED AND ISSUED AS STANDARD	YOGESH	S.C.S	SC JAIN		A.SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	GM(E)	Stds. Bureau Chairman
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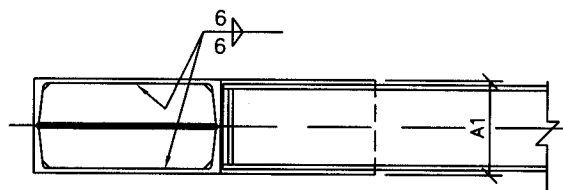
DETAIL-A



ELEVATION



SEC Y-Y

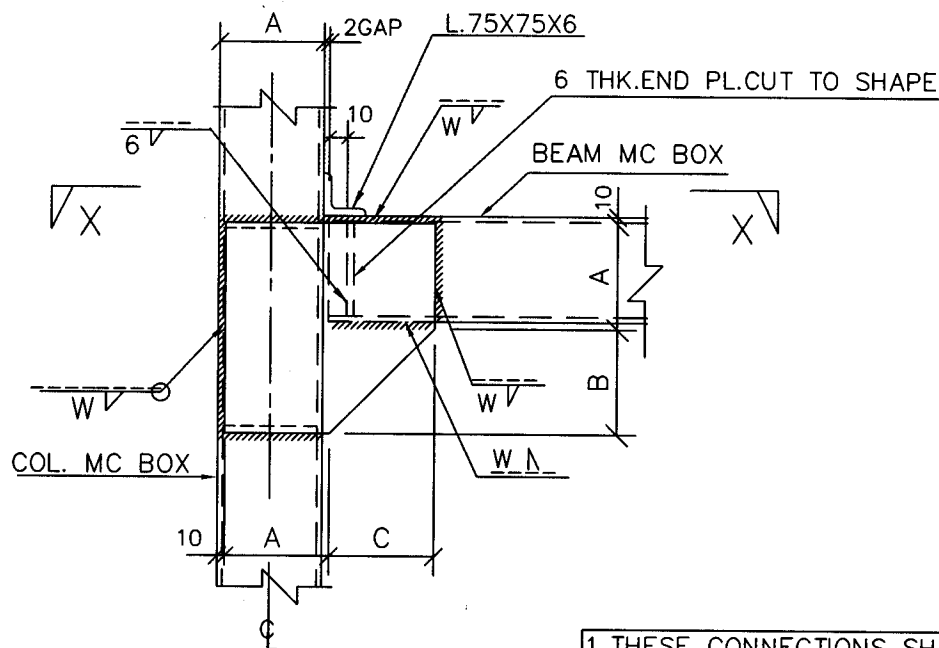


PLAN Z-Z

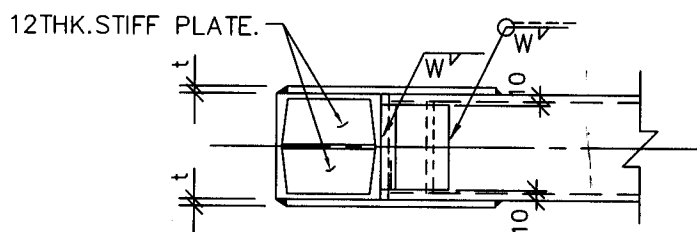
TYPICAL DETAILS OF MOMENT CONNECTION FOR MC BOX SECTIONS
(TYPE-2)

COLUMN	MC 400 BOX				MC 300 BOX			MC 250 BOX		MC 200 BOX	
BEAM	MC-400 BOX	MC-300 BOX	MC-250 BOX	MC-200 BOX	MC-300 BOX	MC-250 BOX	MC-200 BOX	MC-250 BOX	MC-200 BOX	MC-200 BOX	MC-150 BOX
A1 mm	220	200	200	200	200	180	180	180	180	170	170
A2 mm	180	160	140	130	160	140	130	140	130	130	130
A3 mm	350	300	250	200	300	250	200	250	200	200	150
B1 mm	500	400	350	250	400	350	250	350	250	250	200
B2 mm	425	325	275	200	325	275	200	275	200	200	150
t1 mm	20	16	16	12	16	16	12	16	12	12	10
t2 mm	25	20	20	16	20	20	16	20	16	16	12
t3 mm	10	10	10	10	10	10	10	10	10	10	10
w1 mm	10	10	10	10	10	10	10	10	10	10	10
w2 mm	6	6	6	6	6	6	6	6	6	6	6

2	20.07.09	REAFFIRMED AND ISSUED AS STANDARD	N VENU KUMAR	P.K.MITTAL	VINAY KUMAR	N DUARI
1	20.08.01	REAFFIRMED AND ISSUED AS STANDARD	D.K	RP MEHROTRA	SC JAIN	M IYENGAR
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convenor	Std. Bureau Chairman
Approved by						



ELEVATION



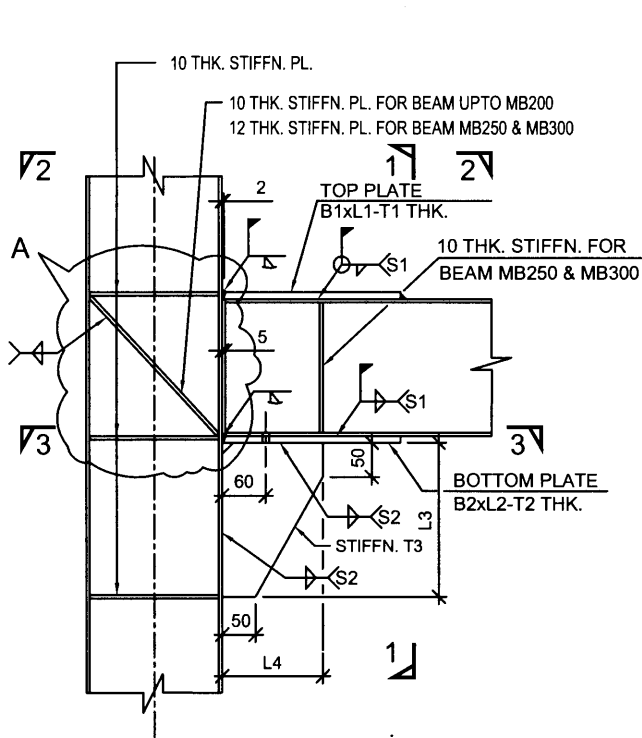
PLAN X-X

1. THESE CONNECTIONS SHALL BE FOLLOWED FOR SHOP WELDING ONLY.
2. CONNECTIONS ARE SHOWN FOR FULL MOMENT PLUS 50% SHEAR CAPACITIES.

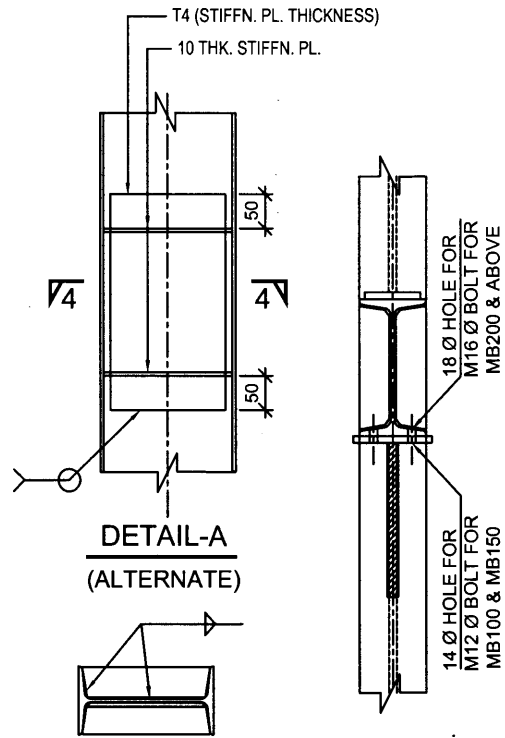
TYPICAL DETAILS OF MOMENT CONNECTION FOR MC BOX SECTIONS
(TYPE-1)

COLUMN	BEAM	A (mm)	B (mm)	C (mm)	t (mm)	w(mm)
MC 150 BOX	MC 150 BOX	150	150	300	10	6
MC 200 BOX	MC 200/150 BOX	200/150	200/150	350	10	6
MC 250 BOX	MC 250 BOX	250	250	400	10	8
MC 300 BOX	MC 300 BOX	300	225	450	10	8
MC 400 BOX	MC 400 BOX	400	300	550	10	8

2	20.07.09	REAFFIRMED AND ISSUED AS STANDARD	N VENU KUMAR	P.K.MITTAL	VINAY KUMAR	N DUARI
1	20.08.01	REAFFIRMED AND ISSUED AS STANDARD	D.K	RP MEHROTRA	SC JAIN	M IYENGAR
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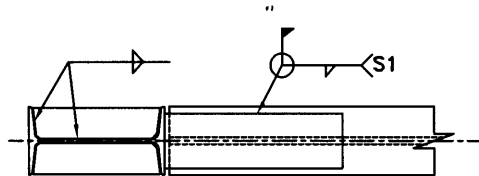


TYP. DET. OF MOMENT CONNECTION

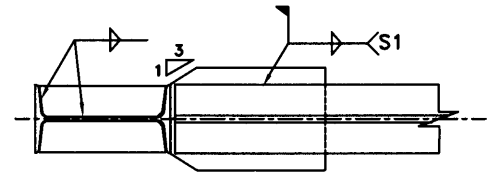


SEC. 4-4

SEC. 1-1



VIEW 2-2



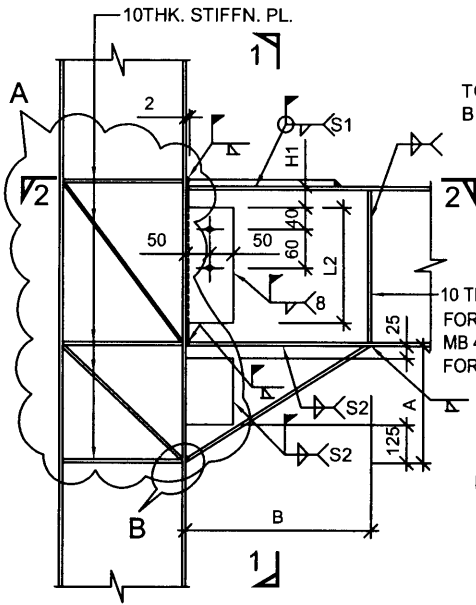
VIEW 3-3

BEAM SIZE	COLUMN SIZE	TOP PLATE SIZE			BOTTOM PLATE SIZE			STIFFN. SIZE				WELD SIZE		
		L1	B1	T1	L2	B2	T2	L3	L4	T3	T4	S1	S2	
MB100	≥MB100	150	55	16	150	95	10	175	150	10	10	6	6	
MB150	≥MB150	155	60	16	155	100	10	230	150	10	8	6	6	
MB200	≥MB200	260	80	20	260	120	16	225	150	10	8	6	10	
MB250	≥MB250	290	105	25	290	145	20	265	150	10	8	8	10	
MB300	≥MB250	335	120	25	335	160	20	330	170	10	10	8	10	

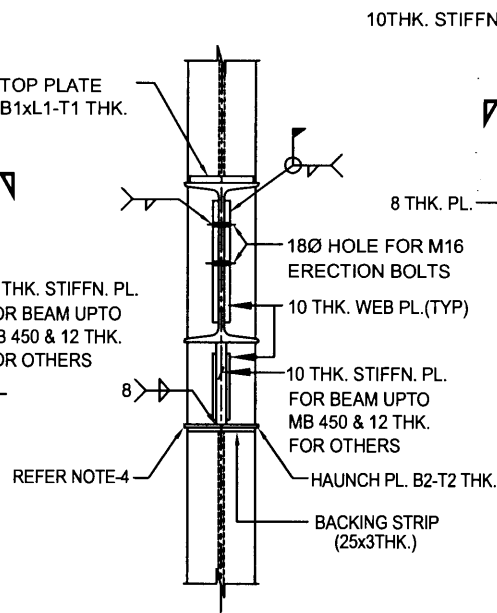
NOTES:-

1. ALL CONNECTIONS ARE DESIGNED FOR FULL BENDING AND SHEAR STRENGTH OF BEAM.
2. ALTERNATE DETAIL 'A' IS TO BE PROVIDED WHEN LONGITUDINAL BEAMS FOUL WITH DIAGONAL STIFFENER.
3. CONNECTION IS SHOWN FOR FIELD MOMENT CONNECTION.
4. WHEREVER FILLET WELD SIZE NOT MARKED IT SHALL BE CONSIDERED AS 6mm.

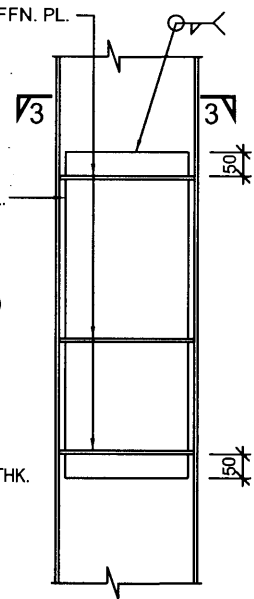
1	15-02-2010	REAFFIRMED & ISSUED AS STANDARD	TAPAS GHOSH	RAJANJI SRIVASTAVA	SUDHIR CHATURVEDI	VINAY KUMAR	NILADRI DUARI
0	16-04-1999	ISSUED AS STANDARD	SK SAGAR	RK GUPTA	SC JAIN		A SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee (CONVENER)	Reviewed GM (E)	Stds. Bureau (CHAIRMAN)
						Approved by	



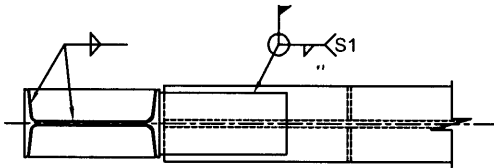
TYP. DET. OF MOMENT CONNECTION



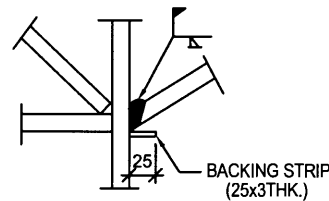
SEC. 1-1



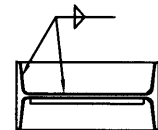
DETAIL-A
(ALTERNATE)



VIEW 2-2



DETAIL-B



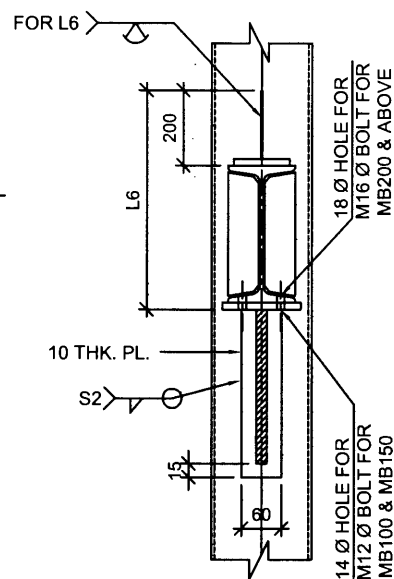
SEC. 3-3

BEAM SIZE	COLUMN SIZE	TOP PLATE SIZE			HAUNCH PLATE SIZE				WEB PL. SIZE		WELD SIZE	
		L1	B1	T1	A	B	B2	T2	H1	L2	S1	S2
MB350	> MB250	225	120	20	260	450	140	16	50	250	8	10
MB400	> MB300	250	120	20	300	525	140	16	55	290	8	10
MB450	> MB300	300	130	22	340	600	150	20	55	340	8	10
MB500	> MB400	350	140	22	375	650	180	20	60	380	8	10
MB600	> MB500	400	180	25	450	800	210	22	70	460	10	10

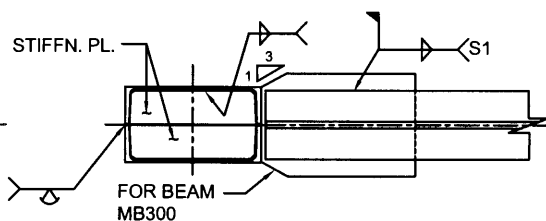
NOTES:

- ALL CONNECTIONS ARE DESIGNED FOR FULL BENDING STRENGTH & 50% OF SHEAR STRENGTH OF BEAM.
- ALTERNATE DETAIL 'A' IS TO BE PROVIDED WHEN LONGITUDINAL BEAMS FOUL WITH STIFFENER.
- CONNECTION IS SHOWN FOR FIELD MOMENT CONNECTION.
- WIDTH OF PLATE SHALL BE NOTCHED IN 1:3 SLOPE AT COLUMN CONNECTION TO MATCH WITH COLUMN FLANGE WIDTH.
- WHEREVER FILLET WELD SIZE NOT MARKED IT SHALL BE CONSIDERED AS 6mm.

1	15-02-2010	REVISED & ISSUED AS STANDARD	TAPAS GHOSH	RAJANJEE SRIVASTAVA	SUDHIR CHATURVEDI	VINAY KUMAR	NILADRI DUARI
0	16-04-1999	ISSUED AS STANDARD	R.D.D.	RK GUPTA	SC JAIN		A SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee (CONVENER)	Reviewed GM (E)	Std. Bureau (CHAIRMAN)
						Approved by	



TYP. DET. OF MOMENT CONNECTION

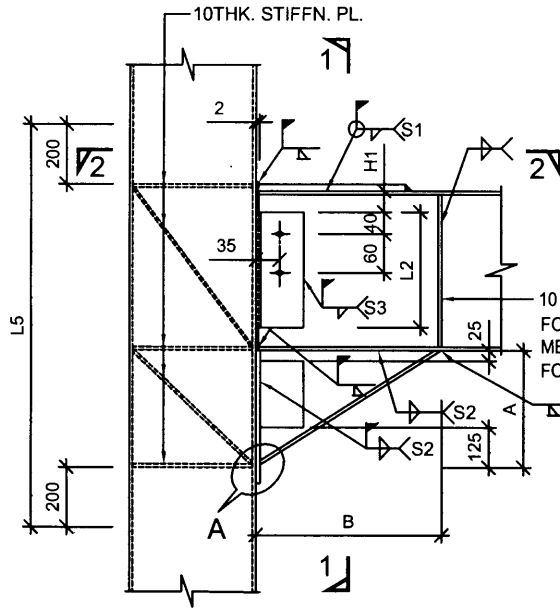


VIEW 3-3

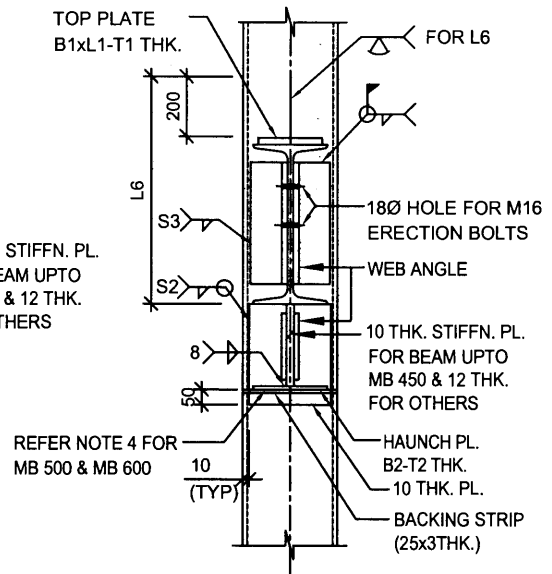
BEAM SIZE	COLUMN SIZE	TOP PLATE SIZE			BOTTOM PLATE SIZE			STIFFN. SIZE			WELD SIZE		
		L1	B1	T1	L2	B2	T2	L3	L4	T3	S1	S2	
MB100	≥MC100 □	150	55	16	150	95	10	175	150	10	6	6	
MB150	≥MC100 □	155	60	16	155	100	10	230	150	10	6	6	
MB200	≥MC150 □	260	80	20	260	120	16	225	150	10	6	10	
MB250	≥MC200 □	290	105	25	290	145	20	265	150	10	8	10	
MB300	≥MC200 □	335	120	25	335	160	20	330	170	10	8	10	

1. ALL CONNECTIONS ARE DESIGNED FOR FULL BENDING AND SHEAR STRENGTH OF BEAM.
2. THIS STANDARD IS NOT APPLICABLE FOR BEAM CONNECTING WITH WEB OF MC BOX COLUMN.
3. CONNECTION IS SHOWN FOR FIELD MOMENT CONNECTION.
4. WHEREVER FILLET WELD SIZE NOT MARKED IT SHALL BE CONSIDERED AS 6mm.

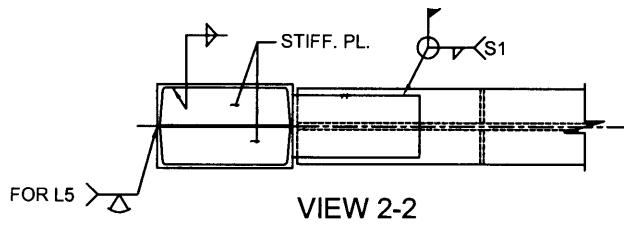
1	15-02-2010	REAFFIRMED & ISSUED AS STANDARD	TAPAS GHOSH	RAJANJI SRIVASTAVA	SUDHIR CHATURVEDI	VINAY KUMAR	NILADRI DUARI
0	16-04-1999	ISSUED AS STANDARD	SK SAGAR	RK GUPTA	SC JAIN		A SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee (CONVENER)	Reviewed GM (E)	Stds. Bureau (CHAIRMAN)
						Approved by	



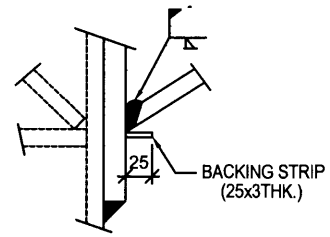
TYP. DET. OF MOMENT CONNECTION



SEC. 1-1



VIEW 2-2



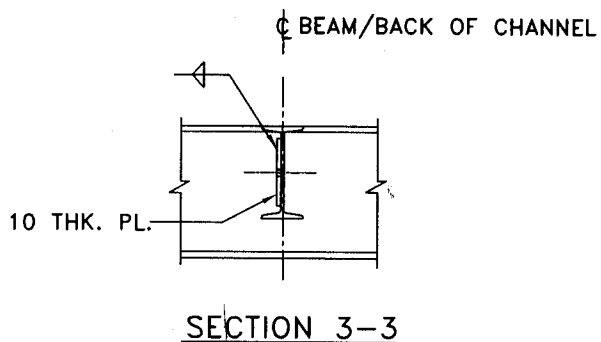
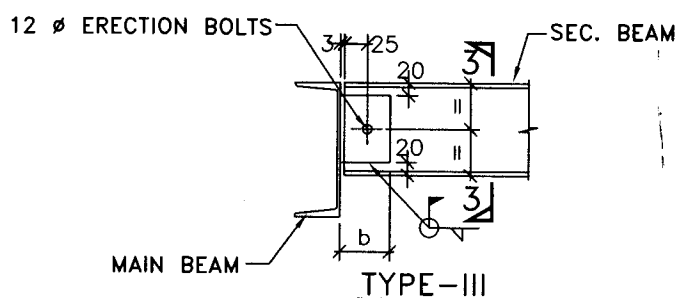
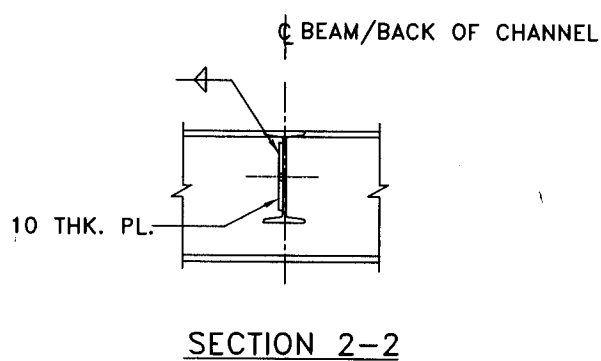
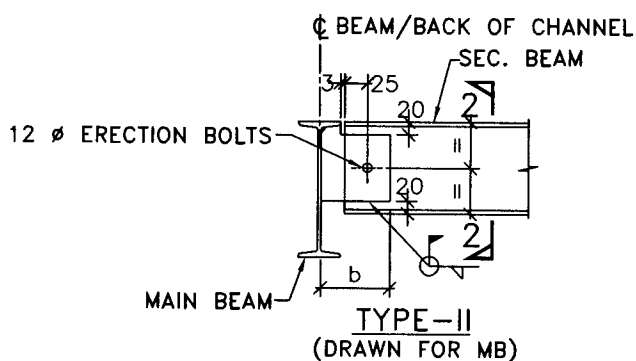
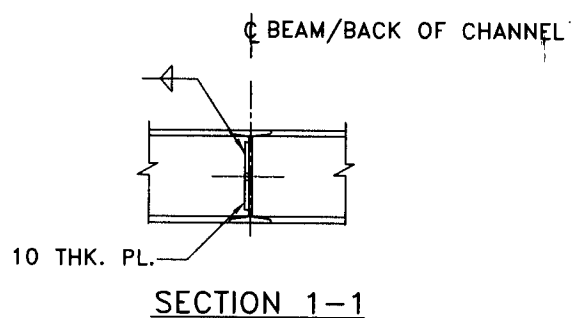
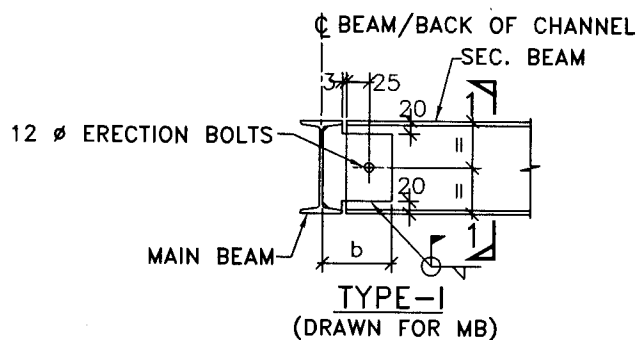
DETAIL-A

BEAM SIZE	COLUMN SIZE	TOP PL. SIZE			HAUNCH PLATE SIZE				WEB ANGLE SIZE			WELD SIZE		
		L1	B1	T1	A	B	B2	T2	H1	L2	ANGLE SIZE	S1	S2	S3
MB350	≥ MC250	225	120	20	260	450	140	16	50	250	65x65x6	8	10	6
MB400	≥ MC250	250	120	20	300	525	140	16	55	290	65x65x6	8	10	6
MB450	≥ MC300	300	130	22	340	600	150	20	55	340	75x75x8	8	10	8
MB500	≥ MC300	350	140	22	375	650	180	20	60	380	75x75x8	8	10	8
MB600	≥ MC400	400	180	25	450	800	210	22	70	460	75x75x8	10	10	8

NOTES:

- ALL CONNECTIONS ARE DESIGNED FOR FULL BENDING STRENGTH & 50% OF SHEAR STRENGTH OF BEAM.
- CONNECTION IS SHOWN FOR FIELD MOMENT CONNECTION.
- WHEREVER FILLET WELD SIZE NOT MARKED IT SHALL BE CONSIDERED AS 6mm.
- WIDTH OF PLATE SHALL BE NOTCHED IN 1:3 SLOPE AT COLUMN CONNECTION TO MATCH WITH COLUMN FLANGE PLATE WIDTH.
- THIS STANDARD IS NOT APPLICABLE FOR BEAM CONNECTING WITH WEB OF MC BOX COLUMN.

1	15-02-2010	REVISED & ISSUED AS STANDARD	TAPAS GHOSH	RAJANJI SRIVASTAVA	SUDHIR CHATURVEDI	VINAY KUMAR	NILADRI DUARI
0	16-04-1999	ISSUED AS STANDARD	R.D.D.	RK GUPTA	SC JAIN		A SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee (CONVENER)	Reviewed GM (E)	Stds. Bureau (CHAIRMAN)
						Approved by	



SEC. BEAM	CONN TYPE	DIMENSION	MAIN BEAM																	
			MB100	MB125	MB150	MB200	MB250	MB300	MB350	MB400	MB450	MB500	MB600	MC100	MC125	MC150	MC200	MC250	MC300	MC400
MB100/ MC100	I	b	90	-	-	-	-	-	-	-	-	-	-	90	-	-	-	-	-	-
	II	b	-	90	95	105	115	125	125	125	130	145	160	-	120	130	130	135	145	155
	III	b	-	-	-	-	-	-	-	-	-	-	-	55	55	55	55	55	55	55
MB125/ MC125	I	b	-	105	-	-	-	-	-	-	-	-	-	-	135	-	-	-	-	-
	II	b	-	-	110	120	130	140	140	140	145	160	175	-	-	145	145	150	160	170
	III	b	-	-	-	-	-	-	-	-	-	-	-	-	70	70	70	70	70	70

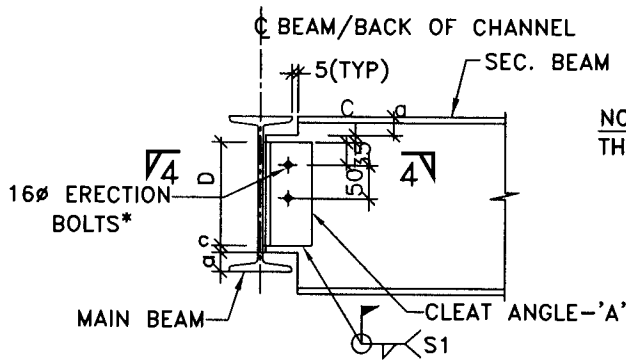
NOTES:-

1 CONNECTION HAS BEEN DESIGNED TO CATER FOR FOLLOWING SHEAR STRENGTH.

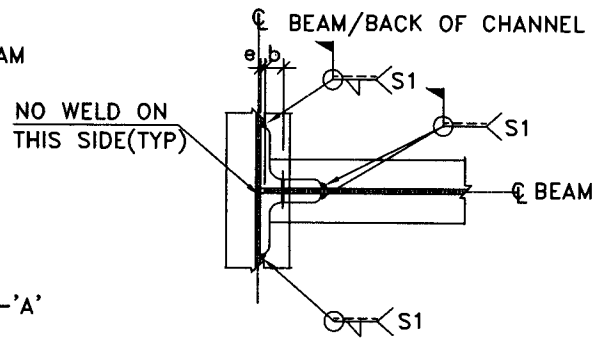
MB100/MC100 = 2.5 T.

MB125/MC125 = 4.5 T.

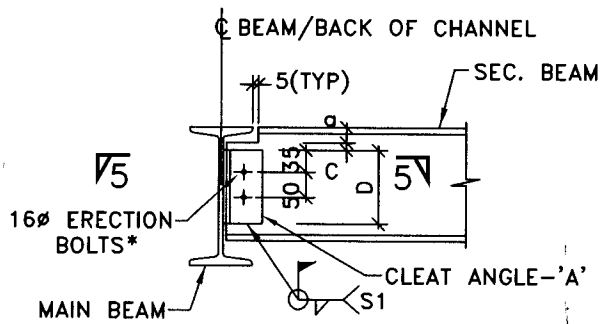
1	20.07.09	REAFFIRMED AND ISSUED AS STANDARD	GAUTAM SANKER	P.K.MITTAL	VINAY KUMAR	N DUARI
0	23.08.99	ISSUED AS STANDARD	J.S.C	R.K.GUPTA	SC JAIN	A SONI
Rev.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman



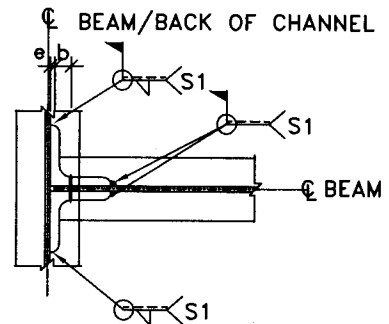
TYPE-IV



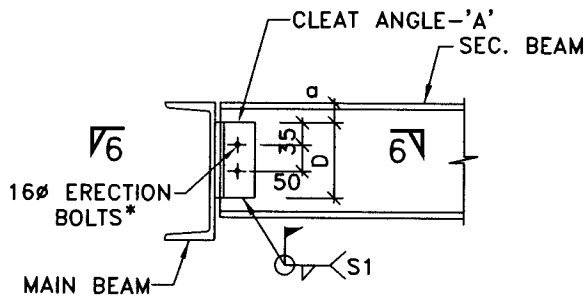
SECTION 4-4
(DRAWN FOR SEC. BEAM AS MB)



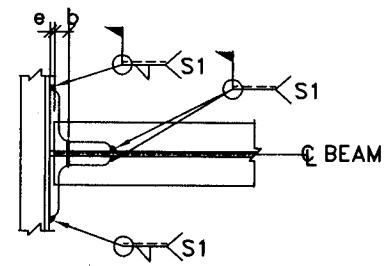
TYPE-V



SECTION 5-5
(DRAWN FOR SEC. BEAM AS MB)



TYPE-VI



SECTION 6-6
(DRAWN FOR SEC. BEAM AS MB)

c = 15 FOR SEC. BEAM MB600

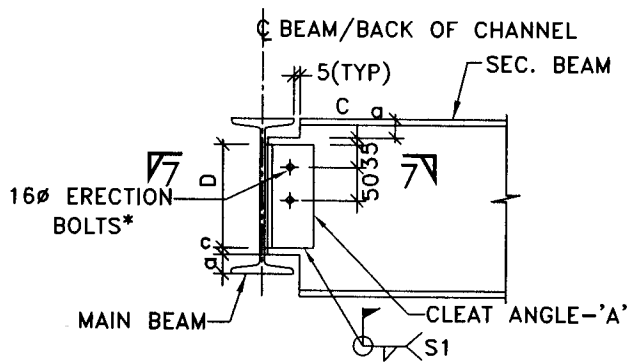
c = 10 FOR OTHERS

e = 2 mm CLEAR GAP

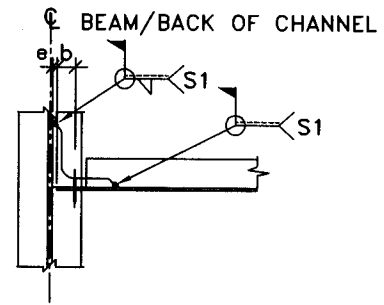
* 2 NOS. ERECTION BOLTS SHALL BE PROVIDED FOR SEC. BEAM ≥ MB250 / MC250

CLEAT ANGLE SIZE	b
L 65x65x6	35
L 75x75x8	40
L 90x90x10	45
L 100x100x12	45

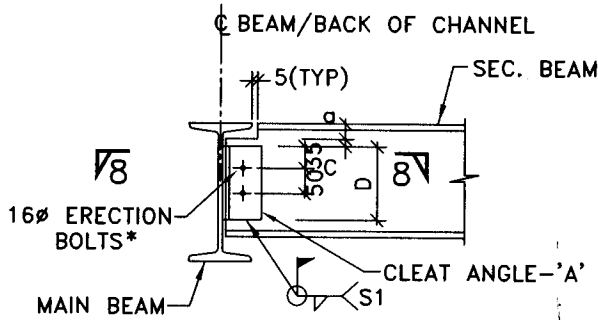
1	20.07.09	REAFFIRMED AND ISSUED AS STANDARD	GAUTAM SANKER	P.K.MITTAL	VINAY KUMAR	N DUARI
0	23.08.99	ISSUED AS STANDARD	J.S.C	R.K.GUPTA	SC JAIN	A SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman



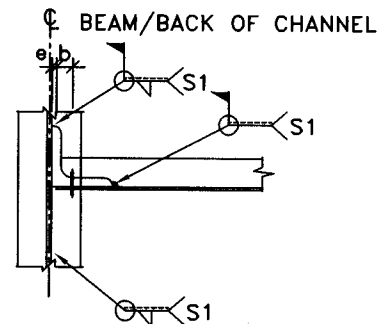
TYPE-VII



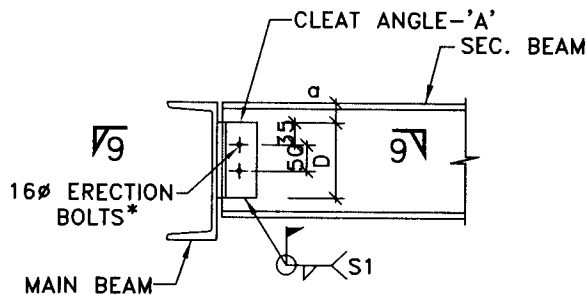
SECTION 7-7



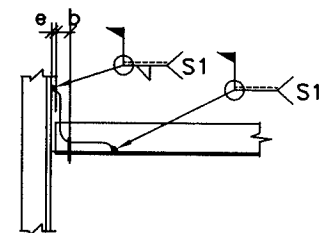
TYPE-VIII



SECTION 8-8



TYPE-IX



SECTION 9-9

$e = 2 \text{ mm}$ CLEAR GAP

* 2 NOS. ERECTION BOLTS SHALL BE PROVIDED FOR SEC. BEAM $\geq$ MB250 / MC250

CLEAT ANGLE SIZE	b
L 65x65x6	35
L 75x75x8	40
L 90x90x10	45
L 100x100x12	45

VALID FOR SEC. BEAM AS CHANNELS ONLY

1	20.07.09	REAFFIRMED AND ISSUED AS STANDARD	GAUTAM SANKER	P.K.MITTAL	VINAY KUMAR	N DUARI
0	23.08.99	ISSUED AS STANDARD	J.S.C	R.K.GUPTA	SC JAIN	A SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman

SCHEDULE OF CONNECTION

SEC. BEAM	CONN. TYPE	DIMENSION	MAIN BEAM														CLEAT ANGLE 'A'		WELD SIZE	MIN. SHEAR CAPACITY
			MB150	MB200	MB250	MB300	MB350	MB400	MB450	MB500	MB600	MC150	MC200	MC250	MC300	MC400	D	SIZE	S1	IN MT
MB150	IV	a	25	-	-	-	-	-	-	-	25	-	-	-	-	80	L65x65x6	6	4.0	
	V	a	-	25	30	30	35	35	35	40	45	-	25	30	30	35			60	3.0
	VI	a	-	-	-	-	-	-	-	-	-	25	25	25	25	25			80	4.0
MB200	IV	a	25	25	-	-	-	-	-	-	-	25	25	-	-	-	80	L65x65x6	6	4.0
	V	a	-	-	30	30	35	35	35	40	45	-	-	30	30	35	100			6.5
	VI	a	-	-	-	-	-	-	-	-	-	25	25	25	25	25	100			6.5
MB250	IV	a	-	30	30	-	-	-	-	-	-	-	30	30	-	-	120	L75x75x8	6	7.5
	V	a	-	-	-	30	35	35	35	40	45	-	-	-	30	35	150			10.0
	VI	a	-	-	-	-	-	-	-	-	-	-	30	30	30	30	150			10.0
MB300	IV	a	-	-	30	30	-	-	-	-	-	-	-	30	30	-	170	L75x75x8	6	11.0
	V	a	-	-	-	-	35	35	35	40	45	-	-	-	-	35	200			13.5
	VI	a	-	-	-	-	-	-	-	-	-	-	-	30	30	30	200			13.5
MB350	IV	a	-	-	-	35	35	-	-	-	-	-	-	-	35	-	210	L75x75x8	6	14.0
	V	a	-	-	-	-	-	35	35	40	45	-	-	-	-	35	250			16.5
	VI	a	-	-	-	-	-	-	-	-	-	-	-	-	35	35	250			16.5
MB400	IV	a	-	-	-	35	35	35	-	-	-	-	-	-	35	35	210	L90x90x10	6	14.0
	V	a	-	-	-	-	-	-	35	40	45	-	-	-	-	-	300		8	25.0
	VI	a	-	-	-	-	-	-	-	-	-	-	-	-	35	35	250		6	16.5
MB450	IV	a	-	-	-	-	35	35	35	-	-	-	-	-	-	35	260	L90x90x10	8	21.0
	V	a	-	-	-	-	-	-	-	40	45	-	-	-	-	-	350			30.0
	VI	a	-	-	-	-	-	-	-	-	-	-	-	-	-	35	350			30.0
MB500	IV	a	-	-	-	-	-	40	40	40	-	-	-	-	-	40	300	L90x90x10	8	26.0
	V	a	-	-	-	-	-	-	-	-	45	-	-	-	-	-	390			36.0
	VI	a	-	-	-	-	-	-	-	-	-	-	-	-	-	40	300			26.0
MB600	IV	a	-	-	-	-	-	-	-	45	-	-	-	-	-	-	380	L100x100x12	10	40.0
	IV	a	-	-	-	-	-	-	-	-	45	-	-	-	-	-	480			50.0
MC150	IV/VII	a	25	-	-	-	-	-	-	-	-	25	-	-	-	-	80	L65x65x6	6	4.0
	V/VIII	a	-	25	30	30	35	35	35	40	45	-	25	30	30	35	60			3.0
	VI/IX	a	-	-	-	-	-	-	-	-	-	-	25	25	25	25	25			80
MC200	IV/VII	a	25	25	-	-	-	-	-	-	-	-	25	25	-	-	80	L65x65x6	6	4.0
	V/VIII	a	-	-	30	30	35	35	35	40	45	-	-	30	30	35	100			6.5
	VI/IX	a	-	-	-	-	-	-	-	-	-	-	25	25	25	25	100			6.5
MC250	IV/VII	a	-	30	30	-	-	-	-	-	-	-	-	30	30	-	120	L75x75x8	6	7.5
	V/VIII	a	-	-	-	30	35	35	35	40	45	-	-	-	30	35	150			10.0
	VI/IX	a	-	-	-	-	-	-	-	-	-	-	-	30	30	30	150			10.0
MC300	IV/VII	a	-	-	30	30	-	-	-	-	-	-	-	30	30	-	170	L75x75x8	6	11.0
	V/VIII	a	-	-	-	-	35	35	35	40	45	-	-	-	-	35	200			13.5
	VI/IX	a	-	-	-	-	-	-	-	-	-	-	-	30	30	30	200			13.5
MC400	IV/VII	a	-	-	-	35	35	35	-	-	-	-	-	-	30	35	210	L90x90x10	6	13.5
	V/VIII	a	-	-	-	-	-	-	35	40	45	-	-	-	-	-	300		8	25.0
	VI/IX	a	-	-	-	-	-	-	-	-	-	-	-	-	35	35	210		6	13.5

NOTES:

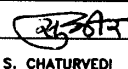
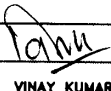
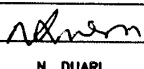
- 1 ALL WELDS SHALL BE 6 mm. THK. UNLESS NOTED OTHERWISE.
- 2 NO AXIAL FORCES ARE INCLUDED AND SHALL BE CHECKED AS PER ACTUAL DESIGN.
- 3 THIS STANDARD IS NOT APPLICABLE FOR COMBINATION OF BEAM MKD. ☐
- 4 SHEAR CAPACITY GIVEN IN THE TABLE IS FOR CONNECTION— TYPE IV, V & VI.

5 CONNECTION TYPE I, II, III, VII, VIII & IX SHALL NOT BE USED FOR EQUIPMENT SUPPORTING MEMBERS.

1	20.07.09	REAFFIRMED AND ISSUED AS STANDARD	GAUTAM SANKER	P.K.MITTAL	VINAY KUMAR	N DUARI
0	23.08.99	ISSUED AS STANDARD	J.S.C	R.K.GUPTA	SC JAIN	A SONI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convenor	Stds. Bureau Chairman

NOTES :-

1. THIS STANDARD NO. 7-68-0697, GIVES DESIGN AND DETAILS OF ELECTROFORGED GRATING.
2. ALL DIMENSIONS ARE IN mm.
3. THE TYPE OF GRATING TO BE USED SHALL BE CALLED OUT ON THE DESIGN DRAWING.
4. MATERIAL FOR THE GRATING (TWISTED BARS / M.S. FLATS) SHALL CONFORM TO IS:2062 GR-A.
5. ALL GRATINGS SHALL BE MADE BY ELECTROFORGING PROCESS.
6. GRATINGS SHALL BE HOT DIP GALVANISED IN ACCORDANCE WITH IS:2629 AND TESTED AS PER IS:2633 AND IS:6745. QUANTITY OF ZINC COATING SHALL BE MINIMUM 900 gm/m² OF SURFACE AREA (0.12mm UNIFORM THICKNESS)
7. THE NET SAFE WORKING LOADS GIVEN ON SHEET 2 OF 6 ARE BASED ON LIMITING VERTICAL DEFLECTION OF SPAN/200 OR 6mm, WHICHEVER IS LESS.
8. THE PANEL WIDTH SHOWN ON THE SUBSEQUENT SHEETS IS INDICATIVE. IT MAY BE INCREASED OR DECREASED AS REQUIRED TO SUIT THE GEOMETRY OF THE PLATFORM AND CONVENIENCE OF HANDLING.
9. GALVANISED GRATING PANEL SHALL BE FIXED TO THE SUPPORTING MEMBERS BY CLAMPS ONLY.
10. UNSUPPORTED EDGES OF ADJACENT GRATING PANELS SHALL BE CONNECTED BY U-CLAMPS MADE OUT OF 25x3 THK. M.S. FLATS WITH M-6 BOLTS AT BOTTOM. MINIMUM TWO CLAMPS PER PANEL SHALL BE PROVIDED. THESE SHALL ALSO BE GALVANISED AS PER NOTE-6 ABOVE.
11. GRATINGS SHALL NOT BE USED FOR SUPPORTING THE PIPES DIRECTLY. ADDITIONAL MEMBERS (MINIMUM MC125) SHALL BE PROVIDED UNDER THE GRATING FOR SUPPORTING THE PIPE HAVING A MAXIMUM LOAD OF 500 kg. THIS MEMBER SHALL SPAN IN SAME DIRECTION AS GRATING.
12. FOR GRATING PANELS WITH CUTOUTS / OPENINGS; STRENGTHENING SHALL BE CARRIED OUT AS PER THE DETAILS GIVEN ON SHEET 5 OF 6. AFFECTED PORTION SHALL BE PAINTED AS PER SPECIFICATIONS. ADDITIONAL MEMBERS WHEREVER SHOWN SHALL BE PROVIDED IN THE STRUCTURE.
13. THE FABRICATED GRATING SHALL FULFILL THE FOLLOWING MINIMUM REQUIREMENTS.
 - (I) THE UNFUSED JOINTS ARE NOT IN EXCESS OF 5% OF THE TOTAL JOINTS AND ARE WELDED BY SMAW/GMAW PROCESS
 - (II) THE JOINTS ARE ABLE TO SUSTAIN A MINIMUM PULL OUT LOAD OF 1.2 TIMES THE ALLOWABLE SHEAR CAPACITY OF THE CROSS MEMBER.
14. EVERY FIFTH BAR SHALL NESCESSARILY BE WELDED TO THE END BAR. HOWEVER, THE END BARS SHALL ALWAYS BE WELDED.

0	29.06.09	ISSUED AS STANDARD				
Rev. No.	Date	Purpose	Prepared by	Checked by	Std. Committee Convener	Std. Bureau Chairman

NET SAFE WORKING LOADS FOR GRATING TYPE-I & II

TYPE	l	500	600	700	800	900	1000	1100	1250	1400	
	$\triangle d$	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0		
I	w	> 19.60					14.80	10.80	8.10	5.30	3.40
	P	14.40	12.00	10.30	9.00	8.00	6.60	5.40	4.00	2.70	
II	w	> 19.60					17.60	13.20	8.70	5.50	
	P	23.60	19.60	16.80	14.60	13.00	10.70	8.80	6.30	4.40	

SYMBOLS :-

l = EFFECTIVE SPAN IN mm

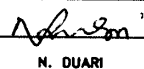
b = BEARING WIDTH IN mm

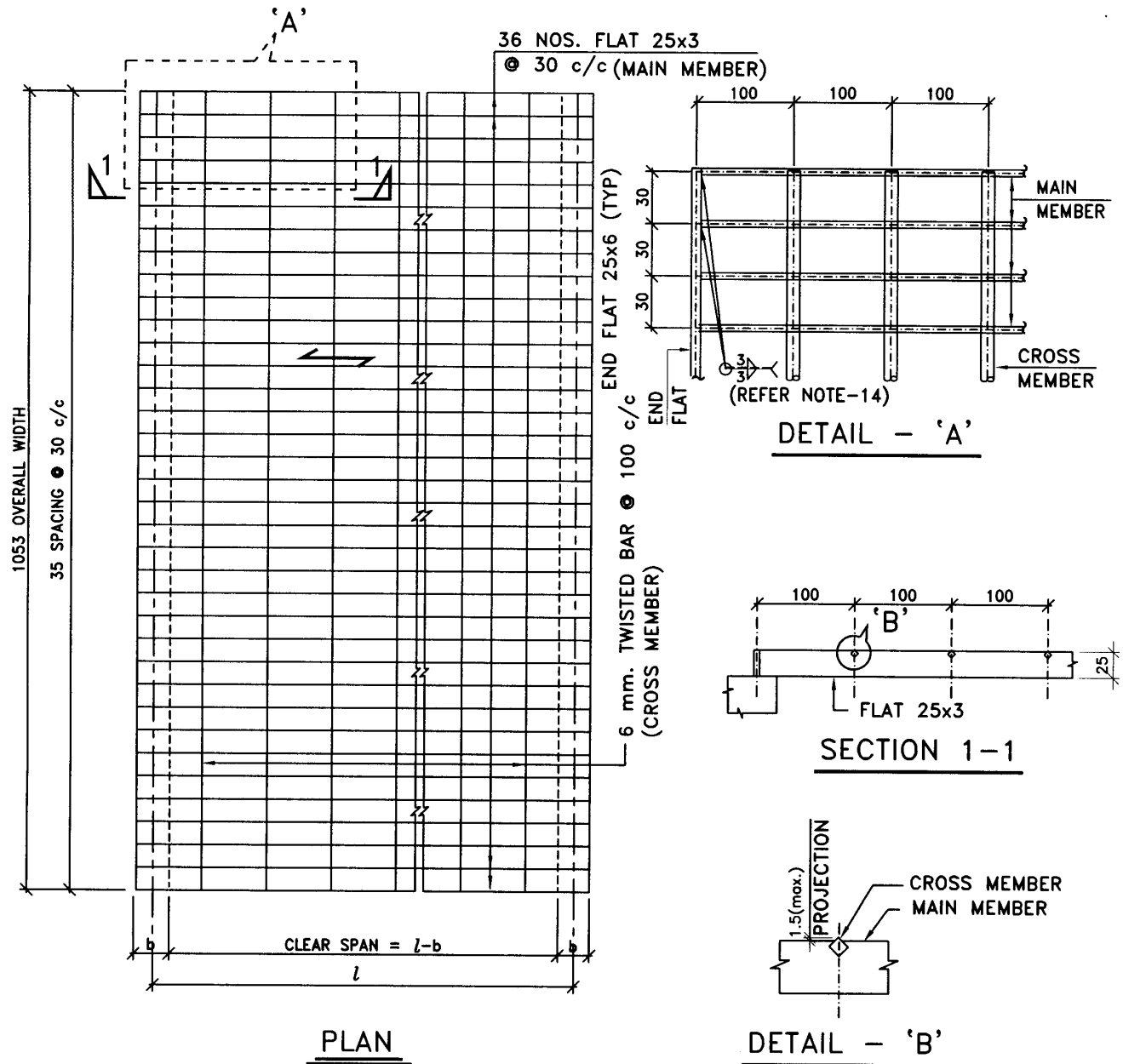
Δd = VERTICAL DEFLECTION IN mm

w = UDL IN kN/m^2

P = UNIFORMLY DISTRIBUTED LINEAR LOAD IN kN/m AT MID SPAN ALONG PANEL WIDTH.

$\leftarrow$ = GRATING SPAN DIRECTION

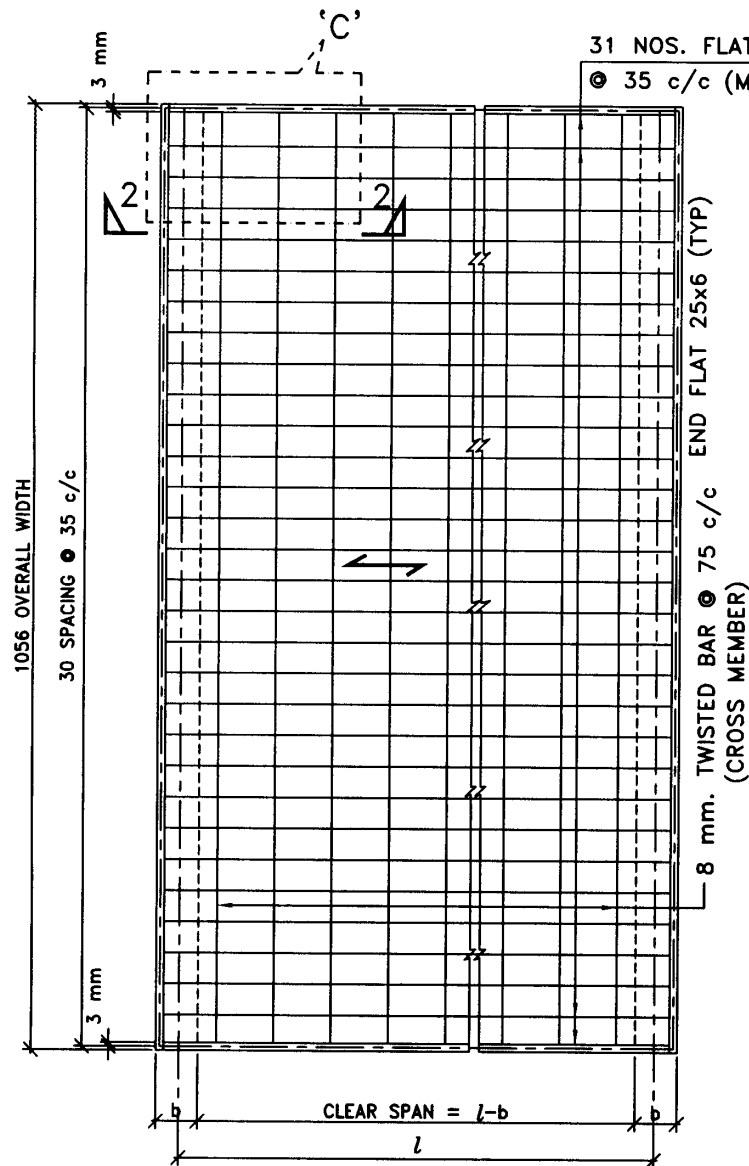
0	29.06.09	ISSUED AS STANDARD	 V. P. SINGH	 S. CHATURVEDI	 VINAY KUMAR	 N. DUARI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman



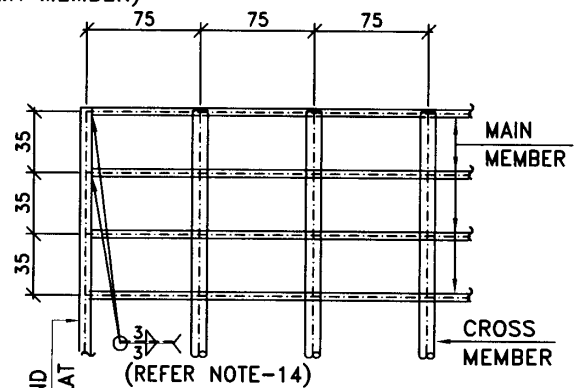
WT. OF GRATING IN kg/m ² (FOR l=1000mm)				PROPERTIES WIDTH = 1053mm			APPLICATION	NOTES
25x6	25x3	6mm. TWISTED BAR	TOTAL	lxx cm ⁴	Zxx cm ³	MR kgm	EQUIPMENT PLATFORM PUMP HOUSE CROSS OVER PIPE RACK GANTRIES (RAIL / ROAD)	REFER SHT. 1 OF 6
2.36	20.13	2.54	25.03	14.84	11.87	195.94		

GRATING TYPE - I

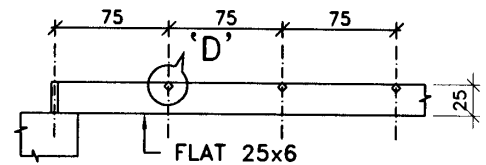
0	29.06.09	ISSUED AS STANDARD	 V. P. SINGH	 S. CHATURVEDI	 VINAY KUMAR	 N. DUARI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
Approved by						



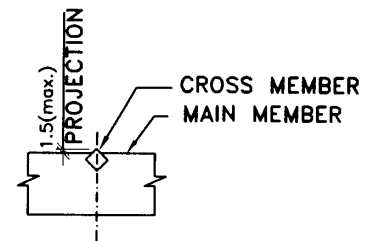
PLAN



DETAIL - 'C'



SECTION 2-2



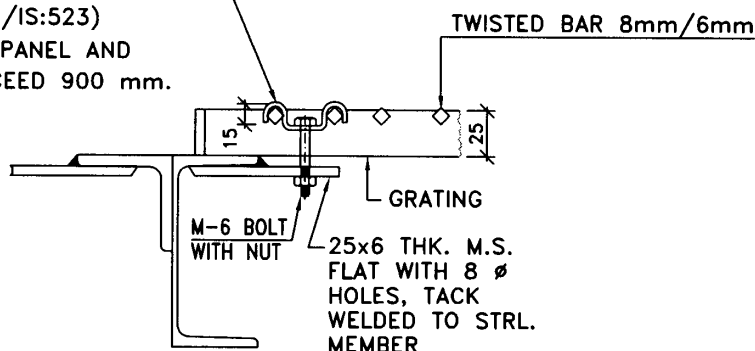
DETAIL - 'D'

WT. OF GRATING IN kg/m ² (FOR $l=1000\text{mm}$)			PROPERTIES WIDTH = 1056mm			APPLICATION	NOTES
25x6	8 mm TWISTED BAR	TOTAL	$I \times x$ cm ⁴	$Z \times x$ cm ³	MR kgm	STAIRS OPERATING PLATFORMS FOR a) COMPRESSOR HOUSE b) TECHNOLOGICAL STRUCTURE c) PIPE RACK WITH VALVE / PIPE SUPPORTS	REFER SHT. 1 OF 6
36.92	6.14	43.06	24.2	19.4	319.69		

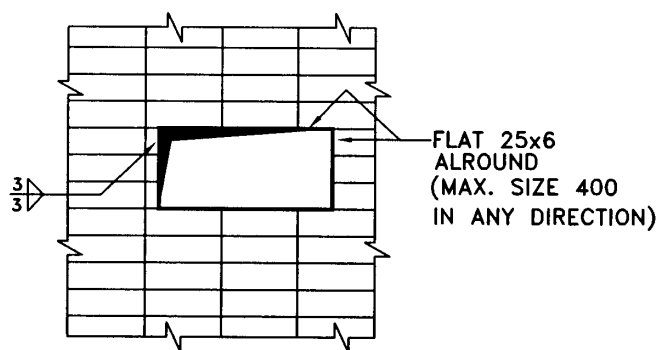
GRATING TYPE - II

0	29.06.09	ISSUED AS STANDARD	V. P. SINGH	S. CHATURVEDI	VINAY KUMAR	N. DUARI
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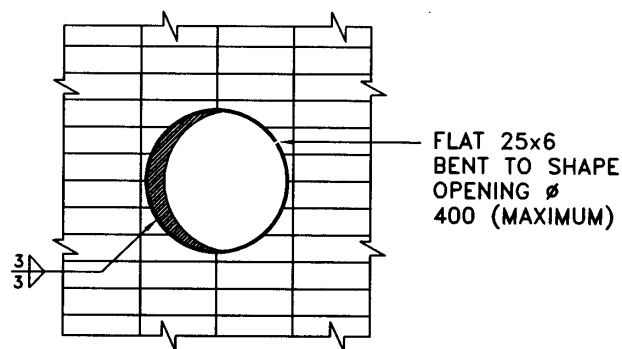
CLAMP 25x3 THK. M.S. FLAT,
WITH 8 ϕ HOLES (AS/IS:523)
MIN. 2 CLAMPS PER PANEL AND
SPACING NOT TO EXCEED 900 mm.



FIXING DETAIL FOR GALVANISED GRATING PANELS WITH CLAMPS
(SEE NOTE - 10)

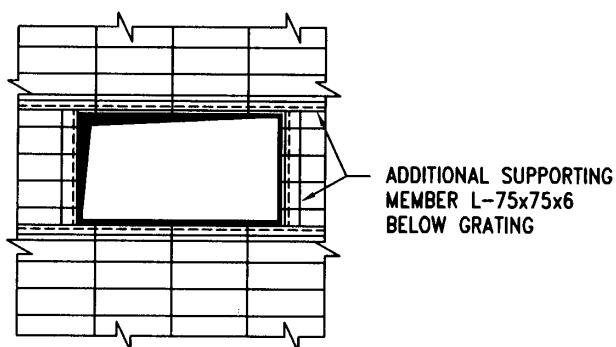


RECTANGULAR

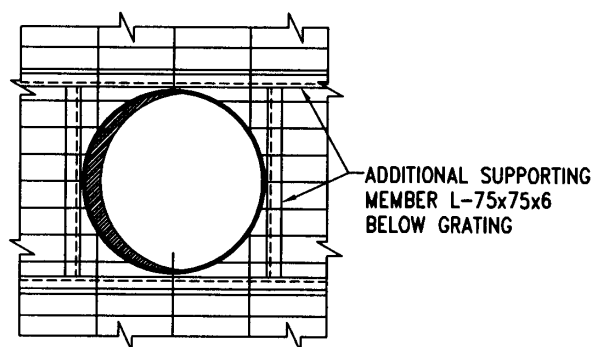


CIRCULAR

(MAXIMUM SIZE OF OPENING 400 mm)



RECTANGULAR

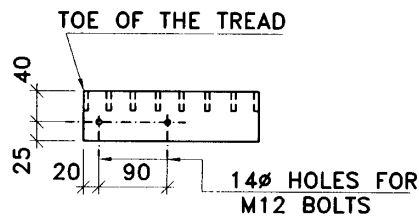


CIRCULAR

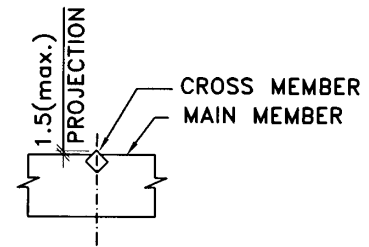
SIZE OF OPENING GREATER THAN 400 mm

TYPICAL DETAIL OF GRATING STRENGTHENING AT OPENINGS
(REFER NOTE-12)

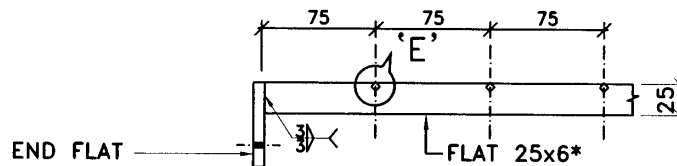
0	29.06.09	ISSUED AS STANDARD	V. P. SINGH	S. CHATURVEDI	VINAY KUMAR	N. DUARI
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Approved by						



VIEW 4-4

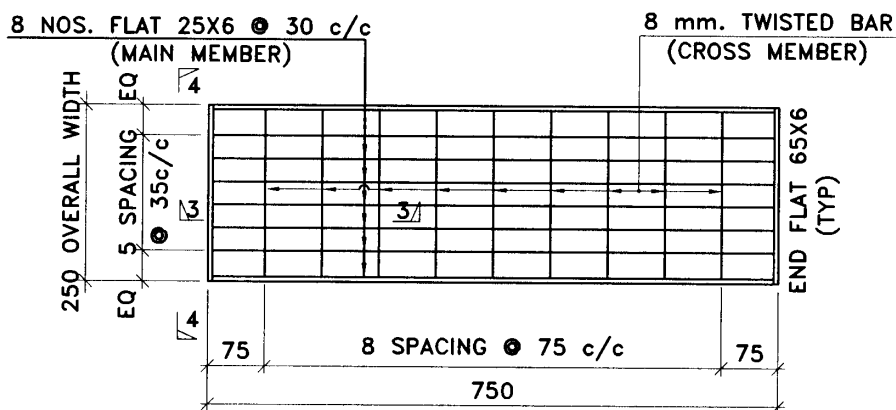


DETAIL- 'E'



SECTION 3-3

*ALL THE FLATS TO BE WELDED TO THE END FLATS



PLAN

TYP. DETAIL OF GRATING TO BE USED AS TREAD FOR STAIRS

0	29.06.09	ISSUED AS STANDARD	V. P. SINGH	S. CHATURVEDI	VINAY KUMAR	N. DUARI
Rev. No.	Date	Purpose	Prepared by	Checked by	Stds. Committee Convener	Stds. Bureau Chairman
Approved by						Copyright EIL - All rights reserved