

EPMC SERVICES FOR DEVELOPMENT OF RUPKHELIA PIPELINE TERMINAL

BID DOCUMENT FOR CONSTRUCTION OF BOUNDARY WALL

TENDER NO.: - AGCL/PROJ/BUNDWALL-RUPK/2024/03

OPEN DOMESTIC COMPETITIVE BIDDING

VOLUME - II OF II

SUBMITTED BY



PIPELINE ENGINEERING CONSULTANTS PVT. LTD.

NOIDA, INDIA

Pipeline Engineering Consultants Pvt. Ltd.



EPMC Services for Development of Rupkhelia Pipeline Terminal

SCOPE OF WORK FOR CONSTRUCTION OF BOUNDARY WALL

DOCUMENT NO. P168-SOW-C002

TA	12.02.24	ISSUED WITH TENDER	SS	RBS	RKB
Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by

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1.0 INTRODUCTION

Assam Gas Company Ltd. (AGCL) is a 61 years old Natural Gas transmission and distribution company, wholly owned by the Govt. of Assam with its registered office at Duliajan, Dist. Dibrugarh, Assam 786602.

The company transports Natural Gas through its integrated pipeline infrastructure to several market segments i.e., Power, Fertilizer, Petrochemicals, Industrial, Commercial and Domestic consumers primarily located in upper Assam. The present infrastructure of the company has a transportation capacity of about 6.0 MMSCM of gas per day.

Assam Gas Company Ltd. intends to Develop Ruphkhelia Pipeline Terminal at Ruphkhelia, Golaghat, Assam.

Pipeline Engineering Consultants Pvt. Ltd. has been appointed as Engineering Consultant by M/s. Assam Gas Company Ltd. for the Development of Ruphkhelia Pipeline Terminal at Ruphkhelia, Golaghat, Assam.

2.0 PURPOSE

This document is for the construction of boundary wall for the Compressor Station at Ruphkhelia, Assam.

3.0 DEFINITION

Where used in this document, the following terms shall have the meanings indicated below, unless clearly indicated by the context to this order.

PROJECT	EPMC Services for Development of Ruphkhelia Pipeline Terminal
CLIENT / OWNER	Assam Gas Company Ltd.
EPMC	Pipeline Engineering Consultants Pvt. Ltd. (PLECO) the party to act for and on behalf of OWNER for Development of Ruphkhelia Pipeline Terminal
CONTRACTOR	Agency appointed by CLIENT/ OWNER for executions of assigned tasks
PURCHASER	Either of CLIENT, OWNER or EPMC
VENDOR/MANUFACTURER	Party, which manufactures and supplies equipment, services to the OWNER or to CONTRACTOR

4.0 SCOPE OF WORK

The scope of Civil and Structural works under this contract shall include supply of all materials, execution and construction of all relevant Civil and Structural works required for successful completion of boundary wall works as per the detailed scope of work,

SCOPE OF WORK FOR CONSTRUCTION OF BOUNDARY WALL

scope of Material Supply, Schedule of Rates, Specifications, Standards and drawings enclosed with the bid document.

The detailed scope of work for in general, but not limited to the following:

1. Construction of Brick masonry compound wall with barbed wire and concertina coil above the boundary wall including steel post, main entrance gate and emergency gate as per drawings, specifications and directions of Engineer-in-Charge.
2. Earthwork in excavation including dewatering by deploying adequate capacity of pumps or dewatering techniques, if required, below ground level for all types of soils including soft rock (if envisaged) and providing shoring & strutting, wherever required, by open and/ or closed timbering method.
3. Backfilling with approved good quality of soil/ murrum from approved borrow areas at all depths and disposal of surplus earth, debris and rock material to the area designated by the Engineer-in-Charge.
4. Storing/ stacking excavated earth at safe location or at designated place for reuse within the plant boundary as instructed by Owner/ Engineer-in-charge.
5. Disposal area for unserviceable material outside the plant boundary limit and serviceable materials within plant boundary limit to be arranged by the contractor.
6. Providing the construction joints, expansion joints etc. in the boundary wall.
7. Weep holes shall be provided in the RCC retaining wall wherever required at suitable location directed by engineer in charge.
8. PCC works including lean concrete below foundations of all types, Plinth beams, etc. at all depths below plinth level.
9. RCC work in all types of foundations, sub structure as well as superstructure for Boundary wall /Retaining Wall at all depth & heights.
10. Centering & shuttering in sub-structure at all depths and in super-structure at all heights/ elevations.
11. Fixing of BITUMEN IMPREGNATED FIBRE BOARD conforming to IS: 1838 of approved quality in expansion joints.
12. Preparation of bar bending schedule for all RCC works as per AFC drawings before construction is taken up.
13. Brick Masonry works in sub-structure and super-structure for all depths and all heights as per specifications.
14. Providing plain cement plaster in cement mortar on brick masonry, PCC/ RCC.
15. Providing and applying waterproof decorative cement paint of approved make and approved shade over masonry wall.
16. Supplying and installation of main entrance gate and emergency exit gate as per drawings and directions of Engineer-in-Charge.

17. Surface Preparation, Primer & Finish Paint for Structural steel shall be as per Table 29 of IS800 (Latest edition) for severe exposure condition wherever required.
18. Obtaining all approvals from owner, statutory authorities such as Factory Inspector, Local Municipal or Development Authorities (including existing refinery) and other designated authorities etc. for necessary construction works.
19. Preparation of AS-BUILT mark-up prints on AFC drawings and subsequent updation of the same in soft copy (Auto Cad) of AFC drawing and submission of hard copy and soft copy to Engineer-in-charge as specified elsewhere in this Bid package.
20. Removal of scrap, generated during construction, includes segregation of scrap into serviceable and unserviceable material and transportation of serviceable material to Owner's storage or the location approved by Engineer-in-charge.
21. Any other Civil-Structural works as specified elsewhere in the bid document.

5.0 SPECIFIC REQUIREMENTS TO BE FULFILLED BY CONTRACTOR

Apart from the conditions mentioned in the Specifications the following shall be strictly adhered to.

1. Brick class 5.0 shall be used for all kind of brick works.
2. In case borrowed earth/ disposal is required outside plant boundary, location for borrow area/ disposal of surplus earth, debris to be identified by the contractor. Contractor shall obtain relevant statutory approval from all statutory authorities (like municipal etc.) and including payment of charges/ royalty/ octroi for the same. Contractor shall keep client indemnified of any liability and/ or complaint from local authorities/ municipal bodies.
3. Mandatory use of mechanical excavators for excavation, however manual excavation for minor foundation can be taken up after due approval of Engineer-in-Charge.
4. Mandatory use of concrete conforming to approved design mix. Ready-mix concrete (RMC) preferably shall be used for concreting.
5. Environment for selection of protective coating/ painting system shall be considered as severe.
6. All construction shall strictly conform to enclosed standards, specifications & drawings.
7. The contractor shall ensure the required founding strata conforming to soil recommendation for all foundations and bring it to the notice of the Engineer-in-charge, if the founding depth encountered is different from that specified in the drawings.
8. All works shall be done to the entire satisfaction of the Engineer-in-Charge. Any work not carried out in accordance with the instructions shall be dismantled and made good without any extra cost and time implication to the owner.

6.0 PREAMBLE TO SCHEDULE OF QUANTITIES

1. The quoted rate of excavation shall include requirement of dewatering etc. for completion of total works and no extra amount is payable on this account.
2. As per Geotechnical report, minimum ground water table is at 0.35m below EGL. The expected water table depth may fluctuate. The quoted rate of excavation shall include requirement of dewatering etc. for completion of total works including concreting, backfilling etc. and no extra amount is payable on this account.
3. During the performance of the work the contractor at his own cost, shall keep structures, materials and equipment adequately braced by guys, struts or otherwise approved means which shall be supplied and installed by the Contractor as required till such time the installation work is satisfactorily Completed. The provided guys, shoring, bracing, strutting, planking supports etc. shall not interfere with the work of other agencies and shall not damage or cause distortion to other works executed by him or other agencies.
4. All items in the Schedule of Rates shall be inclusive of cost of all material, tools tackles, labour etc. Constructional infrastructure like scaffolding/ staging, finishing, cleaning, etc. in brick work/ RCC work and making good the same and rectification of any damaged work and shall be applicable for all heights and locations.
5. The Contractor shall also obtain all necessary approvals from statutory authorities such as Factory Inspector, Local Municipal or Development Authorities for the construction.

Any other Civil / Structure Works, not specifically mentioned herein, but required for the satisfactory and successful completion of the project as per directions of the Engineer-in-Charge shall also be in the scope of the contractor.

7.0 SCOPE OF SUPPLY

7.1 OWNER SCOPE OF SUPPLY

NIL

7.2 CONTRACTOR SCOPE OF SUPPLY

All materials (consumables/ non-consumables) including tools, tackles, plant machinery, workers/labors, etc. required for completion of the works as per Schedule of Rates shall be in contractor's scope of supply and shall be the responsibility of Contractor within the quoted rates.

8.0 LIST OF ATTACHMENTS

8.1 STANDARDS SPECIFICATIONS

SCOPE OF WORK FOR CONSTRUCTION OF BOUNDARY WALL

S. NO.	TITLE	SPEC NO.	NO. OF SHEETS	REV. NO.
1.	Civil & Structural Works-General Scope	C-SPC-101	4	0
2.	Civil & Structural Works-Materials	C-SPC-102	15	0
3.	Civil & Structural Works-Earthwork	C-SPC-103	13	0
4.	Civil & Structural Works-Plain & Reinforced Cement Concrete	C-SPC-104	29	0
5.	Civil & Structural Works-Structural Steel Works	C-SPC-106	24	0
6.	Civil & Structural Works Miscellaneous Steel Works	C-SPC-108	11	0
7.	Civil & Structural Works Brick Masonry	C-SPC-109	8	0
8.	Civil & Structural Works Demolition and Dismantling	C-SPC-111	7	0
9.	Civil & Structural Works Miscellaneous Items	C-SPC-112	9	0
10.	Plastering & Pointing	C-SPC-155	9	0
11.	White/ Colour Washing, Distempering, Painting and Polishing	C-SPC-157	14	0

SCOPE OF WORK FOR CONSTRUCTION OF BOUNDARY WALL

8.2 DRAWINGS

S. No.	TITLE	DRAWING NO.	NO. OF SHEETS	REV. NO.
1.	Boundary Wall Layout for Rupkhelia (Golaghat) Station	P168-00-DWG-C003	1	TA
2.	GA & Details of boundary wall	P168-00-DWG-C004	2	TA

8.3 SCHEDULE OF RATES

Attached with tender document.

**STANDARD SPECIFICATION
FOR
CIVIL & STRUCTURAL WORKS - GENERAL SCOPE

C-SPC-101**

0	26.02.22	ISSUED FOR USE AS STANDARD	MK	ADh	RKB	AD
Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by	Approved by

ABBREVIATION

IS Indian Standard

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/ equipments 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; 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. Vendor List attached in the Tender document shall be followed. 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 Fabrication drawings and getting approval from Engineer-in-Charge after incorporating all the comments.
 - 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.



**STANDARD SPECIFICATION
FOR
CIVIL & STRUCTURAL WORKS - MATERIALS

C-SPC-102**

0	26.02.22	ISSUED FOR USE AS STANDARD	MK	ADh	RKB	AD
Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by	Approved by

ABBREVIATION

API	:	American Petroleum Institute
ASTM	:	American Society for Testing & Materials
BIS	:	Bureau of Indian Standards
BS	:	British Standard
C&D	:	Waste Construction and Demolition Waste
DIN	:	Deutsches Institut' flir Normung
EC	:	Emulsifiable Concentrate
IS	:	Indian Standards
PCC	:	Plain Cement Concrete
PVC	:	Poly Vinyl Chloride
RA	:	Recycled Aggregates
RCA	:	Recycled Concrete Aggregates
RCC	:	Reinforced Cement Concrete

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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 authorized 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 fulfill 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 for concrete). Aggregates shall consist of naturally occurring (crushed or uncrushed) stones, gravel and sand or a combination thereof or manufactured aggregates produced from other than natural sources. These shall be chemically inert, hard, strong, dense durable, clear and free from veins, adherent coatings, injurious amount of disintegrated pieces, alkalies, free lime, vegetable matter and other deleterious substances such as iron pyrites, coal, lignite, mica, shale, sea shells etc. Naturally occurring aggregates shall be obtained from an approved source known to produce the same satisfactorily.

Manufactured aggregates shall consist of Iron and Steel slag aggregates, Copper slag aggregates or aggregates made from Construction & Demolition (C&D) waste such as Recycled Aggregates (RA) and Recycled Concrete Aggregates (RCA). RA shall comprise of waste from concrete, brick, tiles, stone, etc. and RCA shall be derived from concrete after requisite processing. Extent of utilization of manufactured aggregates in RCC and PCC works shall be as per Table-I of IS:383.

- 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 alkalies 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 4.75 mm 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 or may be manufactured from other than natural sources like RCA or RA from C&D waste 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 4.75 mm 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 or manufactured from other than natural sources like RCA from C&D waste. 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	PERCENTAGE	REF. TO
IS: 460 (PART I)	PASSING BY MASS	METHOD OF
4.75mm	100	IS:2386 (Part I)
2.36mm	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.

- Mild Steel and Medium Tensile Steel Bars and Hard-Drawn Steel Wire for Concrete Reinforcement **IS: 432**
- Specification for hard drawn steel wire fabric for concrete reinforcement **IS:1566**
- Specification for plain hard-drawn steel wire for prestressed concrete. **IS:1785**
- Specification for High strength deformed steel bars and wires for concrete reinforcement. **IS:1786**
- Specification for indented wire for prestressed concrete. **IS:6003**
- Specification for fusion bonded epoxy coated reinforcing bars **IS:13620**

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/BR/BO). 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**
- High Strength Structural Bolts **IS:3757**
- High Strength Bolts **IS:4000**

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

All Bricks used for masonry works shall conform to the requirements of following BIS Codes:

- Common Burnt Clay Bricks- Specifications IS:1077
- Pulverized Fuel Lime Ash Bricks- Specifications IS:12894
- Burnt Clay Fly Ash Bricks- Specifications IS:13757

8.1.1 Common Burnt Clay Bricks

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/mm²). 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.

8.1.2 Fly Ash Lime Bricks (FALG Bricks)

The Fly Ash Lime Bricks (FALG Bricks) shall conform to IS 12894. Visually the bricks shall be sound, compact and uniform in shape free from visible cracks, warpage, flaws and organic matter. Fly ash shall conform to IS 3812.

8.1.3 Burnt Clay Fly Ash Bricks

The burnt clay fly ash bricks shall conform to IS 13757. The bricks shall be sound, compact and uniform in shape and colour. Bricks shall have smooth rectangular faces with sharp and square corners. The bricks shall be free from visible cracks, flaws, warpage, nodules of free lime and organic matter, the bricks shall be hand or machine moulded. The bricks shall have frog of 100 mm in length 40 mm width and 10 to 20 mm deep on one of its flat sides. If made by extrusion process may not be provided with frogs. Fly Ash shall conform to grade I or grade II of IS 3812.

8.1.4 Mechanized Autoclave Fly Ash Lime Brick

These bricks shall be machine moulded and prepared in plant by appropriate proportion of fly ash and lime. The autoclave fly ash bricks shall conform to IS 12894. Visually, the bricks shall be sound, compact and uniform shape, free from visible cracks, warpage and organic matters. The brick shall be solid with or without frog, and of 100/80 mm in length, 40 mm width and 10 to 20 mm deep one of its flat side as per IS 12894. The brick shall have smooth rectangular faces with sharp corners and shall be uniform in shape and colour. Fly ash shall conform to IS 3812 and lime shall conform to class 'C' hydrated lime of IS 712.

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 & types, shall be stacked separately.

8.4 Local Bricks/ Class 3.5 Bricks.

Where shown on drawings, locally available bricks of non modular size (230 mm x 110 mm x 70 mm) in place of bricks of modular size (190 mm x 90 mm x 90 mm) can be used in case the bricks satisfy the other requirements of respective BIS codes. Minimum compressive strength of these bricks shall not be less than 3.5 N/mm².

8.5 Concrete Block Masonry

Concrete Block Masonry shall be as per PLECO Specification No. C-SPC-110.

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 150 mm and in no case exceed 1/4th thickness of the wall. Height of the stone shall not be more than 300 mm.

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 BIS 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 BIS recognized/ BIS 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 cement only.
- 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 160 kg/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 5 mm and width less than 150 mm. 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 practice 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 7 N/mm² 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 PAINT

- 15.1 Refer PLECO Specification No. C-SPC-157 or the job specification whichever applicable.

16.0 ANTITERMITE COMPOUNDS

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

Generally 1 part of Chloropyrifos (EC 20) shall be mixed with 19 parts of water to prepare 1% solution (chemical emulsion) or as specified by the Manufacturer.

17.0 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.



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ABBREVIATIONS

CNS : Cohesive Non Swelling



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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:

- a) Sand, gravel, loam, clay, mud, black cotton soil
- b) Vegetables or organic soil, turf, peats, soft shale or loose murrum
- c) Mud concrete below ground level
- d) 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 more than 0.028 m³ and less than 0.400 m³) 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 resorted 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 0.4 m³) 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 (Explosive/ Non-explosive))

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 where blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging, pneumatic/ hydraulic/ electro-mechanical breaking by using splitter or by chemical means 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 refuse, debris, roots, hard lumps and any other foreign organic material.

3.2 Unsuitable Materials

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

- a) Organic material, logs, stumps and perishable materials.
- b) Material susceptible to spontaneous combustion
- c) Materials with undefined properties
- d) Materials having a moisture content greater than the maximum specified
- e) Building rubble and domestic and industrial wastes
- f) Soils and rock susceptible to deterioration/ change of their properties.

- g) Clay, silt and other loose or soft soils not in accordance with compaction criteria.
- h) Dredged material
- i) 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	+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 leveled 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 1.5 m 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 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 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 hard rock 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 the Explosive Rules 2008, 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, 2008 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 m from the blast. Precautions as per Explosive Rules 2008 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. The Blaster 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 (8) 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, the Blaster 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 (Explosive/ Non-explosive)

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. Bidders 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 12 mm thickness.

Reinforcement rod mesh not less than 20 mm dia. at 150 mm 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 Clause 2.3.2 above, but where blasting is prohibited for any reason(s), breaking up of rock can be done by using Splitter and/or chemical substances of approved manufacturer mixed in an appropriate proportion. The method involves drilling holes into rock and then inserting Splitter (hydraulic/ pneumatic/ electro-mechanical) or injecting Chemical solvents into the holes. The breaking-up of rock takes place in a controlled fashion without much noise and spark. Any other method as agreed with Engineer-in-Charge may also be used.
- 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 (applicable for item rate tenders only)
- 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 100 m from construction areas. The rate shall also include setting out and line out work required for the excavation.
- 5.18.3 The following works shall not be measured separately and allowance for the same shall be deemed to have been made in the description of main item:
- a) Setting out works, profiles, etc.;
 - b) Site clearance, such as cleaning grass and vegetation;
 - c) Unauthorized battering or benching of excavation;
 - d) Forming (or leaving 'dead men' or 'tell-tales' in borrow pits and their removal after measurements;

- e) Forming (or leaving) steps in sides of deep excavation and their removal after measurements;
- f) Excavation for insertion of planking and strutting;
- g) Unless otherwise specified, removing slips or falls in excavations;
- h) Bailing out or pumping of water in excavation from rains;
- i) Bailing out or pumping of water in excavation from sub-soil water, and
- j) Slings or supporting pipes, electric cables, etc, met during excavation.

5.18.4 Special pumping other than what is included in 5.18.3 (h and i) and well point dewatering where resorted to, shall each be measured separately, unless otherwise stated, in Kilo Watt Hour against separate specific provision(s) made for the purpose.

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

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

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

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

6.0 SHORING AND STRUTTING

- 6.1 The shoring and strutting of the sides to withhold the face of excavation pits/trenches shall be done when approved or directed by the Engineer-in-Charge.
- 6.2 The shoring shall be of close or open timbering type or by Sheet Piling, Soldier Piling, etc. 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 Sheet Piling

The contractor shall design, supply and install hot rolled steel sheet piles including all associated structural steel members viz. waler & runner beams, strut, cross ties, vertical members, guide frames, suitable interlocks, suitable corner sections, splicing & cutting of sheet piling. The contractor shall also apply recommended sealant for complete water tightness (as required) and ensure pre-drilling for installation into bedrock (as necessary), etc. as per site conditions.

The contractor shall mobilize/ demobilize all necessary tools & tackles, hammer (vibratory/ impact), crane(s) etc., shifting plant/ machinery and carryout all ancillary works (as required) and ensure subsequent removal of entire arrangement after completion of works.

6.6 Payment (applicable for item rate tenders only)

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.

Payment for shoring and strutting by sheet piling shall be made on the basis of shoring area of sheet pile exposed after complete excavation.

The rate shall include all labour, design, supply and installation of hot rolled steel sheet piles including all associated structural steel members, application of recommended sealant, pre- drilling for installation into bedrock etc., mobilization/ demobilization of all necessary tools & tackles, hammer, crane(s) etc., shifting plant/ machinery & all ancillary works, fixing and keeping the sheet piling in position, dismantling and removing the same after the work is over, etc. all complete as directed by the Engineer-in-Charge.

No extra payment shall be made for cost of extraction and replacement for installing of sheet pile deviating the specification or rejected by Engineer-in-charge. Extracted sheet piles shall be contractor's property and contractor shall remove the same from site without any extra cost to client.

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 suitable 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 (applicable for item rate tenders only)

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 100 m, placing, watering, rolling, ramming compacting in layers, trimming and dressing finished surface and disposal of surplus material upto a lead of 100 m.

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 (applicable for item rate tenders only)

8.2.1 Payment shall be made only for the lead beyond initial 100 m 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.



STANDARD SPECIFICATION CIVIL & STRUCTURAL WORKS PLAIN AND REINFORCED CEMENT CONCRETE

C-SPC-104

0	26.02.22	ISSUED FOR USE AS STANDARD	MK	ADh	RKB	AD
Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by	Approved by



**STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS**

**SPECIFICATION NO.
C-SPC-104**

PLAIN AND REINFORCED CEMENT CONCRETE

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ABBREVIATIONS

ACI	:	American Concrete Institute
ASTM	:	American Society for Testing and Materials
BS	:	British Standards
GI	:	Galvanized Iron
IS	:	Indian Standard
ISO	:	International Organization for Standardization
PVC	:	PolyVinyl Chloride
RCC	:	Reinforced Cement Concrete
SCC	:	Self Compacting Concrete
SWG	:	Standard Wire Gauge



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PLAIN AND REINFORCED CEMENT CONCRETE

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1.0 SCOPE

This specification is applicable for Concrete Grade up to M60 and establishes the requirements of materials, mix proportioning, placing, curing, etc. of all types of cast-in-situ and precast concrete (ref. section 1.6) used in foundations, underground and above ground structures, floors, pavements etc. Any special requirements as shown or noted on the drawings shall supersede the provisions of this specification.

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: 2000 along with all amendments till date and other relevant codes mentioned therein.

1.2 For Liquid Retaining Structures, PLECO Specification No. C-SPC-105 shall be applicable.

1.3 For Structural Steel works, PLECO Specification No. C-SPC-106 & 108 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 PLECO Specification No. C-SPC-102.

2.2 Materials for all reinforcements, embedment, inserts, water bars etc. shall conform to PLECO Specification No. C-SPC-102.

2.3 Materials to be used as additive to concrete shall conform to PLECO specification No. C-SPC-102.

3.0 GRADES OF CONCRETE

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

TABLE-1 GRADES OF CONCRETE

Group	Grade Designation	Specified Characteristic Compressive Strength of 150 mm cube at 28 days (N/mm ²)
Ordinary Concrete	M10	10
	M 15	15
	M20	20
Ordinary Concrete	M10	10
	M 15	15
	M20	20
Standard Concrete	M25	25
	M30	30
	M35	35
	M40	40

	M45	45
	M50	50
	M55	55
	M60	60

Note: 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 concrete shall be of Nominal Mix type and reinforced concrete shall be of Design Mix type.

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 Table 9 of IS: 456.

4.3 Design Mix Concrete

The mix shall be designed as per IS: 10262 in an approved laboratory to produce the grade of concrete having the required workability and characteristic strength not less than appropriate values given in Table- I. 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 source & quality of materials changes or there is a break in the continuity of construction, 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 water cement ratio in the design concrete shall be strictly maintained as stipulated in Table 5 of IS: 456.

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 & surface finish, when hardened. The following information shall be collected prior to design of the concrete mix:

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 as per clause 10.2.3 of IS 456. This shall be determined by mathematical means, laboratory tests, field trials and suitable changes in aggregate gradation. The contractor shall ensure the same to the satisfaction of Engineer-in-Charge.

5.2 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.

5.3 Workability

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

5.4 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. Concrete mix design shall always take into account the type of cement, minimum cement content irrespective of the type of cement and maximum water cement ratio and minimum grade of concrete conforming to environmental exposure conditions (refer Table 3 of IS 456) as given in Table 5 of IS: 456.

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

- a) 43 Grade Ordinary Portland Cement conforming to IS: 8112.
- b) 53 Grade Ordinary Portland Cement conforming to IS: 12269.
- 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.

5.4.1 Water Cement Ratio

Once a mix, including its water cement ratio, has been determined and approved for use by the Engineer-in-Charge, that 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 water cement ratio. Maximum water-cement ratio shall be as per Table 5 of IS: 456 for different exposure condition.

The minimum cement content as mentioned in Table 5 of IS: 456 shall be adjusted for aggregates other than 20mm nominal maximum size as defined in Table 6 of IS 456.

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

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

All records and charts for the batching and mixing operations shall be prepared and maintained by the contractor in accordance with IS: 4926 or as per the instructions of Engineer-in-Charge.

In case Ready Mixed Concrete is not available, 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.

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-2. 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.

TABLE-2

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 upto grade M20 and located at far away isolated places, this may be permitted by the Engineer-in-charge as a special case. 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.

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/ Batching Plants, concrete shall be transported from the plants to the sites only by transit mixers and Delivery Ticket for each delivery of concrete shall be maintained by the contractor.
- 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. However, drop height can be relaxed by the Engineer-in-Charge as per the provisions given under Cl. 8.1.1. 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 shoveling. 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 below 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.
- 8.3.10 Continuous Concreting
- 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. 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.
- 8.3.11 Concreting under special conditions
- a) 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).
- b) Under water concreting shall be as per clause 14.2 of IS: 456.
- 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.
- 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 PLECO Specification No. C-SPC-102 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 Cl. 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 as given in Table-3A & 3B below:

TABLE-3A

**(For Concrete prepared at site by using Mechanical mixers)
MANDATORY TESTS ON SAND & STONE AGGREGATES**

S. No	MATERIAL	TEST	FIELD/ LAB TEST	MIN.QTY OF MATERIAL/ WORK FOR CARRYING OUT TEST	FREQUENCY OF TESTING*
1.	Sand	(a) Bulking of sand	Field Test	20 m ³	Every 20 m ³ or part thereof or more frequently as decided by the Engineer-in-Charge
		(b) Silt content	Field Test	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 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
		c) Ten percent Fine value	Laboratory	45 m ³	Initial test and subsequent test as & when required by Engineer-in-Charge

* Fresh testing is mandatory whenever there is change in Source of materials.

TABLE-3B

(Refer Cl. 4.4 & 4.6.1 of IS:4926)

(For Ready Mixed Concrete supplied by Ready Mixed Concrete Plants
or from on/off-site Batching Plants)

MATERIALS TESTING REQUIREMENTS

S. No	AGGREGATE PROPERTY/ PARAMETER	TYPE OF AGGREGATE	ASSESSMENT OF TYPICAL PROPERTIES AND HIGH TEST RATE*	NORMAL MONITORING AND LOW TEST RATE*	REQUIREMENT FOR NORMAL MONITORING AND LOW TEST RATE
1.	Grading	Sand/Fine	Weekly	Monthly	Last 8 results conform to IS 383 or representative values
		Coarse-Single sized/ Graded	Weekly	Monthly	
2.	Particle density -Oven Dry -Saturated Surface Dry -Apparent	All Types	Weekly	3 Monthly	Last 4 results ± 0.04 percent
3.	Absorption	All Types	Weekly	3 Monthly	Last 4 results ± 0.04 percent
4.	Bulk Density - Loose - Compacted	All Types	Monthly	6 Monthly	Last 4 results $\pm 75 \text{ kg/m}^3$
5.	Fines (Silt) Content	Sand	Weekly	Monthly	Last 10 results < 75 percent maximum allowed
		Coarse	Monthly	3 Monthly	
6.	Aggregate Impact Value	Coarse	As specified	As specified	-
7.	10 % Fines	Coarse	Yearly	Yearly	-
8.	Flakiness	Coarse	2 Weekly	6 Monthly	Last 3 results conform to standard
9.	Chloride Content	All Types	Weekly	6 Monthly	Last 3 results < 0.01 percent
10.	Aggregate Abrasion Value (Los Angeles Method)	Coarse	-	Yearly/ Source Change	-
11.	Soundness	Fine and Coarse	-	Yearly/ Source Change	-
12.	Potential Alkali Aggregate Reactivity Including Petrography	Fine and Coarse	-	5 Yearly/ Source Change	-
13.	Petrographic Description (General)	All Types	-	5 Yearly	-

*Note: The high- or low-test rates apply in accordance with the following conditions:

- a) High test rate
 - i) To establish the typical characteristics of an aggregate, and
 - ii) When significant changes in properties occur outside the tolerances for low test rates given.
- b) Low test rate
 - i) When the typical characteristics of the aggregate have been established, and
 - ii) When subsequent tests lie within the tolerances for low test rates given

15.2 Compaction Factor 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.

In case of Ready Mixed Concrete, provisions of IS: 4926 shall be followed.

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- I shall alone be the criterion for acceptance or rejection of the concrete in accordance with clause 15.3.9.

15.3.3 Sampling 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

(Refer Cl. 15.2.2 of IS:456)

FREQUENCY OF CONCRETE SAMPLING

Quantity of concrete in the work (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.
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At least one sample shall be taken from each shift.

When concrete is produced at continuous production units such as ready mixed concrete/ batching plants, atleast one sample shall be taken for every 50m³ of concrete or after every 50 batches, whichever occurs at a greater frequency or as decided by the Engineer-in- Charge. Samples shall be avoided from the first and the last cubic metre of concrete mix in a lot.

15.3.5 Test Specimen

Three test specimens shall be made for 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 I).

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 more, the test results of the sample shall be considered invalid.

15.3.8 Standard Deviation

Standard deviation for each grade of concrete shall be calculated separately. Standard deviation based on test results of samples:

- 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.
- For design of mix in the first instance, the value of standard deviation given in Table 8 of IS: 456, Amendment No. 4 may be assumed.
- As soon as sufficient results of samples are available, actual calculated standard deviation shall be used and the mix design shall be revised/ updated. However, when adequate past records for a similar grade exist and justify to the designer a value of standard deviation different from that shown in Table 8 of IS: 456, Amendment No. 4, it shall be permissible to use that value.
- For additional requirement on standard deviation refer clause 9.2.4 of IS : 456.

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 col. 2 & col.3 of Table-5 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 shall 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 non-overlapping consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm².

(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)
- b) The strength determined from any test result is not less than the specified characteristic strength less 0.3 N/mm²

Table-5

(Refer Cl. 16.1 & 16.3 of IS:456)

Characteristic Compressive Strength Compliance Requirement

Specified Grade	Mean of the Group of 4 Non-Overlapping Consecutive Test Results in N/mm²	Individual Test Results in N/mm²
M15 or above	$\geq f_{ck} + 0.825 \times \text{established standard deviation (rounded off to nearest } 0.5 \text{ N/mm}^2)$ or $\geq f_{ck} + 3 \text{ N/mm}^2$, Whichever is greater	$\geq f_{ck} - 3 \text{ N/mm}^2$
<p>NOTE : 1) In the absence of established value of standard deviation, the values given in Table 8 of IS:456, Amendment No. 4, may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.</p> <p>2) For concrete of quantity 30 m³ (where the number of samples to be taken is less than four as per the frequency of sampling given in cl. 15.3.4, Table 4), the mean of test results of all such samples shall be $f_{ck} + 4 \text{ N/mm}^2$ minimum and the requirement of individual test results shall be $f_{ck} - 2 \text{ N/mm}^2$ minimum. However, when the number of sample is only one as per Table 4, the requirement shall be $f_{ck} + 4 \text{ N/mm}^2$.</p>		

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 will be used for establishing acceptance criteria as per clause 16.1.a of IS: 456.

For the individual test result requirements given in col. 3 of 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 60m³.

15.3.9.4 If the concrete is deemed not to comply pursuant to Cl. 15.3.9.1 or 15.3.9.2, the structural adequacy of the parts affected shall be investigated and any consequential action as needed shall be taken (Refer Cl. 16.0).

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.

15.3.9.7 Tolerance in leveling of concrete surface at foundation/ pedestal top level where grouting is to be done:

Maximum Plan Dimension	≤ 2m	>2m but ≤4m	>4m
Tolerance in leveling	+ 10mm	+ 10mm	+ 10mm
	- 10mm	-20 mm	-25mm

15.3.9.8 Tolerance in dimensions of pocket:

20mm overall maximum tolerance on the size of pocket.

For pockets, chemically dissolvable moulds shall be preferred. Smooth removal of moulds without affecting the pocket size shall be ensured.

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 the Engineer-in Charge covering materials used, receipt of materials, their test results, records, workmanship and construction etc.

Contractor shall ensure that the surface which is to receive the grout is at proper level and so are the openings for pockets as per Cl. 15.3.9.7 & 15.3.9.8.

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 of IS: 456 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-I. 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 PLECO Specification No. C-SPC-104 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 WATERPROOF CEMENT PAINT

Wherever specified, 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 provided these surfaces shall not contain any protective coating. 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 (Part-5) 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 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 of cross section of columns and beams | - 5mm to+ 10mm |
| (b) | Deviation from dimensions of footings (see Note below) | |
| i) | Dimensions in plan | -10mm to +50mm |
| ii) | Eccentricity | 0.02 times the width of the footing in the direction of deviation but not more than 50mm. |
| iii) | Thickness | -10mm to +50mm or ± 0.05 times the specified thickness, whichever is less |

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) Tolerance in leveling of concrete surface at foundation/ pedestal top level where grouting is to be done As per Cl. 15.3.9.7

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 mm1mum 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 rectified 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 comers 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 | 21 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:

- i) For other cements, the stripping time recommended for ordinary Portland cement shall be suitably modified as per the instructions of the Engineer- in-Charge.
- ii) 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.
- iii) 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.
- iv) For rapid hardening cement, 3/7 of the above mentioned periods shall be considered subject to a minimum of 16 hours.
- v) For Portland pozzolana or low heat cement, 10/7 of the above mentioned periods shall be considered.

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 underpinnings in addition to base plates shall be provided particularly where scaffolding is 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 place only if forms are properly cared for, stored and treated after each use.

The Engineer-In-Charge may, at his absolute discretion, order removal of any forms considered unsuitable for use in the work.

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. Bars shall be bent in a slow and regular movement to avoid fractures by mechanical means only. 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 cut & bend in a Bar Bending Machine. Bars which develops 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 6 times bar diameter for high strength deformed bars. Care shall also be taken when bending back the dowel 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 multi layers 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. The overlapping bars shall be tied with two strands of 16 SWG black soft annealed binding wire. 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. Where welding of 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 (upto Seismic Zone-III as per IS:1893 Part-I)

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.

Following tests, at the minimum, shall be conducted in advance to prove efficiency of the coupled joint before putting them in actual use:

Name of the Test	Testing Requirement	Code of conformance
Static Tension & Compression Test	Each connection shall develop at least 125% of the specified yield strength of the reinforcing bar	ASTM A370/ ACI 318/ ISO 15835
Permanent Elongation (Slip)	Permanent elongation across the coupled Joint shall be less than 0.1mm After loading at 60% of the yield strength of the reinforcing bar	BS 8110/ ISO 15835
Moderate Oligocyclic (Seismic) Test (Cyclic Tension & Compression Test)	Deformation across the coupled joint shall be less than 0.3mm after subjecting the joint to a series of 20 cycles with 90% tension as well as 50% compression of the yield strength of the reinforcing bar	ISO 15835

All operations relating to reinforcement coupling shall be done by using manufacturer's patented machine/ equipment in the presence of Engineer-in-Charge. Mechanical connections shall be placed away from points of high stress and shall be staggered.

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 + 10mm measured over the steel reinforcement including links.

22.0 PAYMENT

22.1 Plain and Reinforced Concrete

22.1.1 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, 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.

22.1.2 No separate payment shall be made for any additive/ admixture/ Plasticizer/ Fibres used by the contractor for accelerating or retarding the strength of concrete or for achieving specified workability. The rate quoted shall be deemed to be inclusive of all costs related to any such additive/admixture/ Plasticizer/ Fibres.

22.1.3 The rate shall however be exclusive of reinforcement, metal inserts, pipe sleeves, formwork water stops and any filler material in expansion/isolation joints.

22.1.4 Where the strength of concrete mix as indicated by tests, lies in between the strengths of any two grades given in Table- I 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.

22.1.5 Deductions for openings, pockets etc. shall be as specified in relevant parts of IS 1200.

22.1.6 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), even though the same is required to be constructed in single pour. The rate quoted against this item shall be inclusive of all extra cost related to labour, 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.

22.1.7 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.

22.2 Reinforcement

22.2.1 Payment for plain round mild steel reinforcement bars, high strength deformed steel bars and epoxy coated reinforcing steel bar 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 nominal unit weight given in Table- I of IS: 1786. In case actual unit weight of the bars is less than nominal unit weight, but within permissible tolerances, the weight of reinforcement shall be calculated on the basis of actual unit weight. In case actual unit weight of the bars is more than nominal unit weight, the payment shall be made on the basis of nominal unit weight. Standard hook lengths, chairs, spacer bars and authorized 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.

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

22.2.3 Payment for a mechanical threaded coupler/ clamp shall be made by measuring the Lap length of the respective rebar on which coupler/ clamp is used. The rate shall include supply of complete assembly, fixing, testing etc. all complete.

22.3 Water Stops/Water Bars & Expansion/Isolation Joints

22.3.1 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.

22.3.2 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.

22.4 Waterproof Cement Paint

22.4.1 Payment for waterproof cement paint as per Cl. 18.0 shall be made separately on Sqm basis.



**STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS
STRUCTURAL STEEL WORKS**

C-SPC-106

0	26.02.22	ISSUED FOR USE AS STANDARD	MK	ADh	RKB	AD
Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by	Approved by



**STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS
STRUCTURAL STEEL WORKS**

**SPECIFICATION NO.
C-SPC-106**

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ABBREVIATIONS

AFC	:	Approved For Construction
AWS	:	American Welding Society
BIS	:	Bureau of India Standards
IS	:	Indian Standard

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1.0 SCOPE

This specification describes the information to be included in a Project Specification and also 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

2.1.1 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)

2.1.2 International Standard

AWSDI.1

2.2 PLECO Specifications

C-SPC-102- Materials

6-79-0020 (or relevant Job Specification)- Surface preparation & protective coating (New construction)

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 or any project specific specification specified elsewhere shall govern over the provisions of this specification.

3.0 MATERIALS

3.1 General

All materials shall conform to their respective specifications given in PLECO Specification no. C-SPC-102. 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, PLECO Standards issued to the Contractor. These drawings shall be prepared by Contractor or by an agency engaged by the contractor using TEKLA or AUTODESK Advance Steel or equivalent 3D Modeling software 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 PLECO 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.
- xiii) Details of holes and fittings in components necessary for safe lifting and erection purpose.

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.
- 5.2.1.3 After completion of bending or straightening, welds within the area of bending or straightening shall be thoroughly visually inspected. Nondestructive tests required to be carried out for such locations shall be done only after straightening or bending activity.

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 HS 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.

5.2.4.9 Slotted holes shall be punched or formed by drilling two holes and completed by cutting.

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-butt 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.
- iii) 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.
- iv) Tack welding shall be thoroughly removed by grinding or gouging such that subsequent welding shall be done properly.

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 or AWS D1.1. If the welders will be working to approved welding procedures, they shall have satisfied the relevant requirements of IS:7310 or AWS D1.1.

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 or AWS D1.1 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 is 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 or AWS D1.1 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.

- a) Weld defects occurring at the surface such as blow holes, exposed porosity, unfused welds etc.
- b) Surface cracks in the weld metal or in the parent metal adjacent to it.

- c) Damages to the parent metal such as undercuts, burning, overheating etc.
- d) Profile defects such as excessive convexity or concavity, overlapping, unequal leg lengths, excessive reinforcement, incompletely filled grooves, excessive penetration beads, root grooves etc.
- e) Distortion due to welding i.e., local shrinkage, camber, bowing, twisting, rotation, wariness etc.
- f) Linear eccentric, angular and rotational misalignment of parts.
- g) Dimensional errors.

B. Mechanical Tests

The mechanical testing (such as tensile load tests, bend tests, impact tests etc.) shall be done in accordance with the relevant standards and as per the instructions of the Engineer-in-Charge.

C. Magnetic Particle/Dye Penetration/Ultrasonic Examination

The examination shall be done at random as directed by the Engineer-in-Charge. Whenever such tests are directed, the tests shall be carried out on joints chosen by him. The tests shall be carried out by employing approved testing procedure in accordance with IS:822.

D. Radiographic Examination

Radiographic examination shall be carried out only in special cases for random joints as directed by the Engineer-in-Charge. The Contractor shall be paid extra for such examination except for penalty radiographic tests for which the cost shall be borne by him. The Contractor shall make necessary arrangement at his own expense for providing the radiographic equipment, films and all other necessary materials required for carrying out the examination. The tests shall be carried in the presence of the Engineer-in-Charge by employing approved testing procedure in accordance with IS:822. The Contractor shall fulfill all the statutory safety requirements while handling X-ray and Gamma-ray equipment and provide the Engineer-in-Charge all the necessary facilities at site such as dark room, film viewer etc., to enable him to examine the radiographs.

5.2.6.9 Repair of Faulty Welds

No repair of defective welds shall be carried out without proper permission of the Engineer-in-Charge and his approval for the corrective procedure.

Welds not complying with the acceptance requirements (as specified by BIS Codes & the Engineer-in-Charge), as revealed during inspection & testing of welds or erection or in-situ condition, shall be corrected either by removing & replacing or as follows:

- | | |
|--|---|
| a) Excessive convexity | - Reduced to size by removal of excess weld metal. |
| 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.
- 5.2.7.4 Different bolt grades of the same diameter shall not be used in the same structure, except if agreed otherwise by the Engineer-in-Charge.
- 5.2.7.5 Bearing type bolts shall be used (unless noted otherwise) and tightened firmly by available means.

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 gasketed 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. Components which are identical in all respects may have the same erection mark.

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 SHOPPAINTING

- 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 6-79-0020, 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 PLECO Specification no. C-SPC-157 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 surface abrasion, 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 PLECO Specification no. C-SPC-157 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 PLECO specification no. C-SPC-157 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 PLECO specification no. C-SPC-157 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, comers, edges etc. The final primer coat shall be air dried and shall have a minimum film thickness as per PLECO Specification no. C-SPC-157 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 PLECO specification no. C-SPC-157 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,



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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 $\pm H/1000$ or $\pm 25\text{ mm}$
 - ii) Over 30m height $\pm H/1200$ or $\pm 35\text{ mm}$ whichever is less
4. Deviation in straightness in longitudinal & transverse planes of column at any point along the height. $\pm H/1000$ 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 $\pm 5\text{ mm level.}$
7. Deviation in difference in bearing levels of a member on adjacent pair of columns both across & along the building. $\pm 5\text{ mm}$

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.
 $\pm 1/250$ 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.
 $\pm 1/1500$ 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. $\pm 5\text{mm}$

5. Deviation in difference of bearing levels of truss from the true level.
 $\pm 1/1200$ 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.

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

**ANNEXURE –‘B’
(CLAUSE 18.1)**

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



**STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS
MISCELLANEOUS STEEL WORKS**

C-SPC-108

0	26.02.22	ISSUED FOR USE AS STANDARD	MK	ADh	RKB	AD	
Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by	Approved by	



**STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS
MISCELLANEOUS STEEL WORKS**

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ABBREVIATIONS

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



**STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS
MISCELLANEOUS STEEL WORKS**

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1.0 GENERAL

- 1.1 All materials supplied by the Contractor shall conform to specifications given in PLECO Standard Specification No. C-SPC-102.
- 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 PLECO Standard Specification No. C-SPC-102.

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, lockouts, washers, pipe sleeves and anchor plates shall conform to their respective clauses given in PLECO Standard Specification No. C-SPC-102.

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:

- a) For sleeved bolts, one tenth of the bolt nominal diameter.
- b) 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

- 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 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 PLECO Standard Specification No. C-SPC-102.

5.2 Fabrication

Fabrication of inserts shall be done strictly as per drawings/standards and in compliance with the requirements given in PLECO Standard Specification No. C-SPC-106.

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 PLECO Standard Specification No. C-SPC-157 or job specification (wherever applicable), as specified, after fabrication.

5.5 Payment

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 PLECO Standard Specification No. C-SPC-157 or job specification (wherever applicable), as specified, etc. all complete.

6.0 CHEQUERED PLATES

6.1 Material

Material required for chequered plates shall conform to the specifications given in PLECO Standard Specification No. C-SPC-102. Chequering shall be closed or open-ended or of any other pattern as shown on drawings.

6.2 Fabrication Drawings

As per the requirements given in PLECO Standard Specification No. C-SPC-106.

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 150 mm 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/ galvanization as per PLECO Standard Specification No. C-SPC-157 or job specification, as specified, on both surfaces.

6.6 Payment

6.6.1 Payment shall be made on the basis of actual weight in metric tons of the chequered plate. If any stiffening sections are provided below the chequered plates for strengthening, the same shall be separately measured & paid under Structural Steel item (Refer PLECO Standard Specification No. C-SPC-106).

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/ galvanization as per PLECO Standard Specification No. C-SPC-108 or job specification (wherever applicable), as specified, etc. all complete.

6.6.3 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 electro forged galvanized gratings shall be either Type-I or Type-II as per PLECO Standard No. C-SPC-005 and shall be procured from approved manufacturers as per Vendor List.

7.2 Material

Materials for fabrication and fixing of Gratings shall conform to specifications given in PLECO Standard Specification No. C-SPC-102.

7.3 Fabrication Drawings

As per the requirements given in PLECO Standard Specification No. C-SPC-106.

7.4 Fabrication

The gratings shall be manufactured by electroforging process strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on PLECO standard. All units shall be given distinct erection marks in accordance with the marking drawing. 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 Standard.

7.6 Galvanisation

Gratings and the fixing clamps, bolts, nuts shall be cleaned with wire brush and galvanization shall be done in accordance with IS: 2629 and tested as per IS: 2633 & 6745. Quantity of zinc coating shall be minimum 900 gm/sq.m. of surface area (0.12mm uniform thickness).

7.7 Payment

7.7.1 Payment shall be made on the basis of actual weight in metric tons of the gratings manufactured in accordance with PLECO Standard and accepted by the Engineer-in-Charge.

The weight for payment shall also include the weight of galvanization and welding.

7.7.2 The rate shall include supplying, fabricating, erecting electroforged galvanized 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 carrying out galvanization, all complete.

7.7.3 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 PLECO Standard Specification No. C-SPC-102.

8.2 Fabrication Drawings

As per the requirements given in PLECO Standard Specification No. C-SPC-106.

8.3 Fabrication

8.3.1 Hand railing 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 hand railing, 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

Hand railing, 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

Tubes shall be cleaned with wire brush and given coat of primer as per table 29 of IS: 800, as specified, after fabrication.

8.6 Payment

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 coat of primer as per table 29 of IS: 800, 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 PLECO Standard Specification No. C-SPC-102.

9.2 Fabrication

Rungs shall be fabricated as per standards/drawings. Mild steel bars shall be straightened if required, cut, bent to shape and given coat of primer on exposed portions.

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

Payment shall be made on the basis of actual weight in kilogram (Kg) 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 coat of primer as per table 29 of IS: 800, as specified, and two coats of anti-corrosive paint or any other paint, 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 PLECO Standard Specification No. C-SPC-102.

10.2 Fabrication Drawings

As per the requirements given in PLECO Standard Specification No. C-SPC-106.

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 thoroughly and given coat of primer as per table 29 of IS: 800, as specified, after fabrication.
- 10.6 Payment
- 10.6.1 Payment shall be made on the basis of admissible weight in metric tons of the structure accepted by the Engineer-in-Charge. 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 as per IS 808/ IS 1161. BIS Handbook/ Manufacturer's catalogues/ charts shall be adopted in case relevant weights of sections used are not covered in IS 808/ IS 1161. No allowance in weight shall be made for rolling tolerances. In case of any doubt, actual weight of the section shall be measured at site.
- 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 clause no. 8.5 above etc., all complete.
- 10.6.2 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.
- 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) for:
- a) Ladders and stairs supports.

- b) Cables and cable trays supports.
- c) Electrical panels and fixtures.
- d) Hangers for pipes and cable trays.
- e) Pipe supports.

11.2.2 Heavy Duty (Mild steel/ High tensile steel) for:

- a) Platform supports (beam and columns)
- b) 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 1,000 mm and 1,000 Kg of concentrated load at the free end.

11.3 Selection

The Contractor shall procure the expansion fasteners from the approved manufacturers as per Vendor List.

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 pre-marked 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 the from damage.

11.7 Payment

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 re-drilling 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.

12.0 CHEMICAL ANCHORS AND DOWELS

12.1 Material

Chemical Anchors shall be of high tensile steel rods of minimum grade 5.8 galvanised to at least 5 microns.

Grade of Rebars for chemical anchoring shall be as per the General Notes of the project.

12.2 Selection

The Contractor shall select the chemical anchors based on the parameters such as Loads and rebars for dowels as specified in the AFC drawings/ documents. The chemical anchors shall be procured from the approved manufacturers as per Vendor List.

12.3 Testing

The Contractor shall carry out, at the work place, the requisite tests like pull out test, shear test, etc. for chemical anchors and pull out test for dowels. The chemical anchors shall withstand the load specified in the drawing/ documents and the Dowels shall be tested for full tensile capacity of the rebars. The decision of the Engineer-in-Charge regarding the adequacy of strength and load carrying capacity of the anchors/ dowels shall be final and binding to all. The cost of all such tests shall be borne by the Contractor.

12.4 Installation

The Contractor shall install the chemical anchors/ dowels 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 pre-marked 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.

12.5 Payment

Payment for installing chemical anchors shall be made on number basis (each). The rate shall include supply of complete assembly i.e. chemical anchors along with chemical foils as per manufacturer specifications.

Payment for installing chemical dowels shall be made on number basis (each). The rate shall include fixing of dowels by drilling/ cleaning hole and injecting odourless chemical as per manufacturer specifications. Rebars used as dowels shall be paid separately under relevant SOR item.

For chemical anchors/ dowels, the rate shall be inclusive of handling, transporting, providing necessary temporary staging, installing (as per manufacturer's specifications) in PCCI RCC structures to a required depth with a specified hole diameter, at all levels and locations, testing, drilling holes, cleaning, covering with jute cloth, relocating and re-drilling 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.



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0	26.02.22	ISSUED FOR USE AS STANDARD	MK	ADh	RKB	AD	
Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by	Approved by	



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ABBREVIATIONS

BIS : Bureau of Indian Standards
IS : Indian Standard



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1.0 SCOPE

This specification establishes the materials, dressing, laying, joining, curing, workmanship etc. for brick masonry works. Brick masonry shall also comply with all the requirements of IS: 2212.

2.0 REFERENCES

2.1 BIS Codes

1. IS:2212 Brick works- code of practice
2. IS:2250 Code of practice for preparation and use of Masonry mortars
3. IS:2750 Specification for Steel Scaffoldings

2.2 PLECO specifications C-SPC-102: Materials

3.0 MATERIALS

Refer PLECO Specification No. C-SPC-102.

4.0 GENERAL REQUIREMENTS

4.1 Cement Mortar

Cement mortar shall meet the requirements of IS:2250 and shall be prepared by mixing cement and sand by volume. Proportion of cement and sand shall be 1:6 (1 part of cement and 6 parts of sand), or as directed by the Engineer-in-Charge/shown on the drawing, for brick masonry of one brick thickness or more, while 1:4 cement mortar (1 part of cement and 4 parts of sand) shall be used for brick masonry of half brick thickness. The sand being used for mortar shall be sieved. The mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within initial setting time of cement after water is added to the dry mixture. Mortar unused for more than initial setting time of cement, shall be rejected and removed from the site of work.

4.1.1 Proportioning

The unit of measurement for cement shall be a bag of cement weighing 50 Kg and this shall be taken as 0.035 cubic metre. Sand shall be measured in boxes of suitable size on the basis of its dry volume. In case of damp sand, its quantity shall be increased suitably to allow for bulkage.

4.1.2 Mixing

The mixing of mortar shall be done in a mechanical mixer operated manually or by power. The Engineer-in-Charge may, however, permit hand-mixing as a special case, taking into account the magnitude, nature and location of work. The Contractor shall take the prior permission of Engineer-in-Charge, in writing, for using hand-mixing before the commencement of work.

4.1.2.1 Mixing in Mechanical Mixer

Cement and sand in specified proportions, by volume, shall be thoroughly mixed dry in a mixer. Water shall then be added gradually and wet mixing continued for atleast one minute. Care shall be taken not to add more water than that which shall bring the mortar to the consistency of stiff paste. Wet mix from the mixer shall be unloaded on water-tight masonry platform, made adjacent to the mixer. Platform shall be atleast 150 mm above the levelled ground to avoid contact of surrounding earth with the mix. Size of the platform shall be such that it shall extend atleast 300mm around the loaded wet

mix area. Wet mix, so prepared, shall be utilised within initial setting time of cement after addition of water. Mixer shall be cleaned with water each time before suspending the work.

4.1.2.2 Hand Mixing

The measured quantity of sand shall be levelled on a clean water-tight masonry platform and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by being turned over and over, backward and forward, several times till the mixture is of uniform colour. The quantity of dry mix which can be consumed within initial setting time of cement shall then be mixed with just sufficient quantity of water to bring the mortar to the consistency of stiff paste.

5.0 CONSTRUCTION PROCEDURE

5.1 Soaking of Bricks

Bricks shall be soaked in water before use for a period that is sufficient for the water to just penetrate the whole depth of bricks as well as to remove dirt, dust and sand. Proper soaking of bricks shall prevent the suction of water from the wet mortar as otherwise mortar will dry out soon and crumble before attaining any strength. The bricks shall not be too wet at the time of use as they are likely to slip on mortar bed and there will be difficulty in achieving the plumbness of wall as well as proper adhesion of bricks to mortar. The period of soaking shall be determined at site by a field test by immersing the bricks in water for different periods and then breaking the bricks to find the extent of water penetration. The least period that corresponds to complete soaking, will be the one, to be allowed for in the construction work.

The soaked bricks shall be stacked over a clean place, wooden planks or masonry platforms to avoid earth, dirt being smeared on them. It shall be ensured that at the time of laying of soaked bricks, they are skin dry.

5.2 Laying

5.2.1 Brick Work (one or more brick thickness)

Brick work (one or more brick thickness) shall be laid in English Bond unless otherwise specified. Half or cut bricks shall not be used except when needed to complete the bond. In no case the defective bricks shall be used.

A layer of average thickness of 10mm of cement mortar shall be spread on full width over a suitable length of lower course or the concrete surface. In order to check and achieve uniformity in masonry, the thickness of bed joints shall be such that four courses and three joints taken consecutively shall measure equal to four times the actual thickness of the brick plus 30mm. Each brick with frog upward, shall be properly bedded and set in position by gently tapping with handle of trowel or wooden mallet. Its inside faces shall be buttered with mortar before the next brick is laid and pressed against it. After completion of the course, all vertical joints shall be filled from top with mortar.

All brick courses shall be taken up truly plumb; if battered, the batter is to be truly maintained. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. The level and verticality of work in walls shall be checked up at every one metre interval.

The masonry walls of structures shall be carried up progressively, leaving no part one metre lower than the other. If this cannot be adhered to, the brick work shall be raked back according to bond (and not left toothed) at an angle not more than 45 degrees but raking back shall not start within 60 cm of a corner. In all cases returns, buttresses, counter forts, pillars etc. shall be built up carefully course by course, and properly bonded with the main walls. The brick work shall not be raised more than fourteen (14) courses per day.

At the junction of any two walls, the bricks shall at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work.

The courses at the top of plinth and sills, at the top of the wall just below the soffit of the roof slab or roof beam and at the top of the parapet, shall be laid with bricks on edge. Brick on edge course shall be so arranged as to tightly fit under the soffit of the roof beam or roof slab, restricting the mortar layer thickness upto 12mm. However, any gap between the finished brick work and soffit of roof slab/beam shall be suitably sealed with the mortar.

5.2.2 Brick Work (half brick thickness)

For brick walls of half brick thickness, all courses shall be laid with stretchers. Wall shall be reinforced with 2 nos. - 6mm diameter mild steel bars, placed at every fourth course. The reinforcement bars, shall be straightened and thoroughly cleaned. Half the mortar thickness for the bedding joint shall be laid first and for steel reinforcement, one on each face of the wall, shall be embedded, keeping a side cover of 12mm mortar. Subsequently, the other half of the mortar thickness shall be laid over the reinforcement covering it fully.

The reinforcement bars shall be carried at least 150mm into the adjoining walls or RCC columns. In case the adjoining wall being of half brick thickness, the length of bars shall be achieved by bending the bars in plan. During casting of reinforced concrete columns, 6mm dia. mild steel bars shall be placed at every fourth course of brick masonry. At the junction of two walls, the brick shall, at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work. The brick masonry work shall not be raised more than 14 courses per day.

Brick course under the soffit of beam or slab, shall be laid by restricting the mortar thickness to 12mm. However, any gap between the finished brickwork and soffit of slab/beam, shall be suitably sealed with the mortar.

5.2.3 Cavity Walls

Brick work in cavity walls shall be similar to general brickwork. It shall consist of one wall of one or more brick thickness while the other wall shall be of half brick thickness at a clear gap of 50mm. The brick work on either side of cavity shall conform to the specifications already as stated in Cl. No. 5.2.1 and 5.2.2. At the base of the cavity wall, the walls shall be solidly constructed upto 300mm above the ground level. The cavity wall shall be terminated 300mm below the soffit of roof slab/beam and the courses over this shall be continued as solid brickwork.

Cavity should be continuous and free from obstructions. Mortar droppings shall be prevented from falling down the cavity by the use of laths or by hayhands which shall be drawn up the cavity as the work proceeds. Any mortar which may unavoidably fall on the wall-ties, shall be removed daily and temporary openings shall be provided to permit the daily removal of mortar droppings from the bottom of the cavity.

The outer and inner leaves shall be tied by means of wall ties. Ties shall be of tor steel bars of 8mm dia. 200 mm long with hooks at both the ends. These shall be placed not more than 750mm c/c horizontally and not more than 300mm vertically, and staggered. Additional ties shall be provided near the openings. There shall at least, be 5 ties per square metre of surface area of the wall. Ties shall be given a bituminous coat before placement, to protect them from corrosion.

In order to keep the cavity dry, air slots shall be provided in the cavity walls at bottom as well as top to the extent of 50 sq.cm area of vents to every 2.0 sq.metre area of the wall.

5.2.4 Circular Brick Work

The detailed specification for brick work covered under clauses 5.2.1 & 5.2.2 shall also apply for circular brickwork. Bricks forming skew backs, shall be dressed or cut so as to give proper radial bearing. Defects in dressing of bricks shall not be covered up by extravagant use of mortar, nor shall the use of chips etc. be permitted.

The circular brick work shall be carried up from both ends simultaneously and keyed in the centre. The bricks shall be flushed with mortar and well pressed into their positions so as to squeeze out a part of their mortar and leave the joints thin and compact. All joints shall be full of mortar and thickness of joints shall be between 5mm and 15mm.

5.3 Jointing

Joints shall be restricted to a width of 10mm with brickwork of any classification. All bed joints shall be normal to the pressure upon them i.e. horizontal in vertical walls, radial in circular brick masonry and at right angles to the face in the battered retaining walls. The vertical joints in alternate courses shall come directly one over the other and shall be truly vertical. Care shall be taken that all the joints are full of mortar, well flushed up. In case no pointing is to be done, cement mortar shall be neatly struck as the work proceeds. The joints in faces which are to be plastered or pointed shall be squarely raked out to a depth of 12mm while the mortar is still green. The rake joints shall be brushed to remove loose particles. After the day's work, the faces of the brick work shall be cleaned on the same day with wire brush and all mortar droppings removed.

5.4 Curing

Green work shall be protected from rain or any other running water or accumulated water from any source, by suitable means. Masonry work, as it progresses, shall be kept thoroughly wet by sprinkling water at regular intervals, on all faces. Curing shall be done after 24 hours of completion of day's work as per IS:2212.

5.5 Staging/Scaffolding

5.5.1 Staging/scaffolding shall be properly planned and designed by the Contractor. Use of only steel tubes is permitted for staging/scaffolding. Design of staging/scaffolding shall be submitted for approval of the Engineer-in-Charge, before commencement of work.

Single scaffolding having one set of vertical support, shall be used and other end of the horizontal scaffolding member shall rest in a hole provided in the header course. The support shall be sound and strongly clamped with the horizontal pieces over which the scaffolding planks shall be fixed. The holes left in the masonry work for supporting the scaffolding shall be filled and made good with plain cement concrete of grade 1:2:4 (M15)

during plastering. Suitable access shall be provided to the working platform area. The scaffolding shall be strong enough to withstand all loads likely to come upon it and shall also meet the requirements specified in IS:2750.

Double scaffolding shall be provided for pillars less than one metre in width or for the first class masonry or for a building having more than two storeys.

Following measures shall also be considered during erection of the scaffolding/ staging:

- a) Sufficient sills or underlinings, in addition to base plates, shall be provided, particularly, where scaffoldings 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 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. Efforts 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 the clamps/couplings are firmly tightened to avoid slippage.
- i) Erection work of a scaffolding/staging, under no circumstance shall be left totally to semiskilled or skilled workmen and shall be carried out under the supervision of Contractor's technically qualified civil engineer.

5.5.2 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 5.5.1 above.

5.6 Embedment of Fixtures

All fixtures, pipes, conduits, holdfasts of doors and windows etc. required to be built in walls, shall be embedded in plain cement concrete block of grade 1:2:4 (M15), at the required positions, as the work proceeds.

6.0 PAYMENT

This clause shall apply to Item Rate tender only.

6.1 General

The payment of brick masonry shall be inclusive of all labour, material, scaffolding/staging sampling and testing, soaking of bricks, laying of bricks, raking of joints, cutting of bricks, providing recesses and making rectangular or round openings, sealing the gap between brick masonry and soffit of beam/slab with and including cement mortar, curing, making of masonry platform for unloading the wet mix, embedding the fittings/fixtures including providing PCC 1:2:4 (M15) etc, all as specified for all heights and depths. Deduction for rectangular or circular openings shall be done as per relevant BIS Codes.

6.1.1 Payment for brick masonry works of one or more brick thickness, including circular brickwork, shall be made on cubic metre basis of the work done.

6.1.2 Payment for half brick masonry work shall be made on square metre basis on the area of work done and shall also include the cost of supplying and fixing of reinforcement bars in position.

6.1.3 Payment for forming the cavity shall be in square metres and shall include the cost of laying of bitumen coated tor steel ties in position, labour required for keeping the cavity clear, providing air slots etc.



STANDARD SPECIFICATION CIVIL & STRUCTURAL WORKS DEMOLITION AND DISMANTLING

C-SPC-111

0	26.02.22	ISSUED FOR USE AS STANDARD	MK	ADh	RKB	AD	
Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by	Approved by	



**STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS
DEMOLITION AND DISMANTLING**

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ABBREVIATIONS

C&D	:	Construction & Demolition
GI	:	Galvanized Iron
RA	:	Recycled Aggregates
RCC	:	Reinforced Cement Concrete



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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 segregated as serviceable or unserviceable materials and kept in safe custody until handed over to the Engineer-in-Charge.
- 2.3 Contractor shall follow the principle of selective demolition by sequencing the demolition activities in such a way that the non-structural materials like window/ door frames, pipes, tiles, bricks, asphalt, ceramics, etc. shall be removed first before starting the main demolition activities.
- 2.4 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.
- 2.5 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 works.
- 3.3 Temporary enclosures/ barricading made out of GI sheets, fencings, danger lights, warning tapes, 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 equipments/ 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.

3.9 Dismantling of equipments/ instruments and such other fixtures shall be done with utmost care with proper tools & tackles and shall be stacked separately. Their disposal or retainment shall be as per the directions of Engineer-in-Charge.

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 Necessary work permits (as applicable) shall be obtained prior to start of demolishing/ dismantling activities.

4.4 Demolition of any structure shall be carried out in the sequence reverse to that followed at the time of its construction.

4.5 Dismantling shall be done in a systematic manner. All elements including equipments/ instruments shall be carefully removed without causing any damage.

4.6 Blasting in any form shall not be permitted. However, techniques like pneumatic/ hydraulic breakers, diamond cutting, etc. shall be utilized to the maximum possible extent.

4.7 Chipping of concrete/grout shall be done with precision by chiseling. The finished surfaces shall be made true to the requisite size and shape.

4.8 Pockets/holes of specified size shall be made/ cut by drilling/ chiseling/ core cutting/ diamond cutting, etc.

4.9 Cut-outs in RCC Slab/ wall shall be made by vibration-less spark-free mechanical means like core-cutting, wet cutting by diamond wall saw system, etc.

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 C&D WASTE MANAGEMENT

Contractor shall make all possible efforts to reduce, reuse and recycle Construction & Demolition (C&D) waste. A comprehensive Waste Management Plan shall be submitted to the Engineer-in-Charge for review. As a social responsibility, contractor shall promote and spread awareness about recycling of C&D waste that can act as a perfect substitute for depleting natural aggregate resources, shortage of dumping sites, increasing transportation & disposal cost, stringent regulations for extracting new materials and environmental pollution as a whole. Recycling equipments like jaw/ cone crushers, shaft impactors, magnetic separators, vibrating screens, washing equipments, etc. are now easily available in the market. Recycled Aggregates (RA) both coarse & fine can be used in PCC, pavements, drains, plastering, making bricks, kerb stones, pavement blocks and for soil stabilization. Residual concrete can be recycled in Ready Mixed Concrete Plants by installing Recycling Drum and rebars extracted from C&D waste can be used in drains, pavements, chairs, spacers, stirrups, etc.

8.0 PAYMENT

8.1 General

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

8.2 Masonry/Concrete Works (Demolition)

8.2.1 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.

8.2.2 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.

8.3 Excavation & Backfilling

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

8.4 Chipping of Concrete Works

8.4.1 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.

8.4.2 The rate for chipping shall include supply of all labour, tools and tackles, necessary safety measures, scaffolding, chiseling, 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.

8.5 Making Pockets/Holes in Concrete Works and Cut-outs in RCC Slab/ Wall

8.5.1 Payment for Pockets/ holes shall be made on the basis of number (Each) of pockets/ holes of sizes upto & inclusive of 200x200x500mm deep, made or cut in the concrete works at all depths & heights.

8.5.2 Payment for cut-outs in RCC slab/ wall shall be made in CuM on the basis of plan/ elevation area for a thickness upto & inclusive of 400mm at all depths & heights.

8.5.3 The rate for making pockets/holes and cut-outs shall include supply of all labour, tools & tackles, necessary safety measures, scaffolding, chiseling, drilling, core/ diamond cutting, diamond wall saw system, handling, cutting or relocating reinforcement bars, cleaning, disposal of all unserviceable material etc. all complete as directed.

8.6 Dismantling of Structural Steel Works



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- 8.6.1 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.
- 8.6.2 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.
- 8.7 Dismantling of Roof & Wall Sheeting
- 8.7.1 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.
- 8.7.2 The rate for dismantling shall include supply of all labour, tools and tackles, equipment's, 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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Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by	Approved by



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ABBREVIATIONS

BIS	:	Bureau of Indian Standards
DPC	:	Damp Proof Course
FGL	:	Finished Ground Level
IS	:	Indian Standard
RCC	:	Reinforced Cement Concrete



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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

1. IS:73 Paving bitumen - specification
2. IS:383 Specification for coarse and fine aggregates from natural sources for Concrete
3. IS:6313 Code of practice for Anti-termite measures in buildings

2.2 PLECO specifications

C-SPC-102: Materials

C-SPC-104: Plain and Reinforced Cement Concrete

3.0 MATERIALS

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

4.0 GENERAL REQUIREMENTS

The Contractor shall test the materials, wherever 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 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 PLECO Specification No. C-SPC-102.

5.3 Procedure for Treatment

5.3.1

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

5.3.2 Site Preparation

Prior to start of Anti Termite 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

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 300 mm, with emulsion @ 7.5 litres/m² of the vertical surface of the substructure (i.e. $7.5 \times 0.3 = 2.25$ litres/meter of perimeter) for each side. The treatment shall be given after ramming of each layer of soil, by rodding the earth at 150 mm 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 750 mm, 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 mm to 75 mm deep at 150 mm centre, both ways, shall be made on the surface with 12 mm 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 sub-grade has been laid.
- b) Treatment of Junctions of plinth filling and wall/column faces shall be done after making a small channel 30 mm x 30 mm, by making rod holes 150 mm 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 150 mm and to depth of 300 mm. 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. $7.5 \times 0.3 = 2.25$ 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 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 VG10 conforming to IS:73.

6.3 Mixing and Laying

The bitumen shall be heated till it melts. 3% kerosene may be added if required. Sand shall be thoroughly mixed with bitumen (8% to 10% by volume) 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 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 75 mm.

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 BREAKING PILE HEADS

8.1 Scope

This specification covers procedure for breaking pile heads of RCC piles.

8.2 Procedure

- 8.2.1 Head of already cast/ driven RCC piles shall be broken after 28 days of casting up to a length and elevation as shown on the drawing by chiseling or by approved mechanical means 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 broken.

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 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 & PLECO specification shall be same as that for the pile.

9.2.2 Reinforcement shall be of the same grade 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 or by approved mechanical means upto a length of 800 mm.

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 and 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 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 150 mm 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 specification of sand to be used for filling, reference shall be made to PLECO Specification No. C-SPC-002.

11.2 Filling shall be carried out in layers not exceeding 150 mm 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 PLECO Specification No. C-SPC-102.

12.2 The 40 mm thick Damp Proof Course shall consist of plain cement concrete of the same grade as used for RCC work.

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 DPC shall be laid in layers of 20 mm 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 VG10 conforming to IS:73 shall be applied over it at the rate of 1.7 kg/m². Over this, the second layer of 20 mm thick concrete shall be laid and cured as described in case of the first layer and two coats of hot bitumen 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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0	26.02.22	ISSUED FOR USE AS STANDARD	MK	ADh	RKB	AD	
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ABBREVIATIONS

IS	:	Indian Standard
ASTM	:	American Society for Testing and Materials
BS	:	British Standards



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1.0 MATERIALS

1.1 Cement

Cement shall conform to 'Technical Specification for Civil and Structural Works'

1.2 Sand

Sand for plaster and pointing shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these and shall conform to IS: 1542. Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of silt, clay balls or pellets. Sand shall not contain harmful impurities such as iron pyrites, coal particles, lignite, mica shale etc in such form or in quantities as to affect adversely the hardening, strength or durability of the mortar.

The maximum quantities of clay, fine silt, fine dust and organic impurities in the sand shall not exceed the following limits:

1. Clay, fine silt and fine dust when determined in accordance with IS 2386 (Part 2): In natural sand or crushed gravel sand & crushed stone sand: Not more than 5% by mass
2. Organic impurities when determined in accordance with IS 2386 (Part 2): Colour of the liquid shall be lighter than that indicated by standard specified in IS 2386 (Part-2)

Grading of sand for use in Plaster shall conform to IS 1542 (as below)

IS sieve designation	Percentage passing
10mm	100
4.75mm	95 to 100
2.36mm	95 to 100
1.18mm	90 to 100
600 micron	80 to 100
300 micron	20 to 65
150 micron	0 to 50

1.3 Water

Water for plastering and pointing shall conform to 'Technical Specification for Civil and Structural Works'.

1.4 Cement Mortar

Preparation of cement mortar shall conform to 'Technical Specifications of Civil and Structural Work' unless otherwise mentioned.

1.5 Cement Mortar with Waterproofing Compound

Waterproof compound shall conform to IS: 2645 of approved make. The compound shall be well mixed with dry cement in the proportion of 3% by weight or as recommended by manufacturer. Further procedures for preparation of cement mortar shall be as per clause No.1.4

1.6 Gypsum Plaster

Gypsum plaster (Calcium Sulphate Hemi-hydrate - $\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$) is obtained as a result of calcinations of raw Gypsum (Calcium Sulphate Di hydrate - $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$), in an automatic kettle under controlled temperature conditions. The material shall conform to IS 2542 (Part 1)- 1978 (for physical characteristics) and IS 2547 (Part 11)-1976 (for chemical characteristics).

2.0 WORKMANSHIP

2.1 Preparation of Background Surface

The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surfaces shall be roughened by wire brushing or hacking for non-hard and hard surfaces respectively. Projections on surfaces shall be trimmed wherever necessary to get even surfaces. In case of brick/stone masonry, raking of joints shall be carried out wherever necessary. The masonry shall be allowed to dry out for sufficient period before carrying out the plaster work. The masonry shall not be soaked but only damped evenly thereafter before applying the plaster.

In case of concrete work, projecting blurs of mortar formed due to the gaps of joints in shuttering shall be removed. Such surface shall be scrubbed clean with wire brushes. The surface shall be pock marked with a pointed tool at spacing of not more than 50 mm centers, the pocks being made not less than 3 mm deep to ensure a proper key for the plaster. The surface shall be washed off and cleaned of all oil, grease etc. and well wetted before the plaster is applied.

2.2 Sequence of Operations

For external plaster, the plastering operations shall be started from the top floor and carried downwards. For internal plaster, the plastering may be started wherever the building frame, roofing, and brick work are ready.

The surfaces to be plastered, shall first be prepared as described in 'Preparation of background surface' in clause no 2.1

The first under layer shall then be applied to ceilings. After the ceiling plaster is complete and scaffolding for the same removed, plastering on wall shall be started.

After a suitable time interval as detailed under various types of plaster in subsequent paras, depending upon the type of mortar, the secondary layers if required shall be applied. After a further suitable time interval as detailed under various type of plaster in subsequent paras, the finishing coat shall be applied first to the ceiling and then to the walls.

Plastering of cornices, decorative features, etc. shall be completed before the finishing coat is applied. Unless otherwise specified corners and edges shall be rounded off to a radius of 25mm, such rounding off shall be complete along with the finishing coat to prevent any joint marks showing out later.

2.3 Scaffolding/Staging

Scaffolding/staging for plastering/pointing shall be as per 'Technical Specification for Civil and Structural Work'.

2.4 Damage Rectification

Any cracks, damages, any part of work which sound hollow when tapped or found damaged or defective otherwise shall be cut out in rectangular shape and redone as directed by Engineer-in-charge.

2.5 Chicken Wire Mesh

150mm wide, closely knit , 20 gauge chicken wire mesh stretched tight and fixed with G.I. "U" type nails shall be provided at all the brick/stone masonry and RCC joints.

3.0 PLAIN CEMENT PLASTER

3.1 Preparation of Mortars

The mortars of specified mix shall be used as per the specifications of 'Cement Mortar' described in clause no. 1.4

3.2 Application of Plaster

3.2.1 One Layer Plaster Work

To ensure even, specified thickness, plaster of 150 mm x 150 mm shall be first applied horizontally and vertically at not more than 2 meter interval over the entire surface to serve as gauges. The surface of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall be brought to true surface by working with a wooden straight edge reaching across the gauges with small upward and sideways movements at a time. Finally the surface shall be finished off true with a trowel or wooden float to obtain a smooth texture. Excessive trowelling or overworking the float shall be avoided. All comers, arises. angles and junctions shall be truly vertical/ horizontal and shall be carefully finished. Rounding or chamfering of comers, arises, junctions etc. shall be carried out with proper templates to the size required.

In suspending the work, the plaster shall be left. cut clean to line, both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scrapped clean and wetted before plastering the adjoining area. Plastering work shall be closed on the border of the wall and nearer than 150 mm to any comers or arises and shall not be closed on the body of the features such as plaster bands, cornices nor at the comers or arises.

3.2.2 Two Layer Plaster Work

3.2.2.1 First or Under Layer

The first or underlayer of the specified thickness shall be applied as described in clause no.

3.2.1. Before the first coat hardens, surface of it shall be beaten up by edges of wooden tapers and close dents shall be made on the surface. The subsequent coat shall be applied after this coat has been allowed to set for 3 to 5 days depending upon weather conditions. The surface shall not be allowed to dry during this period.

3.2.2.2 Second or Finishing Layer

The second layer shall be complete to the specified thickness in the same manner as for first layer.

3.3 Curing

Curing shall be started 24 hours after finishing the plaster. The plaster shall be kept wet for a period of 7 days. During this period the plaster shall be suitably protected from all damages at the contractor's expense by such means as approved by the Engineer-in-charge. The date of execution of plastering shall be marked on the plastering to ensure the proper duration of curing.

4.0 SAND FACE PLASTER

4.1 Preparation of Mortar

The mortar of specified mix shall be used as per the specifications of cement mortar described in clause no. 1.4.

4.2 Application of Plaster

Sand face plaster shall consist of 13 mm thick (1 cement: 4 coarse sand by volume) underlayer and 7 mm thick (1 cement:2 coarse sand, granule size 2 to 2.5mm by volume) top layer. Application of plaster shall be as described in 'two coat plaster work' in clause no. 3.2.2.

The surface of the sand face plaster shall be finished rough with sponge or as directed by the Engineer-in-charge.

4.3 Curing

Curing shall be described in clause 3.2

5.0 EXPOSED AGGREGATE FINISH

5.1 Preparation of Mortar

The mortar of specified mix shall be used as per the specifications of cement mortar described in clause no. 1.4. White and coloured marble chips shall be of 6 mm to 12mm size out of Makrana/Ambaji, grade I or Dongri Chittor Brown/Rajnagar/Abu green grade-I quality as specified. Marble dust shall be obtained from crushing hard marble stone.

5.2 Application of Plaster

Exposed aggregate finish plaster shall consist of 12mm thick plain cement plaster underlayer (1 cement: 4 coarse sand by volume) finished rough and 20 mm thick top layer. Underlayer shall be applied in accordance with 'One layer plaster work' described in clause no. 3.2.1.

Top layer shall be 20 mm thick admixture of white cement and grey cement (mix. ratio 1:1 by volume) mixed with white/coloured marble chips/pebbles of 6mm to 9mm nominal size as per item description. Mix ratio shall be 1 cement: 1 marble chips/pebbles by volume. Marble dust @ 15% by volume shall be added to the admixture. The pebbles to be used shall be well washed and drained. The admixture shall be thrown wet on to the under layer while it is still plastic using strong whipping motion at right angles to the face of the wall. One coat of neat cement slurry @ 2.75 kg cement per square meter of area shall be applied on to the under layer to receive the top layer. The whole plastering shall be laid in panels of maximum 1.2 M x 1.2M or as per drawing with 12mm x 20mm grooves in between formed by holding removable wooden batons of 12mm x 25mm size over the under layer.

Loose mortar etc. on the top surface shall be cleaned/removed by brushing/washing/spraying with water jet after initial setting of mortar.

5.3 Curing

Curing shall be as described in Clause no. 3.3

6.0 GYPSUM PLASTER

6.1 Preparation of Mortar

The powder (gypsum plaster) should be mixed with clean water preferably in clean plastic buckets to avoid mixing with impurities, ensuring thorough mixing by help of mixing rod so as to avoid formation of lumps and unmixed residues. The water to plaster ratio should be maintained as per manufacturer's specification.

6.2 Application of Plaster

Gypsum plaster can be applied in thickness range of 3-25 mm. However, while applying gypsum plaster in thickness excess of 12-13 mm, it has to be applied in layers of 10mm each. Similar will be

the application process for RCC columns. However, it is not recommended to go beyond a thickness of 13mm for ceilings.

6.3 Curing

There is no requirement of curing. Gypsum plaster dries in 3 days, after which painting can be done directly over the finished surface.

7.0 POINTING

Pointing shall be of the type specified such as flush, cut or weather struck, raised and cut etc.

7.1 Preparation of Base Surface

The joints shall be raked to such a depth that the minimum depth of the new mortar measured from either the sunk surface of the finished pointing or from the edge of the brick shall be less than 20 mm.

7.2 Mortar

Mortar shall be in accordance with the specifications of cement mortar described in clause no. 1.4

7.3 Application of Mortar and Finishing

The mortar shall be pressed into the raked out joints with a pointing trowel according to the type of pointing specified. The mortar shall be spread over the corner edges or surfaces of the masonry. The pointing shall then be finished with the pointed tool. The superfluous mortar shall be cut off from the edges.

7.4 Flush Pointing

The mortar shall be pressed into joints and shall be finished off flush and leveled. The edges shall be neatly trimmed with trowel and straight edges.

7.5 Cut or Weather Struck Pointing

The mortar shall first be pressed into joints. The top of the horizontal joints shall then be neatly pressed back by about 15 mm with the pointing tool so that the joint is sloping from top to bottom. The vertical joint shall also be similarly pointed. The junctions of vertical joints with the horizontal joints shall be at true right angles in case of brick & coursed rubble masonry.

7.6 Raised and Cut Pointing

This type of pointing shall project from the wall facing with its edges cut parallel so as to have a uniformly raised band about 6 mm and width 10 mm more as directed. The pointing shall be finished to a smooth but hard surface.

7.7 Curing

Curing shall be as described in clause no. 3.3

8.0 MEASUREMENT & RATE

The description of each item, unless otherwise mentioned includes wherever necessary all material, conveyance and delivery, handling, loading/unloading, storing, fabrication, hoisting, all labour for finishing the work, preparation of background surface, staging/scaffolding, application, finishing, removal of staging/scaffolding, curing and other incidental charges. The rate for item rate tenders shall be for all heights and at all heights of work.

8.1 Plastering & Pointing

Thickness of the plaster shall be the minimum thickness at any point on a surface and shall be exclusive of the key i.e. grooves or open joints in masonry. No extra payment shall be allowed for extra thickness of plaster done by contractor, drip moulds, rounding of edges etc.

For item rate tenders, all plastering/pointing shall be measured in square meters unless otherwise specified. Length, breadth and height shall be measured correct to 0.1 meters. Soffits of stairs shall be measured as plastering on ceiling. Ceiling with projected beams shall be measured over beams and plastered side of beam shall be measured and added on ceiling.

Deductions and additions shall be made in the following manner.

- a) No deductions shall be made for ends of joists, beams, posts, openings not exceeding 0.5 Sq. M. area and no addition shall be made for reveals, jambs, soffits etc. of these openings mortar finish to plaster around ends of joists, beams, posts etc.
- b) Deductions for openings exceeding 0.5 Sq. M but not exceeding 3 Sq. M each shall be made as follows and no addition shall be made for reveals, jambs, soffits etc. of these openings.
 - i) When both faces of wall are plastered with same type of plaster, deduction shall be made for one face only.
 - ii) When two faces of wall are plastered with different types of plasters or if one face is plastered and the other pointed, deduction shall be made from the plaster or pointing on the side of frame for door, window etc. on which width of reveals is lesser, but no deduction shall be made on the other side. Where widths of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made.
 - iii) When only one face is plastered, full deduction shall be made from plaster if width of reveal on plastered side is lesser. But if widths of reveal on both sides are equal or more on un-plastered side, no deduction shall be made.
- c) In case of openings of area above 3 Sq. M each, deduction shall be made for openings but jambs, soffits, and sills shall be measured.



**STANDARD SPECIFICATION
FOR
WHITE/ COLOUR WASHING, DISTEMPERING,
PAINTING AND POLISHING
C-SPC-157**

0	27.02.22	ISSUED FOR USE AS STANDARD	MK	ADh	RKB	AD	
Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by	Approved by	



**STANDARD SPECIFICATION FOR
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ABBREVIATIONS

IS : Indian Standard
ASTM : American Society for Testing and Materials
BS : British Standards



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1.0 GENERAL

Reference shall be made to the following Indian Standards for further information etc. not covered in the specification. In case of conflict/contradictions provisions of the specification shall override.

IS 6278	Code of practice for white washing and colour washing.
IS 2395	Code of practice for painting concrete, masonry and plaster surfaces. Specification for building limes.
IS 712	Specification for Ultramarine blue for paints. Specification for whitening for paint and putty. Distemper (dry), colour as required.
IS 55	Distemper (Oil Bound), colour as required. Specification for plastic Emulsion paint for interior use.
IS 63	Code of practice for finishing of wood, and wood based materials. Part-1 : Operations & workmanship
IS 427	Code of practice for finishing of wood, and wood based materials. Part-2 : Schedule
IS 428	Cement paint, colour as required.
IS 5411	Code of practice for painting non ferrous metals in buildings. Part-1 : Pretreatment
IS 2338 Part-1	Code of practice for painting non ferrous metals in buildings. Part-2 : Painting
IS 2338 Part-2	Code of practice for painting ferrous metals in buildings. Part-1 : Pretreatment
IS 5410	Code of practice for painting ferrous metals in buildings. Part-1 : Painting
IS 2524 Part-1	Brushes, paints and varnishes, flat.
IS 2524 Part-2	Brushes, sash, tool, for paints and varnishes.
IS 1477 Part-1	Ready mixed paint, brushing, grey filler enamels for use over primers. Paste filler for colour coats.
IS 1477 Part-2	Wood filler, transparent liquid.
IS 384	Ready mixed paint, aluminium brushing priming water resistant for wood work.
IS 486	Code of practice for white washing and colour washing.
IS 110	Code of practice for painting concrete, masonry and plaster surfaces. Specification for building limes.

IS 426	Specification for Ultramarine blue for paints. Specification for whiting for paint and putty. Distemper (dry), colour as required.
IS 345	Distemper (Oil Bound), colour as required. Specification for plastic Emulsion paint for interior use.
IS 110	Ready mixed paint, brushing, grey filler for enamels for use over primers
IS 106	Ready mixed paint, brushing, priming for enamels, for use on metals.
IS 2395 Part- I	Painting of concrete, masonry & plastered surface, code of practice Part- I : Operations and workmanship
IS 2395 Part-2	Painting of concrete, masonry & plastered surface, code of practice Part-2 : Schedule

All materials required for the execution of painting work shall be obtained direct from approved manufacturers and shall be brought to the site in makers drums, bags etc. with seals unbroken.

In case of ready mixed paints, thinning if necessary, the brand of thinner shall be as per recommendations of the manufacturer.

Paint shall be applied by brushing or spraying. The brushing operations are to be adjusted to the spreading capacity advised by the manufacturer. During painting, every time after the paint has been worked out of the brush bristles, the bristles shall be opened up by striking the brush suitably.

Spray machine used may be of high pressure type or low pressure depending on the nature and location of work. After work, the brushes shall be completely cleaned of paint and shall be hung in a thinner if intended to be used afterwards. The spray guns shall be cleaned thoroughly after every break in work. The paint containers, when not used shall be kept close and free from air.

After the finishing of work, the adjacent surfaces not intended to be washed/distempered/painted/polished shall be thoroughly cleaned of all paint patches and shall be finished in accordance with surface finishing of such surfaces.

2.0 WHITE WASHING

White washing in general shall conform to IS 6278.

2.1 Workmanship

2.1.1 Scaffolding

Wherever scaffolding is necessary, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be white/ colour washed. For white washing of ceiling, proper stage scaffolding shall be erected.

2.1.2 Preparation of Surfaces

The surface shall be thoroughly cleaned of all dirt, dust, mortar dropping and other foreign matter before white wash is to be applied. Surfaces already white/colour washed shall be broomed down to remove all dust, dirt, loose scales of lime wash or other foreign matters.

All damaged portions of the surface plaster shall be removed to full depth of plaster in rectangular patches and plastered again after raking the joints in masonry properly. Such portions shall be wetted and allowed to dry before any operation.

All holes, cracks, patches etc. not exceeding 0.1 sq. m. in area shall be made good with material similar to that of the surface. Surfaces affected by efflorescence, moss, fungi, algae, lichen etc. shall be treated in accordance with IS: 2395.

2.1.3 Preparation of White Wash

The fat lime conforming to IS: 712 shall be slaked at site and shall be mixed and stirred with about 5 litres of water for 1 kg. of unslaked lime to make thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 4 kg of gum dissolved in hot water shall be added to each cubic metre of lime cream. Approved quality ultramarine blue conforming to IS 55 @ 3 gram per kg. of lime shall also be added to the solution. The whole solution shall be stirred thoroughly before use.

2.1.4 Application

White wash shall be applied with "MOONJ" brush to the specified number of coats. The operation for each coat shall consist of stroke of the brush from the top to down wards, another from the down to upwards over the first stroke, similarly one stroke horizontally from right and another stroke from the left. Each coat shall be allowed to dry before the next coat is applied. The white washing on ceiling should be done prior to that on walls.

2.1.5 Protective measures

Surfaces of doors, windows, floors etc. which are not to be white washed shall be protected from being splashed upon. Such surfaces shall be cleaned of white wash splashed if any.

3.0 COLOUR WASHING

3.1 Workmanship

3.1.1 Scaffolding

Wherever scaffolding is necessary, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be white/ colour washed. For white washing of ceiling, proper stage scaffolding shall be erected.

3.1.2 Preparation of Surface

Surface shall be thoroughly cleaned of all dirt, dust, mortar dropping and other foreign matter before white wash is to be applied. Surfaces already white/colour washed shall be broomed down to remove all dust, dirt, loose scales of lime wash or other foreign matters.

All damaged portions of the surface plaster shall be removed to full depth of plaster in rectangular patches and plastered again after raking the joints in masonry properly. Such portions shall be wetted and allowed to dry before any operation.

All holes, cracks, patches etc. not exceeding 0.1 sq. m. in area shall be made good with material similar to that of the surface. Surfaces affected by efflorescence, moss, fungi, algae, lichen etc. shall be treated in accordance with IS: 2395.

3.1.3 Preparation of Colour Wash

Sufficient quantity of colour wash enough for the complete job shall be prepared in one operation to avoid any difference in colour. The basic white wash solution shall be prepared in accordance with

clause 2.1.3. Mineral colours of approved shade and quality not affected by lime shall be added to the white wash solution in proportions as directed by Engg.in-charge Solid lumps etc. in the colour powder shall be ground to fine powder, sieved and mixed evenly and thoroughly to the white wash solution.

3.1.4 Application of Colour Wash

Colour wash shall be applied with "MOONJ" brush to the specified number of coats. The operation for each coat shall consist of stroke of the brush from the top to down wards, another from the down to upwards over the first stroke, similarly one stroke horizontally from right and another stroke from the left. Each coat shall be allowed to dry before the next coat is applied. The white washing on ceiling should be done prior to that on walls.

3.1.5 Protective Measure

Surfaces of doors, windows, floors etc. which are not to be white washed shall be protected from being splashed upon. Such surfaces shall be cleaned of white wash splashed if any.

4.0 DRY DISTEMPERING

4.1 Workmanship

4.1.1 Scaffolding

Wherever scaffolding is necessary, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be white/ colour washed. For white washing of ceiling, proper stage scaffolding shall be erected.

4.1.2 Preparation of Surface

The surface shall be thoroughly brushed free from dust, dirt, grease, mortar droppings, other foreign matter and shall be made smooth by sand papering.

In case of distempering over existing distempered surface, the existing distempering shall be scraped by steel scrapers leaving a clean surface.

All nails shall be removed. Pitting in plaster shall be made good with plaster-of-paris mixed with dry distemper of colour to be used. The surface then shall be rubbed down again with a fine grade sand paper and made smooth. A coat of distemper shall be applied over the patches. The surface shall be allowed to dry thoroughly before the regular coat of distemper is allowed.

The surface affected by moss, fungus, algae, efflorescence shall be treated in accordance with IS: 2395.

4.1.3 Priming Coat

A priming coat of whiting conforming to IS 63 shall be applied over the prepared surface. The priming coat shall be prepared by mixing 2.5 kg. of whiting and one litre of glue solution (prepared by mixing 250 gm. glue conforming to IS: 852 with boiling water) together and placing it in a covered vessel with enough water to cover the mixture which shall be left to cool until it becomes a jelly.

Priming coat shall be applied with "MOONJ" brush to the specified number of coats. The operation for each coat shall consist of stroke of the brush from the top to down wards, another from the down to upwards over the first stroke, similarly one stroke horizontally from right and another stroke from the left. Each coat shall be allowed to dry before the next coat is applied. The white washing on ceiling should be done prior to that on walls.

4.1.4 Preparation of Distemper

The dry distemper of approved shade and quality conforming to IS: 427 shall be stirred slowly in clean warm water using 0.6 litres of water per kg. of distemper. It shall be allowed to settle for at least 30 minutes before applying. The mixture shall be well stirred before and during use to maintain an even consistency.

4.1.5 Application of Distemper

After the priming coat has dried for at least 48 hours, the surface shall be lightly sand papered and dusted off avoiding rubbing off of the priming coat. Prepared distemper shall then be applied in minimum two coats with proper distemper brushes in horizontal strokes immediately followed by vertical ones which together shall constitute one coat. The subsequent coats shall be applied only after the previous coat has dried. The finished surface shall be even and uniform without patches, marks, distemper drops etc. The application of a coat in each room shall be finished in one operation. After each day's work, brushes shall be thoroughly washed in hot water and hung down to dry.

4.1.6 Protective Measure

Surfaces of doors, windows, floors etc. which are not to be white washed shall be protected from being splashed upon. Such surfaces shall be cleaned of white wash splashed if any.

5.0 OIL BOUND DISTEMPERING

5.1 Workmanship

5.1.1 Scaffolding

Same as in clause no. 2.1.1

5.1.2 Preparation of Surface

Preparation of surface shall in general be in accordance with clause no. 4.1.2 except that any unevenness shall be made good by applying putty made of plaster of Paris mixed with water including filling up the undulation and then sand papering the same after it is dry.

5.1.3 Primer Coat

The primer coat shall be alkali resistant primer or distemper primer and shall be of the same manufacture as oil bound distemper.

If the wall surface plaster has not dried completely, alkali resistant primer otherwise distemper primer shall be applied. The mixture of alkali resistant primer shall be prepared as per approved manufacturer's instructions.

The application of primer coat shall be in accordance with 2.1.4

5.1.4 Preparation of Oil Bound Distemper

The distemper shall conform to IS: 428 and shall be diluted with water or any other prescribed thinner recommended by the manufacturer.

5.1.5 Application of Distemper

After the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered and dusted off avoiding rubbing off of the primer coat. Minimum two coats of distemper shall be applied with brushes in horizontal strokes followed by immediate vertical strokes which together shall constitute one coat. The subsequent coats shall be applied after at least 24 hours between consecutive coats to permit proper drying of the preceding coat. The finished surface shall be even and uniform

without patches, brush marks drops etc. Application of a coat in each room shall be finished in one operation. 14 cm double bristled distemper brushes shall be used. After each day's work brushes shall be thoroughly washed in hot water with soap solution and hung down to dry.

5.1.6 Protective Measures

Same as in clause no. 2.1.5

6.0 WATERPROOF CEMENT PAINT

6.1 Workmanship

6.1.1 Scaffolding

Same as in clause 2.1.1

6.1.2 Preparation of Surface

Preparation of surface shall be in accordance with clause no. 2.1.2. The surface so prepared shall be thoroughly wetted with clean water before the paint is applied.

6.1.3 Preparation of Paint

Waterproof cement paint of approved make shall be mixed with water and stirred to obtain a thick paste which shall then be diluted to brushable consistency. The proportion of mixture shall be as per manufacturer's recommendation. The paint shall be mixed in such quantity which can be used up within an hour of mixing to avoid setting and thickening of the paint.

6.1.4 Application of Paint

The surface shall be treated with minimum two coats of waterproof cement paint. No less than 24 hours shall be allowed between two coats and subsequent coats shall be applied only after the preceding coat has become hard to resist marking by subsequent brushing.

The finished surface shall be even and uniform in shade without patches, brush marks, paint drops etc. Cement paints shall be applied with a brush with relatively short stiff hog or fibre bristles.

6.1.5 Curing

Curing shall be started after the paint has hardened. Curing shall be done by sprinkling with water two or three times a day. This shall be done between coats and for at least two days following the final coat.

6.1.6 Protective Measure

Same as in clause in 2.1.5

7.0 PLASTIC EMULSION PAINTING

7.1 Workmanship

7.1.1 Scaffolding

Same as in clause 2.1.1

7.1.2 Preparation of Surface

Same as in clause 5.1.2 under specification of oil bound distempering.

7.1.3 Preparation of Paint

Plastic emulsion paint shall conform to IS 5411 (Part-1) and shall be of approved shade. Preparation of paint shall be as per manufacturer's instructions.

7.1.4 Application of Paint

The paint mix shall be continuously stirred while applying for maintaining uniform consistency. Number of coats shall be as specified. The painting shall be laid evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard at first, then brushing alternately in opposite direction 2 to 3 times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks, no hair marks no clogging of paint puddles shall be permitted. The full process of crossing and laying off will constitute one coat. The paint shall be applied by means of brush or roller.

Before starting painting with plastic emulsion paint, the prepared surface shall be treated with two coats of primer consisting of cement, primer, whiting and plastic emulsion paint shall start only after the preceding coat has become sufficiently hard to resist brush marking. Subsequent coats of plastic emulsion paint shall also be started after the preceding coat is dried by evaporation of water content.

The surface on finishing shall present a flat, velvety smooth finish, even and uniform shade without patches, marks, paint drops etc.

7.1.5 Precautions

A. Brushes shall be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush. Old brushes, if used shall be completely dried of turpentine/oil paints by washing in warm soap water.

B. No oil base putties shall be used in filling cracks/holes.

C. Washing of painted surface shall not be done within 3-4 weeks of application.

7.1.6 Protective Measures

Same as in clause 2.1.5

8.0 ACRYLIC COPOLYMER AGGREGATE FINISH

8.1 Material

It shall be an acrylic based textured wall coating consisting of quartz and silica aggregate, inorganic pigments and other additives to form a crack free, flexible, tough, waterproof coating.

8.2 Preparation of Surface

The surface to be coated shall be cleaned and all dirt, dust, grease and loose particles shall be removed. Any old textured surface shall be removed with removing agent as per manufacturer's instructions.

8.3 Application

Bonding agent and water shall be mixed first. Then the flakes/granules shall be added and mixed thoroughly and kneaded till no lumps are found. The dough shall be left for 20-30 minutes before starting application. The bonding agent, flakes/granules and water shall be mixed in different ratios for different finishes as per manufacturer's specifications.

The first application shall be by steel trowel. It shall be smoothened, if the specified finish requires, by a plastic trowel.

9.0 ACRYLIC BASED EXTERIOR EMULSION PAINT

9.1 Material

It shall be an acrylic based wall coating for exterior surfaces consisting of pure acrylic resin and additives to form a crack free, flexible, tough, alkali resistant, UV resistant waterproof coating.

9.2 Preparation of Surface

The surface to be coated shall be cleaned and all dirt, dust, grease and loose particles shall be removed. Any old paint shall be removed with removing agent as per manufacturer's instructions. The surface affected by moss, fungus, algae, efflorescence shall be treated in accordance with IS: 2395.

9.3 Application

A primer coat of similar shade shall be applied as per manufacturer's specifications. The paint shall be stirred to a uniform consistency. Two coats shall be applied over the primer coat by brush or roller. Each coat shall be applied after the previous coat has dried completely. The coverage of paint and application shall be strictly as per manufacturer's specifications.

10.0 PAINTING OF WOOD WORK

10.1 Preparation of surface

Preparation of wood surface shall conform to IS: 2338 (Part-I) in general. All woodwork shall be dry and free from any foreign matter. Nails shall be punched well below the surface. The surface shall be smoothened off with abrasive paper used across the grain prior to painting, with the grain prior to the staining. Any knots, resinous or bluish sap wood, cutting out of which is not justified shall be covered with red lead conforming to IS: 103.

Plywood and block board shall be treated in the same manner as for wood work.

Particle board's surface shall be filled with a thin brushable filler and finished as for solid wood.

10.2 Priming

Priming shall be in accordance with IS: 2338 (Part I and II). Dirt or any other extraneous material on the surface shall be removed and the priming shall be applied by brushing.

Priming shall be done on all exposed and unexposed surfaces. Unless specified otherwise all joinery work intended to be painted shall receive atleast 2 coats of primer. Type of primer shall be in accordance with Table-I and Table-2 of IS: 2338 (Part-II).

10.3 Stopping and Filling

Stopping and filling shall be done after priming. Stopping shall be made to the consistency of stiff paste and shall be used to fill holes and cracks. Filler shall be used to level up slight irregularities of the surface. Filler shall be applied with a putty knife and subsequently rubbed down to a level surface with abrasive paper.

The filler coat shall be allowed to fully flatten and harden before subsequent coat is applied.

10.4 Application of Undercoat

Under coat shall be applied after the surface has been primed, stopped and filled, and rubbed down to a smooth surface. Under coat may be brushed or sprayed. After drying the coat shall be carefully rubbed down and wiped clean before the next coat is applied.

The type of undercoat shall be depending upon the finishing and in accordance with Table I and Table-2 of IS: 2338 (Part II).

- 10.5 Finishing
- The finishing paint shall be as specified and shall be applied either by the brush or by spraying.
- Reference shall be made to the Table-I and Table-2 of IS: 2338 (Part-II)
- 10.6 Application of Clear Finishes
- For the application of clear finishes, the following procedures shall generally be adopted in accordance with IS: 2338 (Part-I)
- A. Filling
 - B. Staining
 - C. Sealing
 - D. Finishing
- 10.6.1 Filling
- Fillers shall be applied to prevent the excessive penetration of the finish to the surface for obtaining a smooth finish. Fillers shall be conforming to IS: 345.
- Fillers shall be heavily applied to the wood surface by hand, using hessian or jute rag across the grain. It shall be rubbed when still wet to get better penetration. After 5-10 minutes it shall be wiped off by hand across the grain followed by a light wipe with the grain. The filled surface shall be dried preferably over night and smoothened with abrasive paper.
- 10.6.2 Staining
- 10.6.2.1 Spirit Stains
- Spirit stains are solutions of spirit soluble dyes in Industrial methylated spirit.
- 10.6.2.2 Oil Stains
- Oil stains are solutions of oil soluble dyes in linseed oil, but, usually consist of insoluble, semi-transparent pigments ground in linseed oil and thinned with turpentine or other solvent.
- 10.6.2.3 Preparation of Wood for Staining
- Surface intended for staining shall be kept scrupulously clean and free from greasy finger marks. It shall be prepared by careful smoothing with fine abrasive paper used in the direction of the grain. Small cracks/nail holes shall be stopped with plastic wood/fine plaster of Paris. The stopping shall be rubbed down with fine abrasive paper when hard and touched with a thinned knotting before staining. In case of oil staining stopping shall be done after staining using tinted putty or wood filler.
- 10.6.2.4 Application of Stains
- Stains shall be applied by brushing and wiping or by spraying. The stain shall be so thinned that it can be applied fairly, liberally without over staining and over lapping.
- 10.6.3 Sealing
- A suitable sealer shall be applied on the filled and sanded surface to prevent absorption by the wood of the succeeding coats of finish and to seal stain and filler and thus preclude their bleeding into the finish coat.

Sealer may be sprayed on taking care not to flood the surface and it shall be allowed to dry hard. When fully dry the surface shall be sanded taking care not to cut through at corners and edges. Dust shall be blown off and surface wiped with a clean rag.

10.6.4 Finishing

The stained surface shall be varnished, wax-polished or French polished as required after it is dried.

10.6.4.1 Varnishing

Varnishing of wood and wood based material shall be in accordance with IS: 2338 (Part-I).

Surfaces to be varnished shall be prepared to produce a smooth, dry and matt surface and all dust and dirt shall be removed from the surface.

The Varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with short light strokes to avoid frothing. It shall be allowed to flow out while the next section is being laid in. Excess Varnish shall be scraped out of the brush and then the first section be crossed, re- crossed and laid off lightly. The Varnish, once it has begun to set, shall not be retouched. In case of any mistake, the Varnish shall be removed and the work shall be started afresh.

Where two coats of varnish are applied, the first coat shall be a hard drying under coating or flattening varnish which shall be allowed to dry hard and then be flattened down before applying the finishing coat. Sufficient time shall be allowed in between two coats.

When flat varnishing is used for finishing, a preparatory coat of hard drying undercoating or flattening varnish shall first be applied and shall be allowed to harden thoroughly. It shall then be lightly rubbed down before the flat varnish is applied. On larger areas, the flat varnish shall be applied rapidly, and the edges of each patch applied shall not be allowed to set, but shall be followed up whilst in free working conditions.

10.6.4.2 French Polish

French polish shall conform to IS :348. Suitable pigments shall be added to get the required colour.

The surface to be French polished shall be rubbed down to smoothness with sand paper and shall be well dusted. Pores in the surface shall be filled up with fillers.

A pad of woollen cloth covered by a fine cloth shall be used to apply the finish. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil may be used on the face of the pad for the purpose. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly damped with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

11.0 PAINTING OF STEEL AND OTHER METAL SURFACE

11.1 General

Reference shall be made to IS :2524 and IS:1447.

11.2 Preparation of Surface

The surface, before painting, shall be cleaned of all rust, scale, dirt and other foreign matter with wire brushes, steel wool, scrapers, sand paper etc. The surface shall then be wiped finally with mineral turpentine which shall then be removed of grease etc. The surface then shall be allowed to dry.



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In case of GI surface, surface so prepared shall be treated with Mordant solution (5 litre for about 100 sq.m.) by rubbing the solution generously with brush. After about half an hour, the surface if required shall be retouched and washed down thoroughly with clean cold water and allowed to dry.

11.3 Application of Priming and Paints

Approved quality primer and paint in specified numbers of coats shall be applied as per manufacturer's recommendations either by brushing or spraying. Each subsequent coat shall be applied only after the preceding coat has dried.

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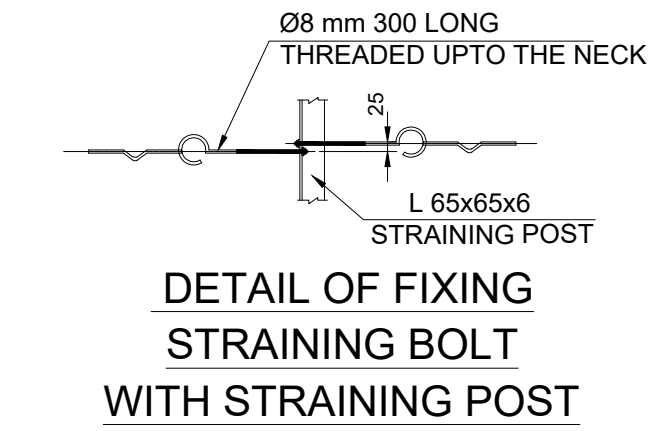
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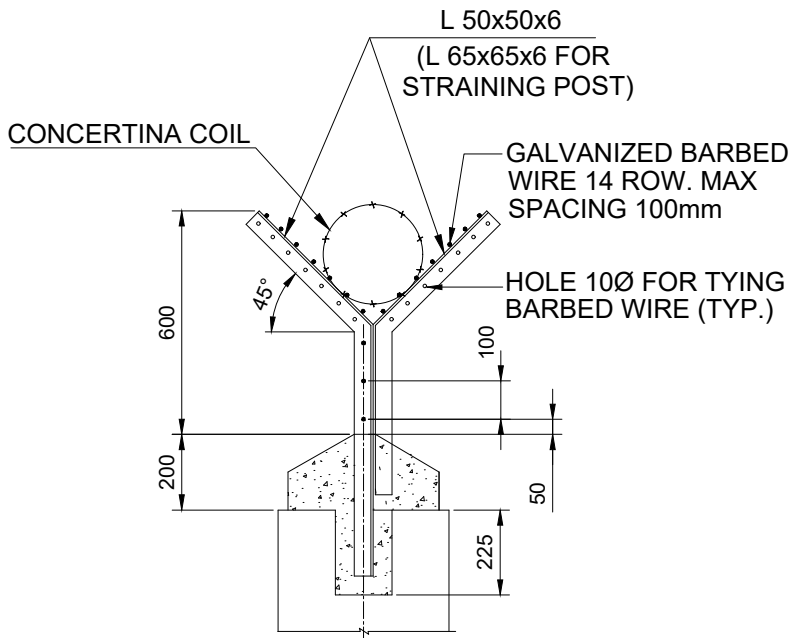
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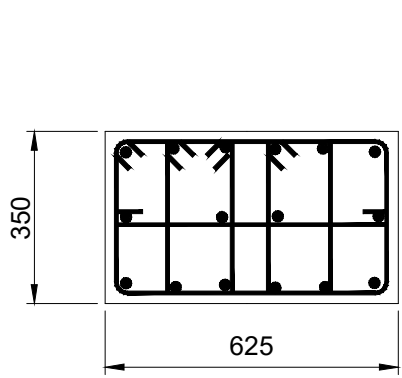
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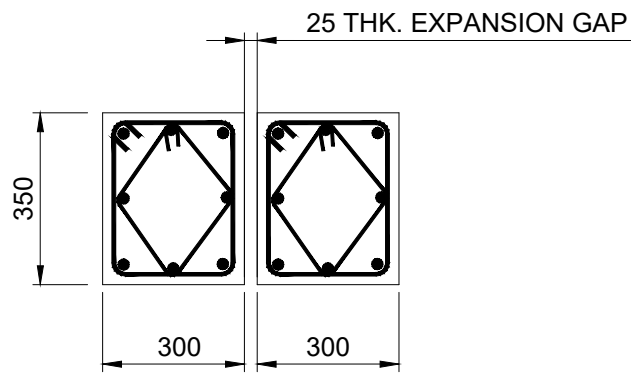
DETAIL-A



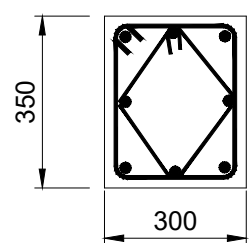
SECTION 2-2
(FOR CORNER COLUMN)



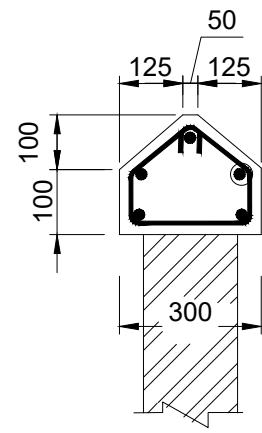
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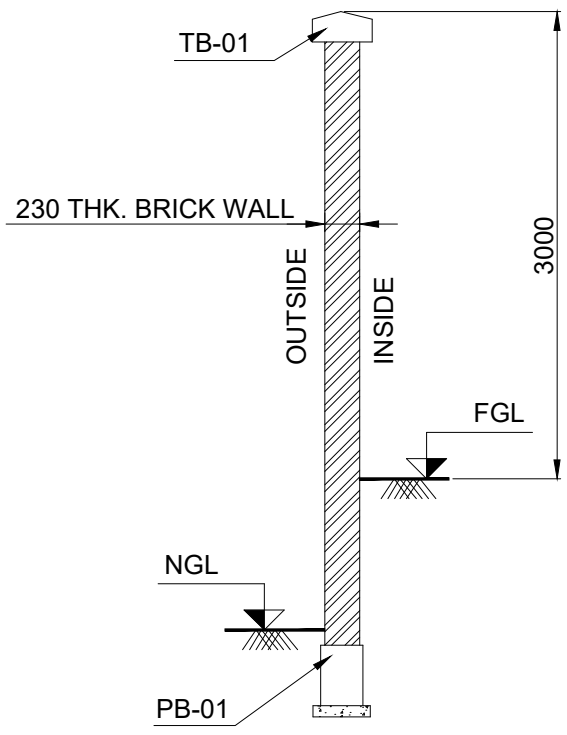
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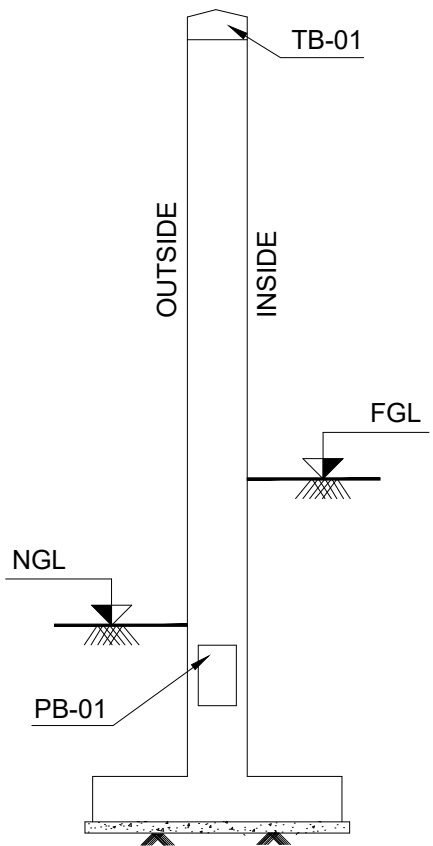
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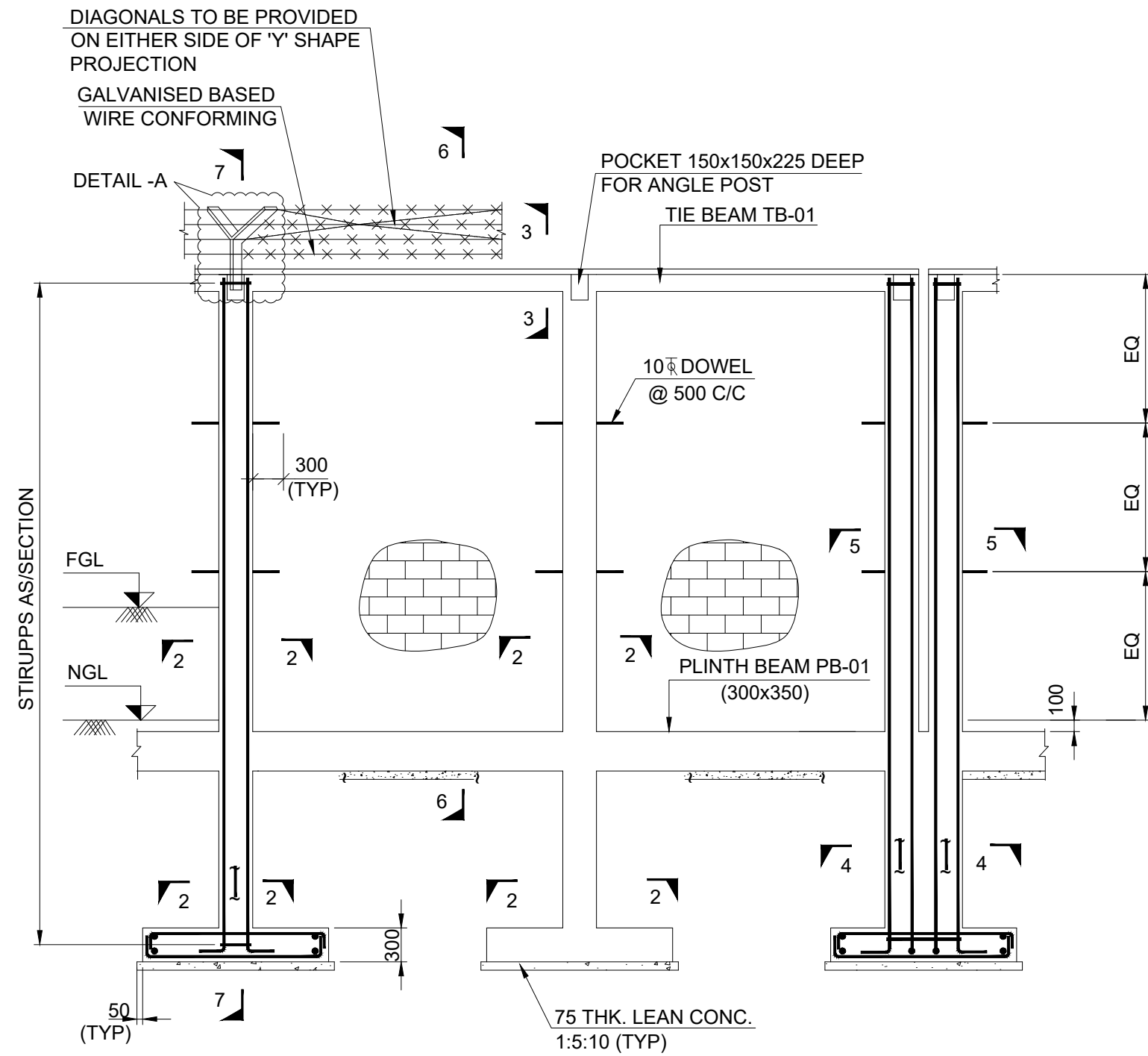
SECTION 3-3
(TYP DET. OF BEAM MKD. TB-01)
(TO BE CAST ON BRICK WORK)



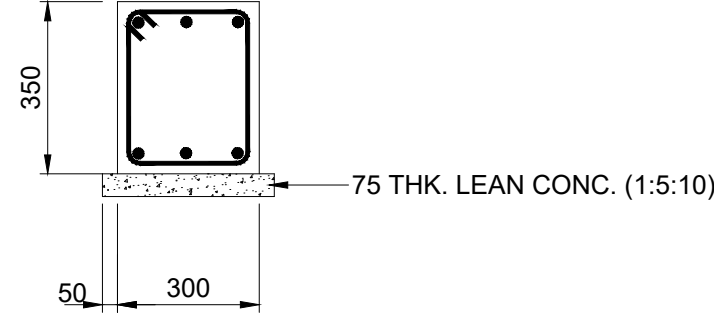
SECTION 6-6
(SHOWING G.A. ONLY)



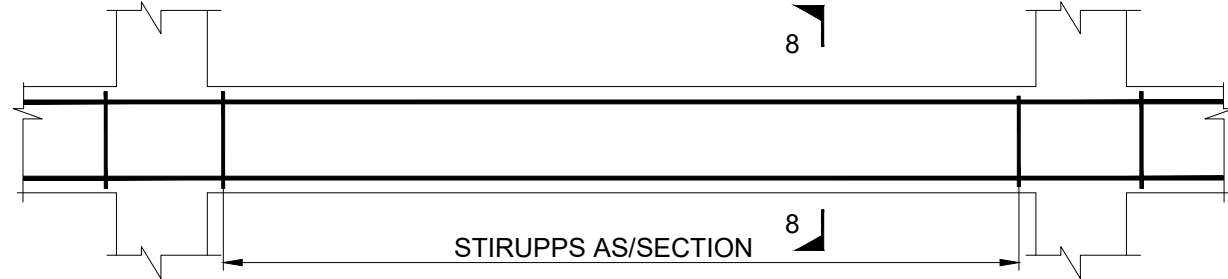
SECTION 7-7
(SHOWING G.A. ONLY)



SECTION 1-1



SECTION 8-8



TYP DET. OF PLINTH BEAM MKD. PB-01

NOTE:-

1. ALL DIMENSION ARE IN MM AND CO-ORDINATES AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
2. GRADE OF CONCRETE SHALL BE M-30 CONFORMING TO IS:456.
3. HIGH YIELD STRENGTH DEFORMED BARS OF GRADE FE 500 D CONFORMING TO IS:1786 SHALL BE USED IN REINFORCEMENT.
4. BRICK MASONRY SHALL BE FIRST CLASS BRICK OF CLASS- 5.0 IN C.M. (1:6)
5. PLASTER SHALL BE 13MM THK. ON EVEN SURFACE AND 16MM THK.ON UNEVEN SURFACE IN C.M (1:4).
6. GALVANIZED BARBED WIRE SHALL CONFORM TO IS:279.
7. DEPTH OF FOUNDATION SHALL BE MEASURED FROM NGL/FGL WHICHEVER IS LOWER.
8. TENSION LAP SPLICE LENGTH (MM) FOR REINFORCEMENT BARS SHALL BE 50 D OF THE BARS.
9. HEIGHT OF COMPOUND WALL SHALL BE MEASURED FROM NGL/FGL WHICHEVER IS HIGHER.

CONCRETE M30

NOTE:-

REFERENCE DRAWING FOR BIDDING PURPOSE ONLY. AFTER AWARD, ISSUED FOR CONSTRUCTION DRAWING WILL BE ISSUED TO SUCCESSFUL BIDDER.

LEGEND:-

NGL	NATURAL GROUND LEVEL
FGL	FINISHED GROUND LEVEL
PCC	PLAIN CEMENT CONCRETE
	BRICK MASONRY

TA	12.02.24	ISSUED WITH TENDER	YS	SS	RBS
REV	DATE	DESCRIPTION	BY	CHKD	APPD

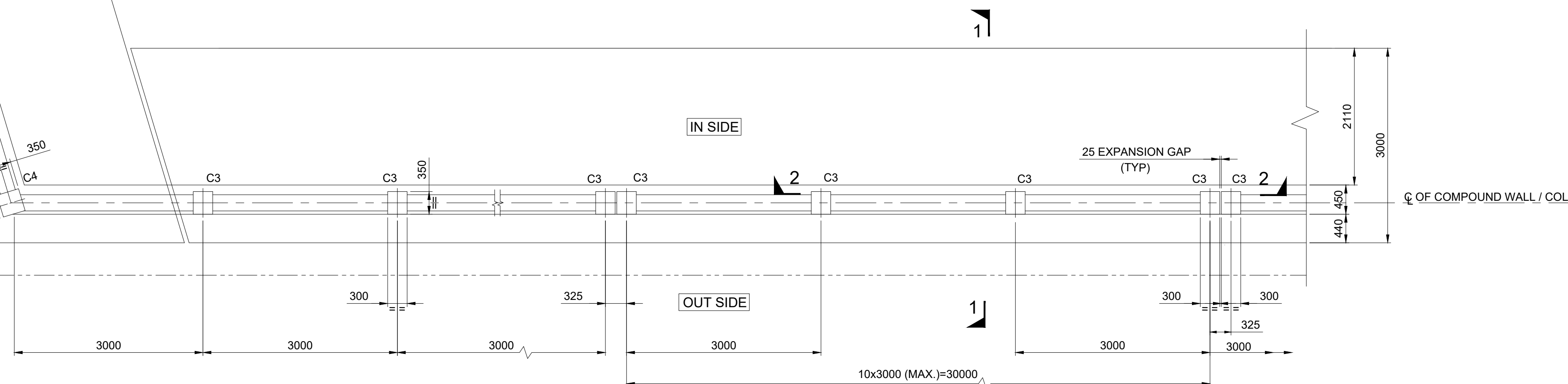
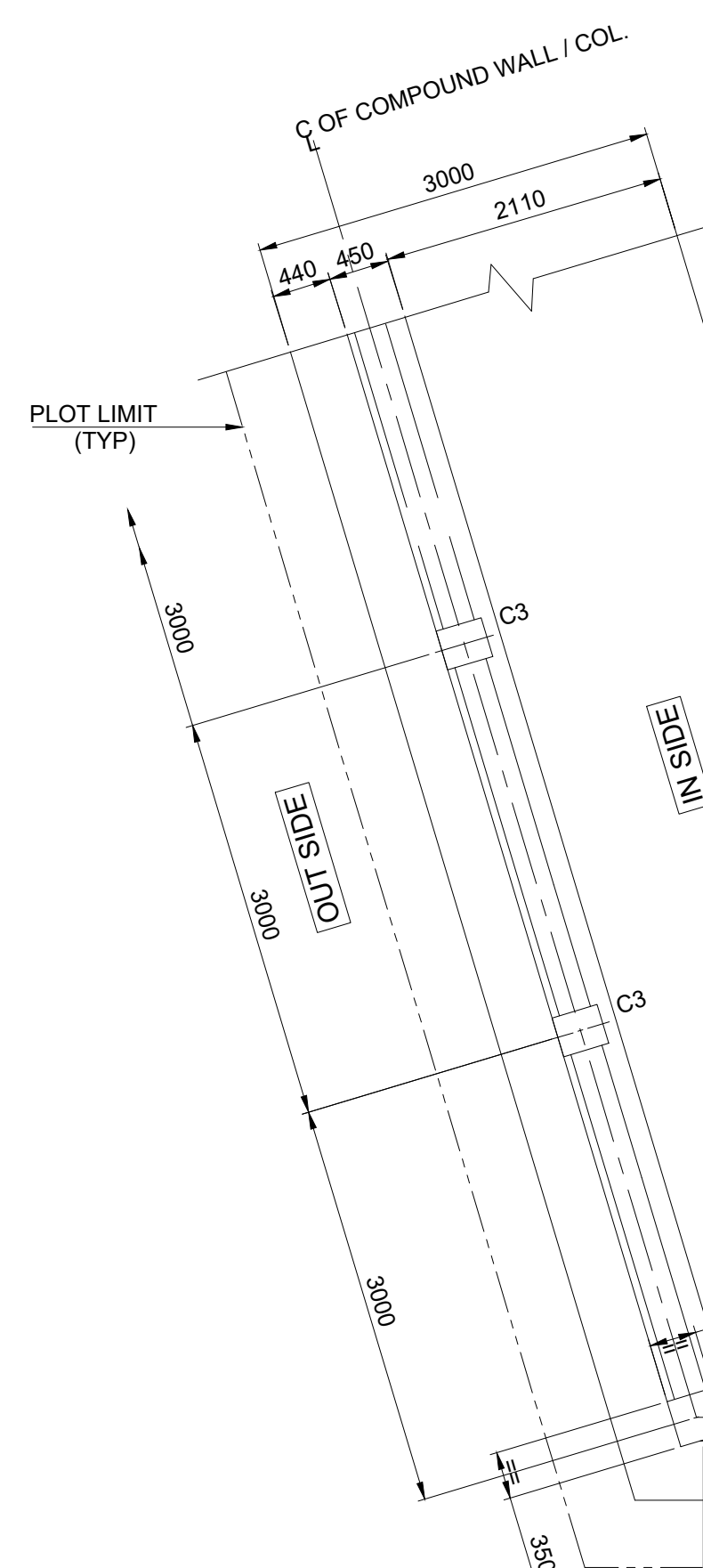
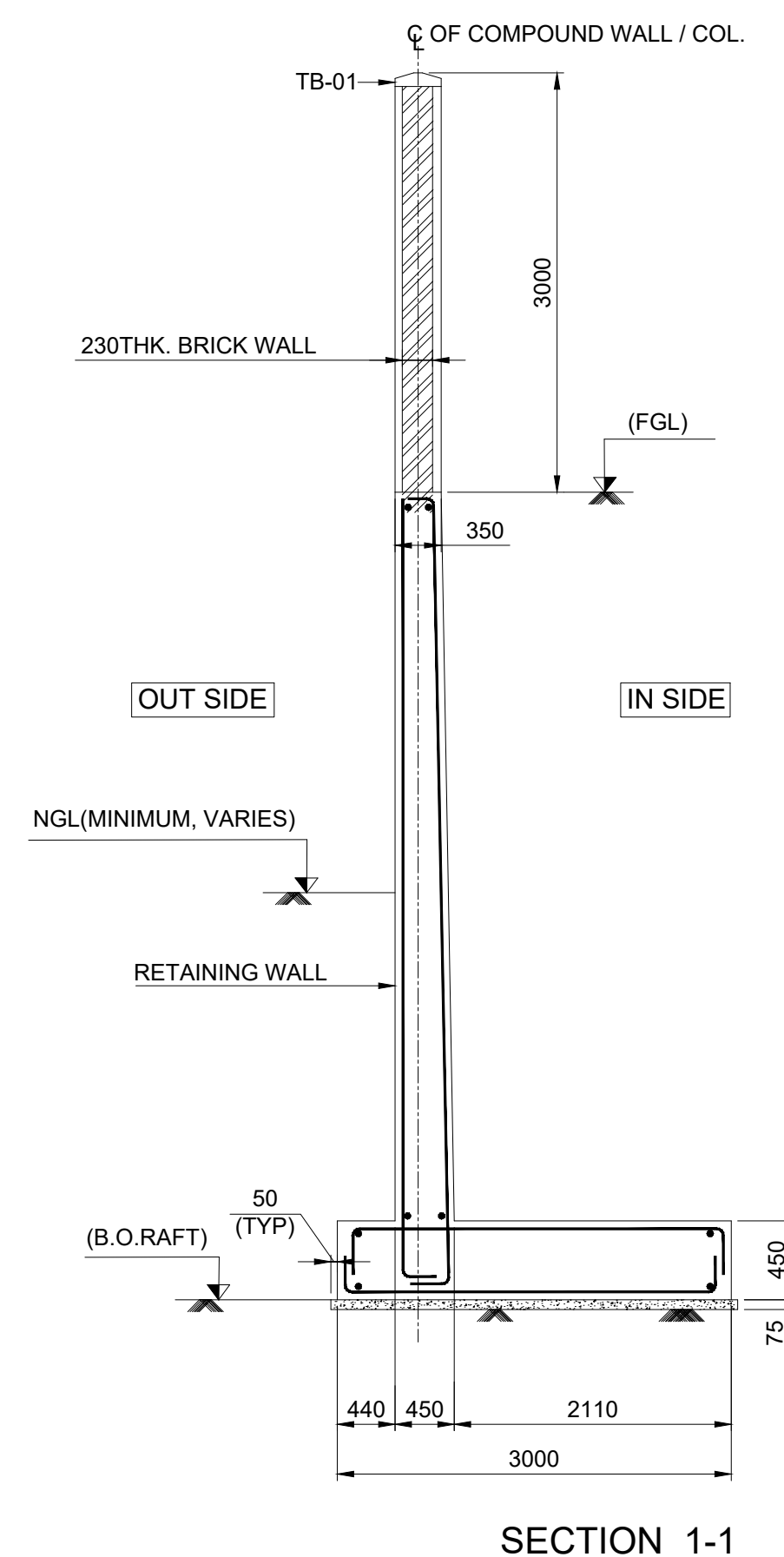
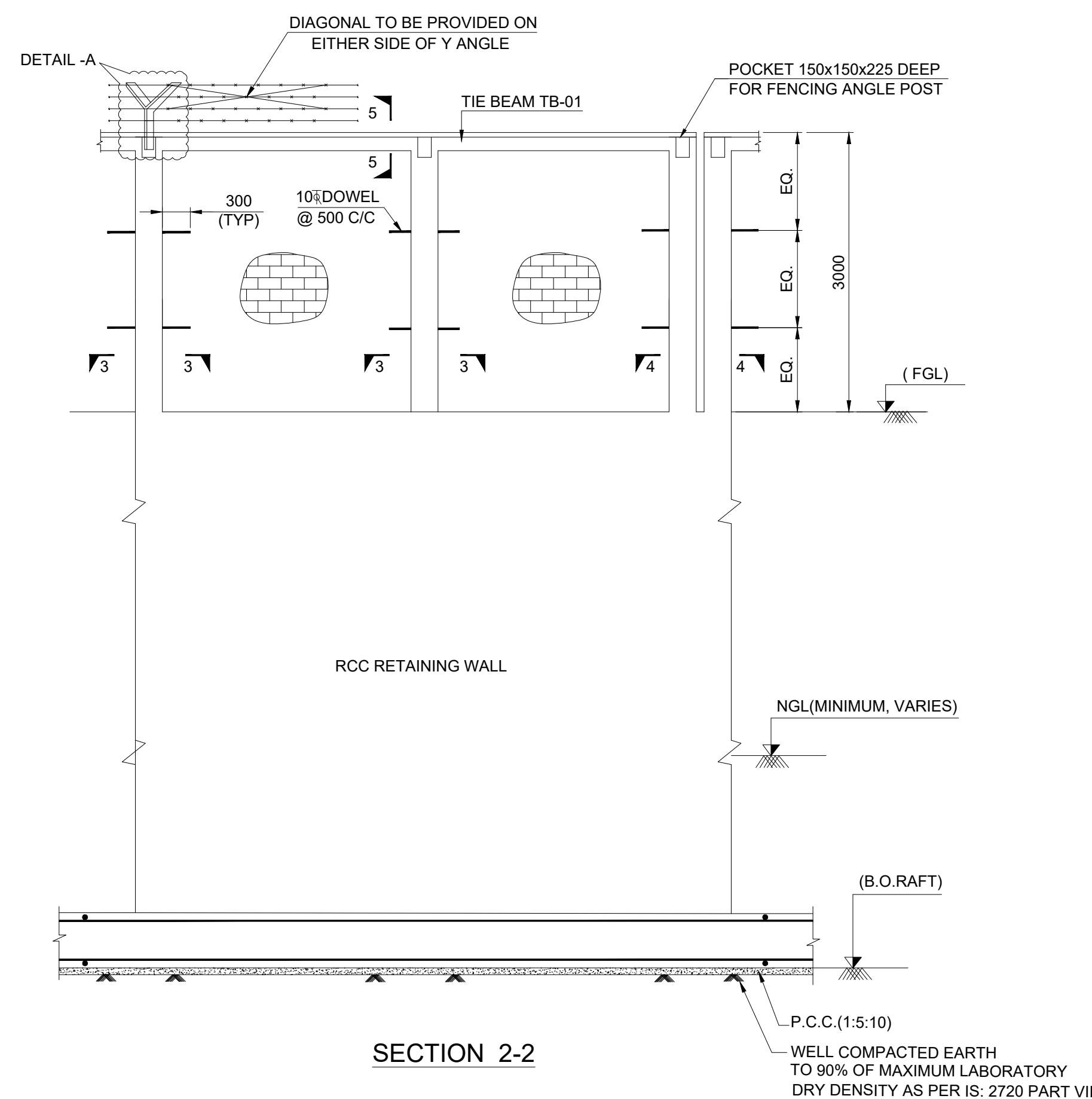
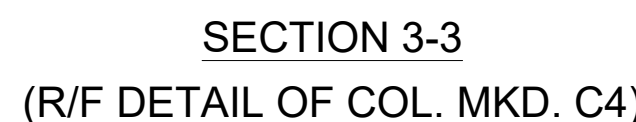
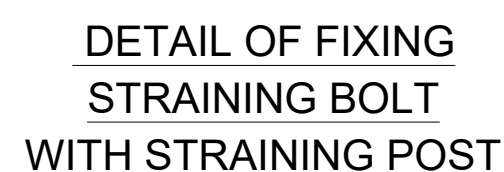
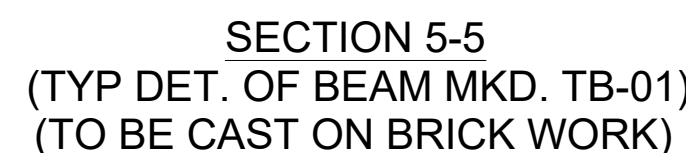
OWNER:	ENGINEERING CONSULTANT :
ASSAM GAS COMPANY LTD	PIPELINE ENGINEERING CONSULTANTS PVT. LTD.

PROJECT: EPMC SERVICES FOR DEVELOPMENT OF RUPKHELIA PIPELINE TERMINAL

DWG. TITLE: GA & DETAIL OF BOUNDARY WALL

SCALE.	JOB NO.	DRAWING NUMBER	REV.
1:150	P168	P168-00-DWG-C004	TA
SHEET 1 OF 2			

SHEET SIZE : A1 (841 mm x 594 mm)



TYPICAL FOUNDATION PLAN (TYPE-II)

NOTES:-


1. ALL DIMENSIONS ARE IN MILLIMETERS & LEVELS, COORDINATES ARE IN METERS.
2. GRADE OF CONCRETE SHALL BE M30 AS PER IS:456.
3. REINFORCEMENT SHALL BE OF HIGH STRENGTH DEFORMED (TMT) BARS OF GRADE Fe 500D CONFORMING TO IS:1786.
4. BRICK MASONRY SHALL BE FIRST CLASS BRICK OF CLASS-5.0 IN C.M. (1:6)
5. PLASTER SHALL BE 13MM THK. ON EVEN SURFACE AND 16MM THK. ON UNEVEN SURFACE IN C.M (1:4).
6. GALVANIZED BARBED WIRE SHALL CONFORM TO IS:278.
7. TENSION LAP SPlice LENGTH (MM) FOR REINFORCEMENT BARS SHALL BE 50 D OF BARS.
8. WEEP HOLE SHALL BE PROVIDED IN THE RETAINING WALL AT SUITABLE LOCATION.

CONCRETE M30

NOTE:-

REFERENCE DRAWING FOR BIDDING PURPOSE ONLY. AFTER AWARD, ISSUED FOR CONSTRUCTION DRAWING WILL BE ISSUED TO SUCCESSFUL BIDDER.

LEGEND:-

BOR	BOTTOM OF RAFT
NGL	NATURAL GROUND LEVEL
FGL	FINISHED GROUND LEVEL
PCC	PLAIN CEMENT CONCRETE
	BRICK MASONRY

TA	12.02.24	ISSUED WITH TENDER	YS	SS	RBS	
REV	DATE	DESCRIPTION	BY	CHKD	APPD	

OWNER:



ASSAM GAS
COMPANY LTD.



PIPELINE ENGINEERING
CONSULTANTS PVT. LTD

PROJECT:	EPMC SERVICES FOR DEVELOPMENT OF RUPKHELIA PIPELINE TERMINAL
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DWG. TITLE: GA & DETAIL OF BOUNDARY WALL

SCALE.	JOB NO.	DRAWING NUMBER	REV.
1:150	P168	P168-00-DWG-C004	TA
SHEET 2 OF 2			

