



EPMC SERVICES FOR DEVELOPMENT OF RUPKALIYA PIPELINE TERMINAL

BID DOCUMENT

FOR

**Site Grading, Roads & Storm
Water Drains**

Bid Document No AGCL/PROJ/GRADING-RUPK/2023/07

OPEN DOMESTIC COMPETITIVE BIDDING

VOLUME - II OF II

PREPARED AND ISSUED BY



PIPELINE ENGINEERING CONSULTANTS PVT. LTD.

A-56/1, Second Floor Sector - 50, Noida,
Gautam Buddh Nagar 201301
Uttar Pradesh, India



**SCOPE OF WORK FOR SITE
GRADING, ROADS & STORM
WATER DRAINS TENDER**

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AGCL

**EPMC Services for Development of
Rupkaliya Pipeline Terminal**

**SCOPE OF WORK FOR SITE GRADING,
ROADS & STORM WATER DRAINS TENDER**

DOCUMENT NO. P168-SOW-C001-RTA

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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 Rupkhelia Pipeline Terminal at Rupkhelia, Golaghat, Assam.

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

2.0 PURPOSE

This document is for the site grading, construction of roads & storm water drains for Compressor Station at Rupkhelia, 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	Development of Rupkhelia 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 Rupkhelia 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 work under this contract broadly covers site grading, construction of roads & storm water drains as per drawings, schedule of rates, specifications, relevant codes, standards enclosed with the bid document. Any other work not specifically listed below



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but required for satisfactory & successful completion of the entire work shall be carried out by the Contractor as per directions of Engineer-in-Charge.

The scope of work mainly includes, but not limited to, the following: -

- a. Cutting of trees up to 30cm girths, clearing of bushes, grass, vegetable growth etc., grubbing of roots, filling of hollows with approved earth, transportation and disposing the unserviceable materials anywhere beyond plant boundary. Area for disposal shall be identify by the contractor at his own cost, stacking the serviceable materials within plant boundary etc. all complete as per specification, drawings, documents and directions of Engineer-in-Charge.
- b. Earthwork in excavation in general site grading & road embankments for all heights and depths in all kinds of soil except soft and hard rock including clearing and stripping of area, as per specifications, drawings and directions of engineer-in-charge. Contractor shall identify the area of disposal of above earth at his own cost anywhere outside plant boundary.
- c. Earth work in excavation in general site grading & road embankments for all heights & depths in soft rock except hard rock including clearing and stripping of area as per specification, drawings, documents and directions of engineer-in-charge. Contractor shall identify the area of disposal of above earth at his own cost anywhere outside plant boundary.
- d. Earthwork in excavation including clearing & stripping of area and disposal of marshy soil, slush / sludge including de-watering of the complete area. Contractor shall identify the area for disposal of above earth at his own cost anywhere outside Plant Complex.
- e. Earthwork in excavation including dewatering, if required, below ground level for all types of soils and providing shoring & strutting, wherever required, by open and/ or closed timbering method.
- f. Earthwork in filling with approved good quality of soil/ murrum from approved borrow areas arranged by the contractor at his own cost in general site grading & road embankments at all heights and depths including stripping and clearing of cutting/filling area, loading, transportation, unloading and spreading of earth in layers, levelling, watering, rolling, compacting, uprooting of vegetation, roots and disposal of the shrubs, bushes, roots etc., all complete as per standards, specifications, drawings, documents and direction of Engineer-in-charge. Disposal area for unserviceable material anywhere outside the plant boundary limit to be arranged by the contractor at his own cost.
- g. Backfilling with approved good quality of soil/ murrum from approved borrow areas arranged by the contractor at his own cost at all depths and disposal of surplus earth, debris and rock material to the area designated by the Engineer-in-Charge.



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- h. Storing/ stacking excavated earth at safe location or at designated place for reuse within the plant boundary as instructed by Owner/ Engineer-in-charge.
- i. Disposal area for unserviceable material outside the plant boundary limit to be arranged by the contractor.
- j. Laying of WBM Grade-I and WBM Grade-II in Roads.
- k. Construction of Storm water drains.
- l. Supply & laying of RCC NP3 pipes for storm water culverts.
- m. Providing the construction joints, expansion joints etc. in the retaining wall.
- n. Weep holes shall be provided in the RCC retaining wall wherever required at suitable location directed by engineer in charge.
- o. Plain Cement Concrete works of various grades including lean concrete below foundations of all types, drains, culverts etc. at all depths below plinth level.
- p. Reinforced Cement Concrete works in all types of foundations, sub structure as well as superstructure for Retaining Wall, etc. at all depth & heights.
- q. Centering & shuttering in sub-structure at all depths and in super-structure at all heights/ elevations.
- r. Supply, cutting, bending, binding, laying in position Reinforcement bars in R.C.C. work.
- s. Preparation of bar bending schedule for all RCC works as per AFC drawings before construction is taken up.
- t. Brick Masonry works in sub-structure for all depths as per specifications.
- u. 13mm thick plaster in cement mortar 1:3 in storm water drains etc. as per specifications
- v. 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.
- w. 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.
- x. Obtaining all approvals from owner, statutory authorities such as Factory Inspector, Local Municipal or Development Authorities and other designated authorities etc. for necessary construction works.
- y. Any other Civil-Structural works as specified elsewhere in the bid document.
- z. Any other item not mentioned specifically above but required **for the satisfactory and successful completion of the project** as per direction of Engineer-in-Charge.



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5.0 SPECIFIC REQUIREMENTS

- a. In case borrowed earth or disposal is required outside Station/Terminal. The location for borrow area/ disposal of surplus earth & debris to be identified by the contractor at his own cost 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.
- b. All site grading, construction of roads & storm water drains shall strictly conform to enclosed standards, specifications & drawings.
- c. Bidder should visit the site to correctly assess the quantum of work before quoting for the job particularly for slush removal including depth of slush to be removed.

6.0 TIMELINE OF WORK

6.1 PHASE-1

- a. Area of grading shown under Phase-1 in drawing.
- b. Construction of approach road.
- c. Construction of Internal Road upto Compressor Station/ Pipeline Terminal.
- d. Construction of RCC Retaining Wall beside the pond as shown in drawing.

6.2 PHASE-2

- a. Overall grading of the plot.
 - b. Construction of Storm Water Drain.
 - c. Construction of Internal remaining road of the plant.
- Phase-1 shall be completed within 2 months from the date of LOI.
 - Phase-2 shall be completed within 6 months from the date of LOI.

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.

7.3 LIST OF ATTACHMENTS

7.4 STANDARDS SPECIFICATIONS

S. NO.	TITLE	SPEC NO.	NO. OF SHEETS	REV. NO.
1.	Classification of soil for earthwork in site grading	C-SPC-004	5	0
2.	Site grading and Rock cutting for site grading	C-SPC-005	12	0
3.	Roads & Flexible Pavements (Upto WBM Layer)	C-SPC-006	10	0
4.	Civil & Structural works- Earthwork	C-SPC-103	13	0
5.	Plain & Reinforced Cement Concrete	C-SPC-104	29	0
6.	Brick Masonry	C-SPC-109	8	0
7.	Plastering and pointing	C-SPC-155	9	0

7.5 DRAWINGS

S. No.	TITLE	DRAWING NO.	NO. OF SHEETS	REV. NO.
1.	Plot Plan of Rupkhelia	P168-00-DWG-C001	1	TA
2.	Site grading, Roads and Storm Water Drains Layout and Sectional details	P168-00-DWG-C002	2	TA

7.6 SCHEDULE OF RATES

Attached with tender document.



**STANDARD SPECIFICATION
FOR
CLASSIFICATION OF SOIL FOR
EARTHWORK IN SITE GRADING
C-SPC-004**

0	24.02.22	ISSUED FOR USE AS STANDARD	MK	ADh	RKB	AD
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**STANDARD SPECIFICATION
FOR CLASSIFICATION OF SOIL FOR
EARTHWORK IN SITE GRADING**

**SPECIFICATION NO.
C-SPC-004**

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ABBREVIATIONS

gm/cc : Gram Per Cubic Centimeter



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**SPECIFICATION NO.
C-SPC-004**

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FOR CLASSIFICATION OF SOIL FOR
EARTHWORK IN SITE GRADING**

**SPECIFICATION NO.
C-SPC-004**

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1.0 SCOPE

This specification covers classification of soil for earthwork in excavation and filling for site grading work. Method of field density for soil compaction, using soft rock and hard rock, is also explained..

2.0 ORDINARY SOIL

2.1 Soft Soil / Loose Soil

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

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

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

Mud concrete below ground level

Any mixture of soil mentioned above.

2.2 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 moorum 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

3.0 SOFT ROCK

This is fissured / disintegrated rocky strata, boulders (volume less than 0.4 m³ and more than 0.028 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, light blasting may be restored to, for loosening the materials, but this will not, in any way entitle the material to be classified as "Hard Rock".

4.0 HARD ROCK

4.1 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.

4.2 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 0.4m³) 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.



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4.3 Hard Rock (Requiring Controlled Blasting)

This type of excavation becomes necessary when excavation is done in formations, mentioned in Clause 4.2, in the vicinity of existing foundations/ structures. Mode of blasting shall be decided by Engineer-in-Charge, keeping in view the sensitivity of structures.

4.4 Hard Rock (Blasting Prohibited)

Hard rock requiring blasting as described in clause 4.2 above, but when blasting is prohibited for any reason and excavation has to be carried out by chiseling, splitter or any other agreed method.

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

5.0 FILLING SOIL

5.1 Ordinary soil used for filling shall meet requirements of clause 4 of Standard Spec. No. C-SPC-005, for Site Grading.

5.2 Use of soft rock for filling shall be determined based on compaction test of filling material. Well graded soft rock with sufficient fines should make a good filling material. This shall be tested in field for compaction and then density of compacted soils shall be determined. Test patches shall be made in field using this material and number of passes of rollers determined for each patch. A minimum of 3 test patches of 10m x 10m shall be made. Density of compaction shall be determined in each patch. A density of 1.90 gm/cc or more shall be acceptable.

5.3 Use of hard rock with soft rock and soil for filling shall be determined based on compaction test of rock material to be used for filling. Test patches shall be made as in case of soft rocks and number of rolls shall be determined for each test patch. Density of material in all test patches shall be found, which should not be less than 2.0 gm/cc.

5.4 The decision of Engineer-in-Charge with regard to suitability of such materials shall be final.

6.0 METHOD OF FILLING / FIELD DENSITY FOR SOIL COMPACTION

6.1 Filling with Soft Rock/ Hard Rock Soil

The earth for filling shall be rock soil mass, available from cutting areas. Filling shall be done in loose thickness of 400 mm. Voids shall be filled with smaller size material to ensure well graded and compacted fill. Watering, ramming and compacting with rollers or other suitable means as approved by Engineer-in-Charge shall be done to achieve at least 90% maximum dry density. Stones used in fill material shall not exceed 150 mm in size.

6.2 Field Testing for Density

Each layer shall be tested in field for density and accepted by the Engineer-in-Charge, subject to achieving the required density, before laying the next layer. In the event, if it is not possible to conduct compaction test due to presence of stones, the compaction shall be determined at site by excavating a pit of size 0.5m x 0.5m x 0.3m (depth) in compacted area. The excavated soil shall be weighed. The pit shall be filled with water after laying a thin polythene sheet and weight of water so filled shall be determined. Alternatively, sand can also be used for filling the pit for determining the density.

Density of filled material shall be equal to the weight of soil / weight of water

This shall not be less than 1.90 gm/cc for soft rock and 2.0gm/cc for hard rock fill area. One test per 4000 m² compacted area shall be done for every layer of filling. Number of tests can be increased due to variation in quality of fill material and / or at the discretion of Engineer-in-Charge.



STANDARD SPECIFICATION
FOR SITE GRADING & ROCK CUTTING
FOR SITE GRADING

SPECIFICATION NO.
C-SPC-005

**STANDARD SPECIFICATION
FOR
SITE GRADING & ROCK CUTTING
FOR SITE GRADING**

C-SPC-005

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ABBREVIATIONS

gm/cc	:	Gram Per Cubic Centimeter
DGMS	:	Director General of Mines Safety
gm/cc	:	Gram Per Cubic Centimeter
IS	:	Indian Standard
NGL	:	Natural Grade Level



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1.0 SCOPE

This specification and the method of measurements described thereon are applicable for earthwork involved in Site Grading & Rock Cutting.

2.0 CODES & STANDARDS

IS:2720 Part IV Methods of tests for soils.

IS:2720 Part V Methods of tests for soils-Part 5 :Determination of liquid & plastic limit.

IS:2720 Part VII Methods of tests for soils

Part-VII :Determination of water content — Dry Density Relation using Light Compaction.

6-65-0016 Std. specification for classification of soil for earthwork in site grading.

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

3.0 GENERAL

3.1 CONTRACTOR shall maintain adequate drainage facilities at SITE at all times during the execution of work. Additional ditches, drains & such other temporary means to achieve this, over and above what is shown in the drawings, shall be provided and maintained by CONTRACTOR at his own cost.

3.2 Adequate dewatering facilities like dewatering pumps and piping etc. shall also be provided by the CONTRACTOR for this work, including dewatering during excavation etc. as required, at his own cost.

4.0 MATERIAL FOR EARTHWORK

4.1 Only soil considered suitable by the Engineer-in-charge shall be deployed for the construction and that considered unsuitable shall be disposed off, as directed by Engineer-in-charge, at his own cost and no claim for compensation will be entertained.

4.2 The CONTRACTOR shall give the samples of soil he proposes to use for filling, along with the following characteristics of the samples, to Engineer-in-charge for approval, prior to collection and use. The tests for these characteristics shall be done in a laboratory / test house as approved by Engineer-in-charge.

i. Mechanical analysis or grain size analysis as per IS: 2720 Part IV.

ii. Liquid limit as per IS: 2720 Part V.

iii. Plastic limit as per IS: 2720 Part V.

iv. Moisture density relationship as per IS: 2720 Part VII.

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

4.4 Soil having plasticity index less than 20 shall be used for filling purpose.

4.5 Soil having laboratory maximum dry density of less than 1.5 gms/cc shall not be used.

4.6 Care shall be taken to see that unsuitable waste material is disposed off in such a manner that there is no likelihood of its getting mixed with the material, proposed to be used, for filling.

4.7 The work shall be so planned and executed that the best available soil are reserved for the top portion of Embankments.

5.0 CUTTING TREES



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- 5.1 All trees having girth above 30 cms, which are not marked for preservation, shall be cut down and their roots dug up to a depth of 1 metre from the existing ground level.
- 5.2 All holes or hollows produced by digging up roots shall be carefully filled with approved soil, including all leads and lifts, rammed and compacted to obtain 90% of maximum laboratory dry density of soil and levelled as directed.
- 5.3 All uprooted trees shall be stacked or disposed off as directed by Engineer-in-charge.
- 5.4 Payment

Cutting of trees above 30 cms girth shall be paid per number. The rate quoted shall include cutting, uprooting removing the trees within plant boundary as directed, including filling holes or hollows produced by removal of roots etc. as per specifications.

6.0 CLEARING AND STRIPPING

- 6.1 All the areas, including depressions, where filling or cutting is to be carried out shall be cleared and stripped completely of bushes, roots, vegetation, plantation trees, shrubs, trees upto 30 cms girth, organic and other objectionable materials. All these shall be completely uprooted and virgin soil exposed and not merely scrapped at the surface. The roots of trees of girth upto 30 cms shall be removed to a minimum depth of 1M below existing ground level and holes, hollows filled up with selected approved available soil within all leads and lifts and compacted to obtain 90% of laboratory dry density of soil as per IS: 2720, Part VII and leveled as directed by Engineer-in-charge. All soft patches must be worked out to remove soft soil and selected approved earth must be filled back and the areas (areas coming under filling) compacted to obtain 90% of maximum laboratory dry density of soil, as per IS: 2720 Part VII. The depth of stripping shall be generally 50 to 150 mm as decided by Engineer-in-Charge.
- 6.2 Material obtained from clearing shall be stacked or disposed off as directed by Engineer-in-charge within a lead as per directions of Engineer-in-Charge.
- 6.3 Payment

No separate payment shall be made for clearing, stripping and disposal of materials obtained from clearing. This shall be considered as part of cutting work in areas of cutting and filling work in areas of filling and the rates quoted under the respective items of

- i. Earthwork in Excavation/ Cutting
- ii. Earthwork in filling (both with available earth & earth obtained from approved borrow areas), shall be inclusive of clearing and stripping with all operations described above in clause no.6 in respective areas of cutting and filling.

No separate payment shall be made for clearing, stripping and disposal of materials obtained from clearing of borrow areas for earth. This shall be considered as part of filling work in area of filling and the rate quoted under the respective items.

7.0 EARTHWORK IN EXCAVATION / CUTTING

- 7.1 After clearing and stripping of areas as specified above in clause No.6, spot levels at intervals and pattern as decided by the Engineer-in-charge, shall be taken jointly by CONTRACTOR and Engineer-in-charge. Excavation / cutting shall commence only after the levels are signed by the contractor as a token of his acceptance.
- 7.2 Excavation/ cutting shall be carried out strictly as per the instruction of Engineer-in-charge.
- 7.3 If the contractor excavates/ cuts beyond the required level, additional quantity of earthwork shall not be paid for. The excavation taken below the specified level shall



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- 7.4 The final bed and sides of excavation must be levelled, dressed and compacted. In case of areas under excavation for site grading, the final surface shall be levelled, dressed and consolidated by means of sheep foot / power driven rollers to obtain maximum compaction. However, no test control is required in such areas.
- 7.5 Shoring and strutting shall be adopted only with the permission of Engineer-in-charge in writing. Such shoring and strutting shall follow the necessary specification.
- 7.6 Provisions for dewatering shall be governed by the relevant clauses.
- 7.7 Payment

Payment for Excavation shall be on the basis of volume of excavation calculated on the basis of joint level taken as per clause 7.1 and the final finished grade levels, the volume being calculated by the Trapezoidal rule including dewatering, if required. Intermediate payment will be on the basis of volume calculated based on spot levels taken during the time of the billing. Reference is also invited to clause 7.3.

8.0 EARTHWORK IN FILLING

- 8.1 After clearing, stripping and consolidation of areas as specified in clause 6, spot levels at intervals and pattern as decided by Engineer-in-charge shall be taken jointly by the CONTRACTOR and Engineer-in-Charge and filling shall commence only after the levels are signed by the CONTRACTOR as a token of his acceptance. Approved fill Material shall be spread in uniform layers not exceeding 30 cms in loose depth.

The contractor has to make his own approach and access roads from the borrow area to the demarcated filling areas. While the CONTRACTOR may make use of such short cuts as may be available to him for earth movement from borrow areas to the filling areas, the OWNER does not guarantee any passage way or right of way for the CONTRACTOR's work other than available at site. No claim shall also be admissible to the CONTRACTOR on account of his having to take longer leads or routes for earth movement, than envisaged by him, either due to any road cuttings, nonavailability of routes, or any other grounds whatsoever.

In case total filling required in any area consists of soil both from borrow areas and available approved excavated material from within plant area, then joint levels, shall be taken before commencing filling with earth from borrow area.

However, earth available from borrow areas required for filling can be used only after the available earth from excavation within demarcated area has been utilised and clearance to this effect obtained from the Engineer-in-charge.

- 8.2 All clods, lumps etc, shall be broken before compaction.
- 8.3 Successive layers of filling shall not be placed until the layer below has been thoroughly compacted and tested to satisfy the requirements laid down in this specification.
- 8.4 Prior to rolling, the moisture content of material shall be brought to within plus or minus 2% of the Optimum Moisture Content as described in IS: 2720 Part VII. The moisture content shall preferably be on the wet side for potentially expansive soil.
- 8.5 After adjusting the Moisture Content as described in clause 8.4, the layers shall be thoroughly compacted by either sheep foot roller or power driven roller or vibratory roller, as approved by Engineer-in-charge, till the specified maximum laboratory dry density is obtained.



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- 8.6 Each layer shall be tested in field for density and accepted by Engineer-in-charge, subject to achieving the required density, before laying the next layer. A minimum of one test per 500m² for each layer shall be conducted.
- 8.7 If the layer fails to meet the required density, it shall be reworked or the material shall be replaced and method of construction altered as directed by Engineer-in-charge to obtain the required density.
- 8.8 The filling shall be finished in conformity with the alignment, levels, cross-section and dimensions as shown in the drawing.
- Earthen embankment shall be filled 300mm more on both sides, where height is more than 1M and this extra filling shall be dressed, after compaction, in conformity with alignment, level, cross-section and dimension as shown in the drawing, to achieve proper compaction in the slope. No extra payment shall be made in this regard.
- 8.9 Extra material shall be removed and disposed off as directed by the Engineer-in-charge.
- 8.10 Tolerances
- General site grading, including cutting and filling in depressions, shall be carried out to within up down tolerance of +5 cms of final lines, grades and slopes.
- 8.11 Earth Work in Filling in Open Lined/Unlined Wells
- For earth work in filling in open lined/unlined wells, only locally available coarse sand shall be used, in layers of 500 mm thickness. Each layer shall be thoroughly wetted by sprinkling water, before next layer is filled up. Filling shall be done upto 1m depth below NGL as above. Layers from a depth of 1m below NGL, upto NGL, shall also comprise of locally available coarse sand and compacted with suitable Mechanical / manual means, to obtain same level of compaction as required for filling above NGL. Filling above NGL shall be done as per Cl. 8.1 to 8.10 above.
- 8.12 Payment
- 8.12.1 Payment for filling shall be made on cubic metre of volume calculated on the basis of cross section plotted from the levels of ground, where filling is to be carried out and the levels reached after filling is duly consolidated, volume being calculated by Trapezoidal method.
- 8.12.2 In case of simultaneous cut and fill operation, wherever specified, payment shall be made on the basis of one composite rate for cutting and filling. All other details about measurement etc. remaining same as above.
- 8.12.3 Payment for filling in open wells, lined or unlined, shall be made on the basis of volume calculated on the basis of average area multiplied with depth of open well
- 8.12.4 No extra payment shall be made towards testing.
- 9.0 REMOVAL OF SURPLUS EARTH**
- 9.1 Surplus earth and soil from excavation and general site grading shall be removed from the construction areas to the area demarcated by the Engineer-in-charge.
- 9.2 Payment
- Payment shall be made only for lead beyond initial lead from construction area. Rate shall include loading, transportation, dumping, stacking the surplus earth and soil in the area demarcated by the Engineer-in-charge.
- Payment shall be made on cubic metre basis of the difference of measurements of the volumes of the excavation and the measurement of the filling with the excavated earth. However, the contractor's



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entitlement to payment shall be restricted to the actual quantity of earth removed. Quantity generated due to void 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.

10.0 EXCAVATION IN ROCK

10.1 Blasting operations shall be carried out with the prior permission and in the presence of the Engineer-in-charge or his authorised representative and during fixed time hours of the day. Blasting operations shall be carried out as per Indian Explosive Rules 1983, amended up to date. The contractor shall have a valid license from Controller of Explosives to carry out blasting operations as well as for obtaining and storing the explosives as per Indian Explosive Rules (latest). All safety precautions such as providing safety nylon netting etc. shall be carried out as per instructions of the Engineer-in-charge.

In case the contractor is not having a valid license from Controller of Explosives to carry out blasting operations and storing / handling explosives as per Indian Explosives Rules (latest). The contractor may engage an agency for blasting who is having valid license required to carry out blasting operation. Prior to start of blasting operation, contractor shall submit all the relevant licenses required for blasting operation to Engineer-in-Charge.

10.1.1 The contractor shall ensure that all workmen and the personnel at site except those who have actually to light the fuse are evacuated from the unsafe area to be determined by the Engineer and warned by loud speaker in local language to safe distance, not less than 200 metres at least 15 minutes before firing time by sounding warning siren. The area shall be encircled by red flags. The contractor shall be responsible for any accident to workmen, public or property due to blasting operation.

10.1.2 Gunpowder, gelatin and other safe explosives only shall be used wherever possible. Explosives with nitroglycerine shall be used only under exceptional circumstances, with prior approval of the Engineer-in-Charge.

10.1.3 All fuses shall be cut to the length required, before being inserted into the holes.

10.1.4 The no. of charges to be fired and the actual no. of shots heard shall be compared and the person responsible must satisfy himself by examination that all the charges have exploded before work people are permitted to approach the scene. The withdrawal of a charge, which has not exploded shall under no circumstances be permitted, such charges shall be flooded with water and the hole marked into a distinguishing manner. The next hole to be fired shall be at a distance of about 500 mm from the unexploded hole and fired in the usual way.

The contractor or sub contractor or any of his competent authorised person shall be in charge of the blasting operations and shall be held responsible for strictly observing the safety rules, particularly applicable to blasting operations, in addition to other safety rules.

10.1.5 For blasting rocks with dynamite, the following general principles shall be observed.

In general, the following diameter of drills shall be used for different depth of boreholes.

From 1-2 metres 25mm diameter

From 2-3.25 metres 37-50mm diameter

From 3.25-4.75metres 50-65mm diameter

The boreholes should generally be not more than 1.5m deep and the distance apart should be from one and a half to twice their depth.

Cracks and fissures in the rock to be blasted shall be carefully studied to ascertain the best position for the boreholes. The charge shall always be placed in a sound piece of rock, if possible not nearer than 300mm from the crack.



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- 10.2 Rules for Blasting with Dynamite and other High Explosives
- 10.2.1 The Person-in-charge must show that he is thoroughly acquainted with the blasting operations and that he understands the rules laid down herewith. He will be held responsible for any accident that may occur. He must be a licenced blaster with a valid licence from DGMS.
- 10.2.2 Boreholes must be of such a size and uniform that the cartridges can easily pass down them.
- 10.2.3 The position of all holes to be drilled must be marked out with white paint and the person-in-charge must take particular note of these positions.
- 10.2.4 The drilling operation after being finished, the person-in-charge must make a second inspection and satisfy himself that the boreholes marked out by him have been drilled and cleaned properly.
- 10.2.5 The person-in-charge must prepare all charges necessary for boreholes.
- 10.2.6 Number of holes to be loaded and fired at one time shall be as per explosive rules. Boreholes must be thoroughly cleared before a cartridge is inserted.
- The loading is to be done by the person-in-charge himself and the position of the charge holes carefully noted by him. Circular wooden tamping rods only to be used in charging holes with flat bottom, (one cartridge at a time must be inserted) and cartridge gently pressed with the tamping rod.
- 10.2.7 Immediately before firing a blast, due warning must be given and the person-in-charge must see that all the labours have retired to safety.
- 10.2.8 The safety fuses of the charged holes are to be lighted in the presence of the person-in-charge, who must see that the fuses of the holes charged have properly ignited.
- After the blast, the person-in-charge must carefully inspect the work and satisfy himself that all the charges have exploded.
- 10.3 Misfires
- 10.3.1 Misfires are a source of great danger. If it is suspected that part of the blast to fire is delayed, sufficient time shall be allowed to elapse before entering the danger zone. When fuse and blasting caps are used, a safe time of at least an hour should be allowed.
- 10.3.2 None of the drillers are to work near these holes until the three following operations have been done by the person-in-charge.
- a. The Person-in-charge should very carefully extract the tamping with a wooden scrapper and withdraw the fuse with the primer and detonator attached, after which a fresh primer and detonator with fuse should be placed in this hole and fired; or
- b. The hole may be cleared of 300mm of tamping and the direction then ascertained by placing a stick in the hole. Another hole may then be drilled 150mm away and parallel to it: this hole to be then charged and fired when the other charge should explode.
- c. Drilling in holes not completely exploded by blasting shall not be permitted.
- 10.4 Precautions Against Misfire
- 10.4.1 The safety fuse should be cut in an oblique direction with a knife.
- 10.4.2 All saw dust must be cleared from the inside of the detonator; this can be done by blowing down the detonation and tapping the open end. No instrument shall be inserted into the detonator for this purpose.
- 10.4.3 After inserting the fuse in the detonator, it shall be fixed by means of nippers.



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- 10.4.4 If there is water present, or if the boreholes be damp, the junction of the fuse and detonator must be made water tight by means of grease, white lead or tar.
- 10.4.5 The detonator should be inserted into the cartridge, so that about one third of the copper tube is left exposed outside the explosives. The safety fuse outside the detonator, should be necessarily tied in position in the cartridge. Waterproof fuse only to be used in the damp boreholes, or when water is present in the borehole.
- 10.4.6 If a misfire has been found to be due to defective fuse, detonator or dynamite, the whole quantity or box from which the detective article was used shall be rejected.
- 10.4.7 Storage of materials for blasting shall be as per statutory regulations / stipulations of the concerned authorities.
- It shall be the Contractor's responsibility to arrange for proper storage of explosives and obtain required permissions from concerned authorities. No separate payment shall be payable for the above.
- 10.4.8. Cleaning of Excavation
- Excavation shall be cleaned, trimmed to exact shape and all disturbed material and other debris shall be removed. When the excavation have been taken out to the lines specified as shown on the drawings and the surface cleaned as specified, the contractor shall notify the Engineer that the excavation is ready for inspection and no further work shall be done with concrete or backfill until it has been inspected and approved by the Engineer. Cost of this work is deemed to have been included in the unit rates for excavation.
- 10.4.9. Use of Excavation Material
- Where any material obtained from the excavation is, in the opinion of the Engineer, suitable for use in a particular section of the work as fill or backfill, such material shall be selected and if necessary, loaded, hauled, placed, spread and used to construct the fill or backfill with respect to the lines and grades specified for the work. As far as possible the most suitable of the materials excavated for the work shall be used to construct the fill and backfill embankments, roads and storage areas, where required. The useful rock available shall be stacked at the locations as decided by the Engineer and the cost of this work is deemed to have been included in the Unit rate of excavation.
- Materials containing brush roots or other perishable materials shall not be considered suitable. The suitability of the materials and their disposition in the work shall be subject to the approval of the Engineer-in-Charge.
- 10.4.10 Disposal of Surplus material
- All surplus materials shall be carried away from the site and disposed at dumping sites selected by the Engineer, up to a lead as indicated in the relevant items of the schedule of rates. The Engineer may ask the contractor to dump the excavated materials in regular heaps, bunds, blankets, riprap with regular slopes as directed by the Engineer and levelled so as to provide natural drainage. As a rule, all softer material shall be laid along the centre of heaps, with the harder and more weather resisting materials forming the casing on the sides and the top. Excavated rocks, which can be used in soling as road metals or for making concrete aggregate shall be stacked separately, as directed by the Engineer.
- All such works as mentioned above is deemed to have been taken into account while quoting for the excavation and the contractor for the above works shall claim no extras.
- All rock excavated from the pits shall be the property of the Owner.
- 10.4.11 Stock Piles



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When the removal of material from excavation progresses at a faster rate or at different times than placement in backfill is being accomplished, such excavated materials shall be stock piled at approved locations adjacent to the work until their use is authorised.

10.4.12 Spoil Areas

Material excavated for the works, which is rejected as unsuitable or not required by the Engineer, shall be disposed of in spoil areas as specified by the Engineer.

The spoil areas shall be left in a neat and sightly condition and sloped to drain properly as may be directed by the Engineer.

10.5 Control Blasting

10.5.1 General

This specification lays down the requirements for control blasting for rock excavations wherever required.

Wherever required by the Engineer, the rock blasting shall be controlled, so that vibration generated during the blasting do not cause damage to the buildings and installation around built up areas. Similarly the rock pieces should not fly off the pits and thus damage the buildings and installation around. Apart from the general precautions mentioned in the preceding paragraphs, following protective measures are suggested as guidelines. Tenderers are requested to carefully check the site conditions and submit the details of the scheme they propose to adopt for controlling the blast.

10.5.2 Protective Measures

- a. Short delay blasting with light charges shall be used.
- b. The blast hole shall be covered with 0.6 to 1.0 sqm. mild steel plate of minimum 6mm thickness.
- c. Reinforcement rod mesh, not less than 20mm dia at 150mm centres in both directions, shall be put over the steel plates.
- d. Steel plate and reinforcements shall be inspected after every blasting operation and all twists shall be removed before reuse, to the satisfaction of the Engineer-in-Charge.
- e. The thickness of the covering plate and the kind of dead weight shall be duly got approved from the Engineer-in-Charge.

When blasting is necessary adjacent to partially or completely built structures, the contractor shall take all precautions necessary to prevent flying rock from causing damage to the structures.

In no case shall blasting be allowed closer than 15m to any structure after concrete placing has started.

The contractor shall be responsible for all damage caused by blasting, whether permanent or temporary structure and shall replace or repair the structures at his own cost.

10.6 Classification of soil

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

In above case, the total quantity of Excavation shall be computed from the measurement of the area 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



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be paid as soil as per the discretion of the Engineer-in-Charge. However, the maximum payment shall be limited to the volume of the area excavated, as approved by Engineer-in-charge.



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ABBREVIATIONS

cm	:	Centimeter
IRC	:	Indian Road Congress
IS	:	Indian Standard
mm	:	Millimeter
P.I	:	Plasticity Index
WBM	:	Water Bound Macadam



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1.0 SCOPE

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

2.0 REFERENCES

2.1 Codes & Standards

IS: 460 Specifications for Test Sieves

IS 2430: Methods for sampling of aggregates for concrete

IS: 2720 Methods of Test of Soil

IRC: 19 Standard Specification and Code of Practice for Water Bound Macadam

IRC: 36 Recommended Practice for the Construction of Earth Embankments for Road Works

2.2 Specifications

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

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

3.0 CONSTRUCTION OF EMBANKMENTS SUBGRADE AND SHOULDERS

3.1 Materials

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

i) Mechanical analysis or grain size analysis as per IS: 2720 Part IV.

ii) Liquid limit as per IS: 2720 Part V.

iii) Plastic limit as per IS: 2720 Part V.

iv) Moisture density relationship as per IS: 2720 Part VIII.

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

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

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

3.2 Filling and Compaction

3.2.1 The area where filling is to be placed must be cleared of all loose material and virgin soil must be exposed. Such exposed surface must be consolidated properly to obtain 95% of maximum laboratory dry density of the soil as per IS: 2720 Part VIII. All soft patches must be worked out to remove the soft soil and selected approved earth must be filled back and compacted.



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- 3.2.2 Payment for the removal of loose top soil as described in clause 3.2.1 above shall be included in the item for earthwork in filling. No separate payment for consolidation of exposed ground surface will be made. The rate quoted for the earth fill shall be inclusive of the cost of clearing and stripping, consolidation, including watering, testing etc. of the exposed ground.
- 3.2.3 Approved fill material shall be spread in uniform layers not exceeding 20 cm in loose depth for embankment filling. Shoulder construction shall be so organised as to keep pace with the construction of different layers of the pavement, which may require earth fill thickness less than 20 cm. All clods, lumps etc. shall be broken before compaction.
- 3.2.4 In general the soil shall be spread uniformly over the entire width of embankment or shoulder as the case may be. For large embankments, the spreading of soil shall be as directed by Engineer-in-Charge.
- 3.2.5 Successive layers of filling shall not be placed until the layer under construction has been thoroughly compacted to satisfy the requirements laid down in this specification.
- 3.2.6 Prior to rolling, the moisture content of material shall be brought to within plus or minus 2% of the optimum moisture content as described in IS: 2720 - Part-VIII. The moisture content shall preferably be on the wet side for potentially expensive soils.
- 3.2.7 After adjusting the moisture content as described in Clause 3.2.6, the layers shall be thoroughly compacted by means of 8-10T rollers or equivalent vibratory rollers till 95% of maximum laboratory dry density for embankment and 97% of maximum laboratory dry density for sub-grade as per IS:2720 Part VIII is obtained.
- 3.2.8 Each layer shall be tested in field for density and accepted by Engineer-in-Charge subjected to achieving the required density before laying the next layer. A minimum of one test per 500m² area for each layer shall be conducted.
- 3.2.9 All type of rollers that should be employed for compaction shall be as per direction of Engineer-in-Charge.
- 3.2.10 If the layer fails to meet the required density, it shall be reworked or the material shall be replaced and method of construction altered as directed by Engineer-in-Charge to obtain the required density.
- 3.2.11 The filling shall be finished in conformity with alignment, levels, cross-sections and dimensions as shown in the drawings.
- 3.2.12 Extra material shall be removed and disposed off as directed by Engineer-in-Charge.
- 3.3 Tolerance
- Embankment and shoulders for roads, units etc. shall be carried to within a tolerance of plus minus 2.5 cm. from final lines but shall be to required grades and slopes.
- 4.0 FILLING WITH SAND/MURRUM**
- 4.1 Sand having Plasticity Index 6 (Max) shall be used for filling. Sand for filling shall preferably be locally available sand, clean and free from any chemical or other impurities. Murrum for filling shall be clean and well graded. Sand/Murrum shall not contain any vegetation, organic, clayey or other material and shall be obtained from a source approved by Engineer-in-Charge.
- 4.2 Murrum/Sand shall be spread in layers not exceeding 15 cm in loose thickness over the areas. Each layer shall be uniform in density, quality of material and ' moisture content before compaction. The moisture content shall be within two percent of the optimum moisture content as per IS: 2720 Part VIII.
- 4.2.1 In case of pure sand, flooding with water is permissible.



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- 4.3 Compaction of each layer shall be by mechanical means as per directions of Engineer-in-Charge. Only in accessible reaches shall be worked manually. Each layer shall be uniformly compacted to obtain 85% relative density in case of sand and 95% of maximum laboratory dry density in case of murrum. If the material fails to achieve the required density, the layer shall be reworked with necessary alteration in compaction, so that the required compaction is obtained. A minimum of one test per 500 m² area for each layer shall be conducted.
- 4.4 Subsequent layers shall be placed only after the layer already laid has been compacted to the required density-and approved by Engineer-in-Charge.
- 4.5 The finished surface must be dressed to required grade and slope. Excess material must be removed from compaction site, as directed by Engineer-in-Charge.

5.0 WATER BOUND MACADAM SUB BASE/BASE COURSE

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

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

5.1 Materials

5.1.1 Stone Aggregate for WBM

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

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

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

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

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

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

- i) Los Angles Abrasion Value 60% (Maximum)

or

ii) Aggregate Impact Value 50% (Maximum)

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

i) Los Angles Abrasion Value 50% (Maximum)

or

Aggregate Impact value 40% (Maximum)

ii) Flakiness index value 15% (Maximum)

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

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

5.1.2 Screenings

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

Grading Requirement of Screening

Size Range	Sieve Designation (IS: 460)	% by weight passing the sieve
13.2mm	13.2 mm	100
	11.2 mm	95-100
	5.6 mm	15-35
	18 micron	0-10

This grading, however, shall not be mandatory, in case either murrum or gravel is used as screening. For procurement of quantities for course aggregates and screenings required for 100mm and 75mm compacted thickness of WBM sub base course and base course shall be as per the IRC-19.

5.1.3 Binding Material

Binding material, to prevent revelling of WBM, shall consist of fine grained material possessing P.1 value up to 6.

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

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

5.2 Laying of WBM

5.2.1 Spreading Course Aggregates

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

aggregate. The practice of constructing WBM in a trench section excavated on the embankment/formation must be avoided.

- 5.2.1.2 The coarse aggregate shall be spread uniformly and evenly on the prepared base in required quantities from the stacks. The aggregate shall be spread to proper profiles by using templates across the road about 6 m apart.
- 5.2.1.3 The surface of the aggregate spread shall be carefully, trued up and all high or low spots remedied by removing or adding aggregate as may be required. The surface shall be checked from time to time, during the spreading and rolling of the coarse aggregate to ensure a finished surface without variation greater than 12 mm, when a 3 meter long straight edge is laid parallel to centre line of the road.
- 5.2.1.4 The WBM layer shall be tested by depth blocks. No segregation on large or fine particle shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pocket of fine materials.
- 5.2.1.5 The coarse aggregate shall not be spread in lengths more than 3 days average work in advance of the rolling, spreading murrum and bonding of the preceding section.
- 5.2.2 Rolling Road Metal
- 5.2.2.1 Immediately following the spreading of the coarse aggregates, it shall be compacted to full width by rolling with either three wheeled power roller of 8 to 10 tonne weight or equivalent vibratory roller true to the line and camber as shown in the drawing. The course shall not be rolled when the sub-grade is soft or yielding or the rolling causes a wave like motion in the base course or sub-grade. When rolling develops irregularities that exceed 12mm when tested with a 3 meter straight edge, the irregular surface shall be loosened and then aggregate added to or removed from it as required and the area rolled until it gives uniform surface conforming to the desired cross-section and grade. The surface shall also be checked transversely by template and any irregularities corrected as above. The use of murrum to make up depression shall not be permitted.
- 5.2.2.2 The rolling shall begin from edges with roller running forward and backward until the edges have been firmly compacted. The rolling shall then progress gradually from edges to the centre parallel to the centre line of the road lapping uniformly each preceding rear wheel track by one half width and shall continue until the entire area of the course has been rolled by the rear wheel. On the super elevated portions of road, the rolling shall commence from the lower edge and progress gradually towards the upper edge of the road.
- 5.2.2.3 Rolling shall be discontinued when aggregate are thoroughly keyed and creating of stone wheel of roller is no longer visible partially compacted with sufficient void space in them to permit application of screenings. Slight sprinkling of water may be done if required.
- 5.2.3 Application of Screening
- 5.2.3.1 After the coarse aggregate has been rolled as described in Clause 5.2.2, screenings shall be applied uniformly and gradually over the surface to completely fill the interstices. Dry rolling shall be continued while the screenings are being spread so that the jarring effect of the roll will cause them to settle into the voids of the coarse aggregates.
- 5.2.3.2 The screenings shall not be dumped in piles on coarse aggregate but shall be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanic spreaders.
- 5.2.3.3 The screenings shall be applied at a uniform and slow rate (in three or more applications so as to ensure filling of all voids. Rolling and brooming shall continue with the spreading of the screenings. Either mechanical brooms or hand brooms or both may be used. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface making the filling of voids difficult or preventing the direct bearings of the roller on the coarse aggregates. The spreading, rolling and brooming of screenings shall be performed on sections which can be completed within one day's

operation and shall continue until no more screenings can be forced into the voids of the coarse aggregates. Damp and wet screening shall not be used under any circumstances.

5.2.3.4 The quantity of screenings used shall be such as to fill all voids in the water bound macadam courses.

5.2.4 Sprinkling and Grouting

5.2.4.1 After spreading the screening, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling shall be continued and additional screenings applied where necessary until the coarse aggregates are well compacted and grout of screenings and water form a wave ahead of wheels of the roller. Care shall be taken to see that the base of the sub-grade does not get damaged due to the addition of the excessive quantity of water during the construction.

5.2.5 Application of Binding Material

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

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

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

5.2.6 Setting and drying

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

5.2.7 Subsequent layers of WBM

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

The specification and mode of measurement for subsequent layers of WBM will be similar to that described before.

6.0 CONSTRUCTION OF SHOULDERS OR BERMS

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

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

7.0 PAYMENT

7.1 Filling in embankment, sub grade and shoulders



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- 7.1.1 Payment for filling shall be made on cubic meter of volume calculated on the basis of cross section plotted from the level of the ground surface prepared as described in clause 3.2 above and from where filling is to be carried out and the levels reached after filling and due consolidation.
- 7.1.2 Rates for embankment, shoulder or fill formation shall include cost of breaking clods, watering, consolidation, providing testing apparatus and testing the degree of consolidation, providing and operating, including POL and operator charges of necessary road rollers and other equipment, dressing and levelling of sides and top surfaces etc.
- 7.2 Filling with sand / murrum
- Payment for sand/murrum filling shall be made on the basis of volume of fill, after placement and compaction. The rate quoted shall include cost of sand/murrum, royalties, transportation, handling, compacting, watering, testing at various stages, dressing, removal of surplus material and any other work incidental to this.
- 7.3 Water Bound Macadam Sub Base/ Base Course
- Paying for laying WBM shall be made on square meter basis of each layer of WBM laid, measured after consolidation and finishing. Rate shall include supply of all materials, royalty, taxes, handling, transportation, spreading metal in layers, including screenings, consolidation by power roller, binding with murrum or other approved binding material, cost of carrying the material to work for all leads and lifts, providing and running roller etc. complete as per specifications and satisfaction of Engineer-in-Charge.
- 7.4 Subsequent layers of WBM
- Payment for surface preparation, rectification of damaged portions of Proceeding layers of water bound macadam and filling in ruts and depressions shall be made in M2 or M3 as per schedule of items. Payment for subsequent layer of WBM shall be made on M2 basis as per Cl. No.5.2.6.
- 7.5 The payment clause indicated above are not applicable in case of LSTK Jobs



**STANDARD SPECIFICATION
CIVIL & STRUCTURAL WORKS
EARTHWORK**

C-SPC-103

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Rev.	Date	Purpose	Prepared by	Reviewed by	Approved by	Approved by



**STANDARD SPECIFICATION
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ABBREVIATIONS

CNS : Cohesive Non Swelling



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EARTHWORK**

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1.0 SCOPE

This specification deals with earth work in excavation and filling.

2.0 CLASSIFICATION OF SOIL

2.1 Ordinary Soil

2.1.1 Soft Soil/ Loose Soil

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

- 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 Ifhe 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**

PLAIN AND REINFORCED CEMENT CONCRETE

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

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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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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



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	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 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-Singlesized/ 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 ± 75 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



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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	$\geq f_{ck} + 0.825 \times$ established standard deviation (rounded off to nearest 0.5N/mm ²) or $\geq f_{ck} + 3$ N/mm ² , Whichever is greater	$\geq f_{ck} - 3$ 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 $f_{ck} + 4$ N/mm² minimum and the requirement of individual test results shall be $f_{ck} - 2$ N/mm² minimum. However, when the number of sample is only one as per Table 4. the requirement shall be $f_{ck} + 4$ N/mm².</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 smoothed 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 |
| 3mto6m | 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 comer shall not be more than the limit given below from the plane containing other three comers:
- | | |
|---------------------------------------|------|
| 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 fanned 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 ± 10mm



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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.



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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 corners, 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 undeq,innings, 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
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 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, day bails 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.

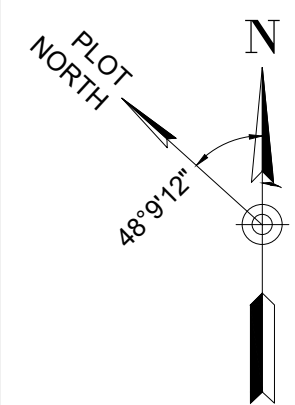
8.1 Plastering & Pointing

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.

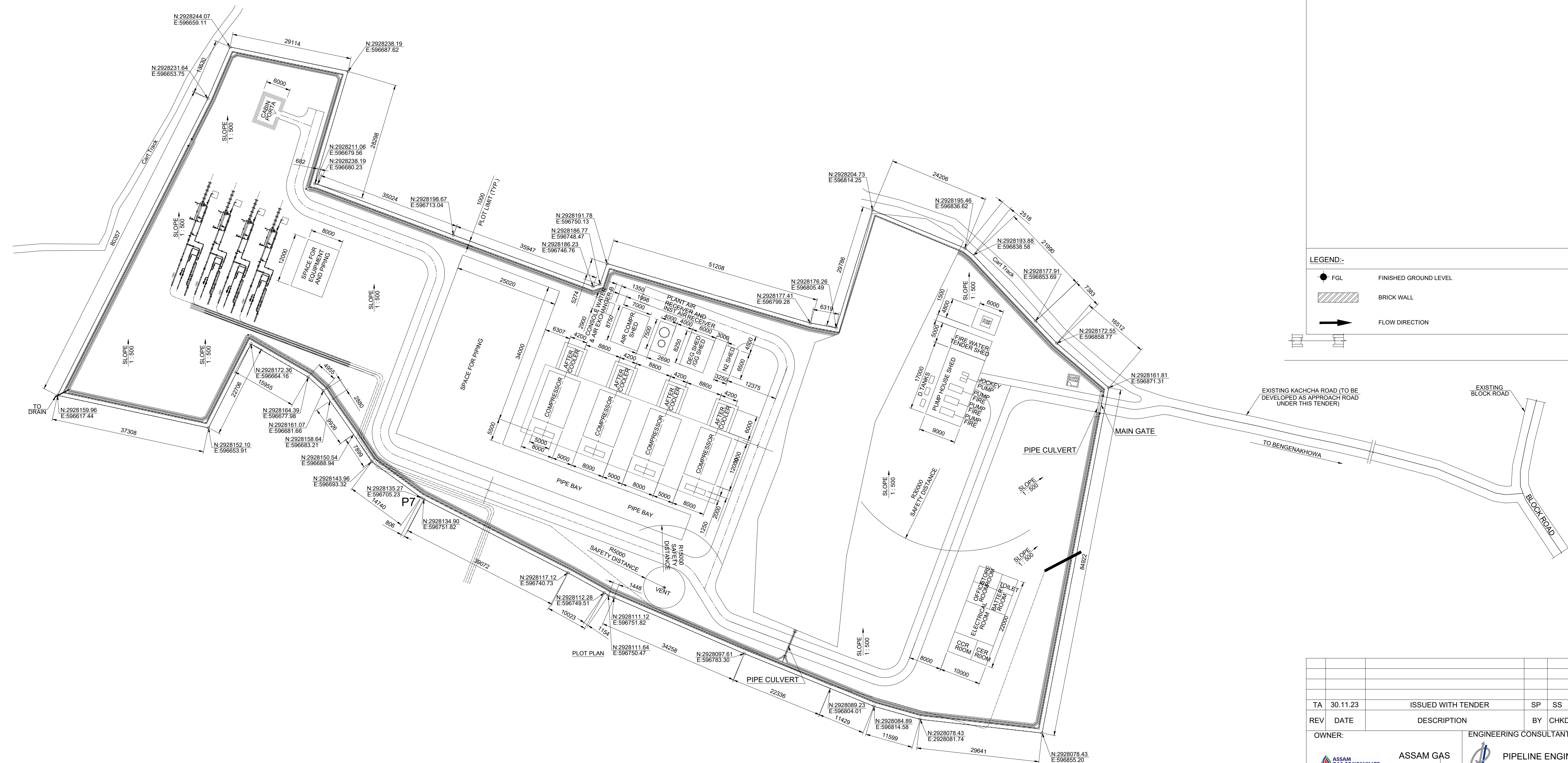


REFERENCE DRAWINGS	
DRAWING TITLE	DRAWING NUMBER
TOPOGRAPHICAL SURVEY DRAWING OF RUPKHELIA TERMINAL SURVEY AREA: 19094.786SQM(4.718ACRES)	SKP/RUPKHELIA TERMINAL

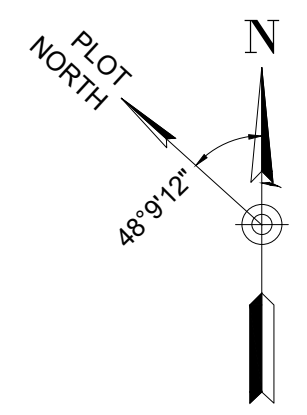
NOTES:-
 1. ALL DIMENSION ARE IN MM AND CO-ORDINATES AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
 2. EL100.00 (FGL) CORRESPONDS TO R.L. 111.400.
 3. MINIMUM SLOPE 1:500 SHALL BE PROVIDED IN GRADED AREA.

LEGEND:-

	FGL FINISHED GROUND LEVEL
	BRICK WALL
	FLOW DIRECTION



TA	DATE	DESCRIPTION	ISSUED WITH TENDER	SP	SS	RKB
TA	30.11.23					
REV						
OWNER:			ENGINEERING CONSULTANT :			
ASSAM GAS COMPANY LTD.			PIPELINE ENGINEERING CONSULTANTS PVT. LTD.			
PROJECT: EPMC SERVICES FOR DEVELOPMENT OF RUPKHELIA PIPELINE TERMINAL						
DWG. TITLE : PLOT PLAN FOR RUPKHELIA (GOLAGHAT) STATION						
SCALE:	JOB NO.	DRAWING NUMBER		REV.		
1:500	P168	P168-00-DWG-C001		TA		



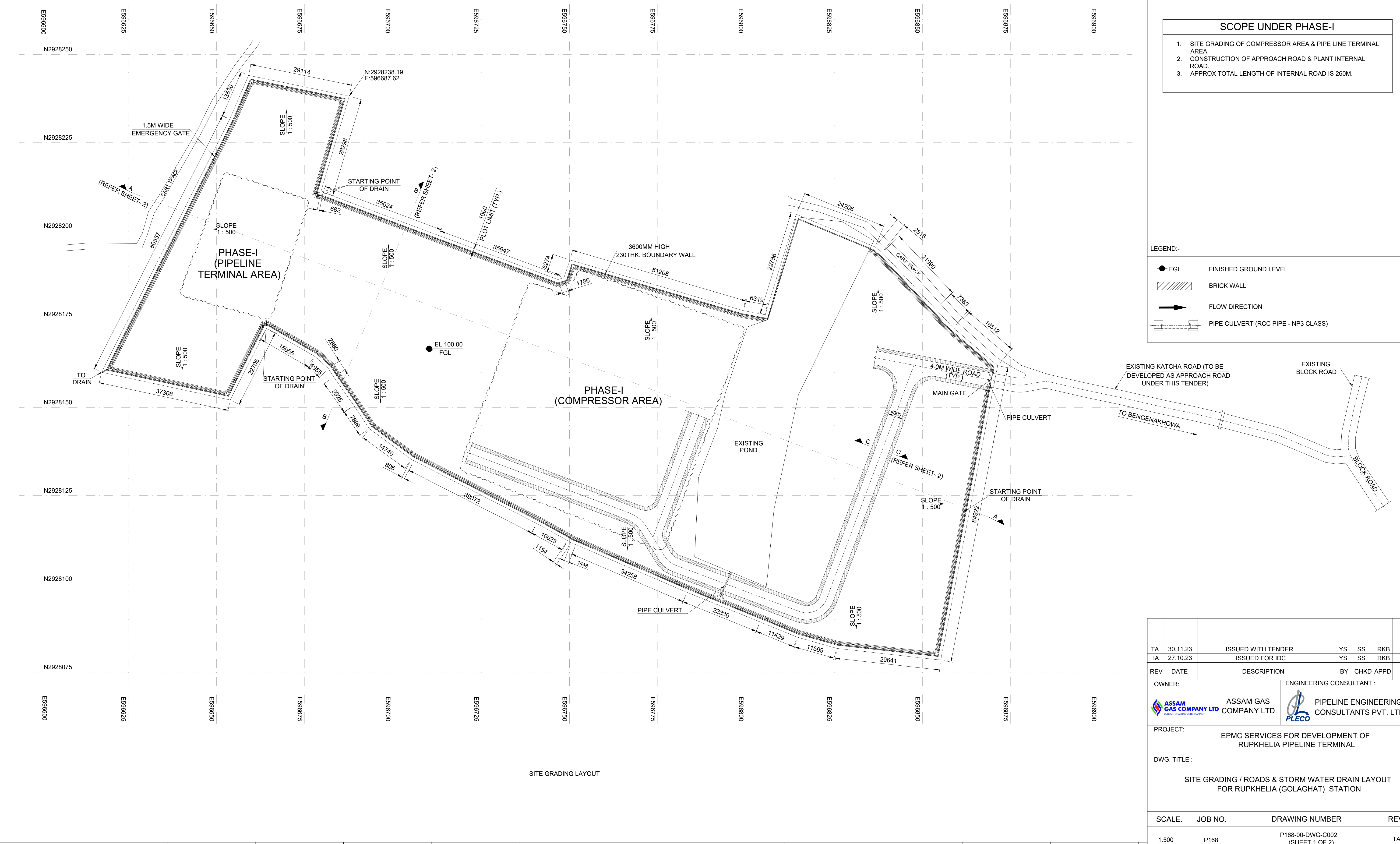
REFERENCE DRAWINGS	
DRAWING TITLE	DRAWING NUMBER
TOPOGRAPHICAL SURVEY DRAWING OF RUPKHELIA TERMINAL SURVEY AREA: 19094.786SQM (4.718ACRES)	SKP/RUPKHELIA TERMINAL
PLOT PLAN FOR RUPKHELIA (GOLAGHAT) STATION	P168-00-DWG-6001

- NOTES:-
1. ALL DIMENSION ARE IN MM AND CO-ORDINATES AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
 2. EL.100.00 (FGL) CORRESPONDS TO R.L. 111.400.
 3. MINIMUM SLOPE 1:500 SHALL BE PROVIDED IN GRADED AREA.
 4. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH SITE GRADING LAYOUT DRAWING NO. P168-00-DWG-C002 (SHEET 2 OF 2)

- SCOPE UNDER PHASE-I**
1. SITE GRADING OF COMPRESSOR AREA & PIPE LINE TERMINAL AREA.
 2. CONSTRUCTION OF APPROACH ROAD & PLANT INTERNAL ROAD.
 3. APPROX TOTAL LENGTH OF INTERNAL ROAD IS 260M.

LEGEND:-

	FGL FINISHED GROUND LEVEL
	BRICK WALL
	FLOW DIRECTION
	PIPE CULVERT (RCC PIPE - NP3 CLASS)



TA	30.11.23	ISSUED WITH TENDER	YS	SS	RKB
IA	27.10.23	ISSUED FOR IDC	YS	SS	RKB
REV	DATE	DESCRIPTION	BY	CHKD	APPD

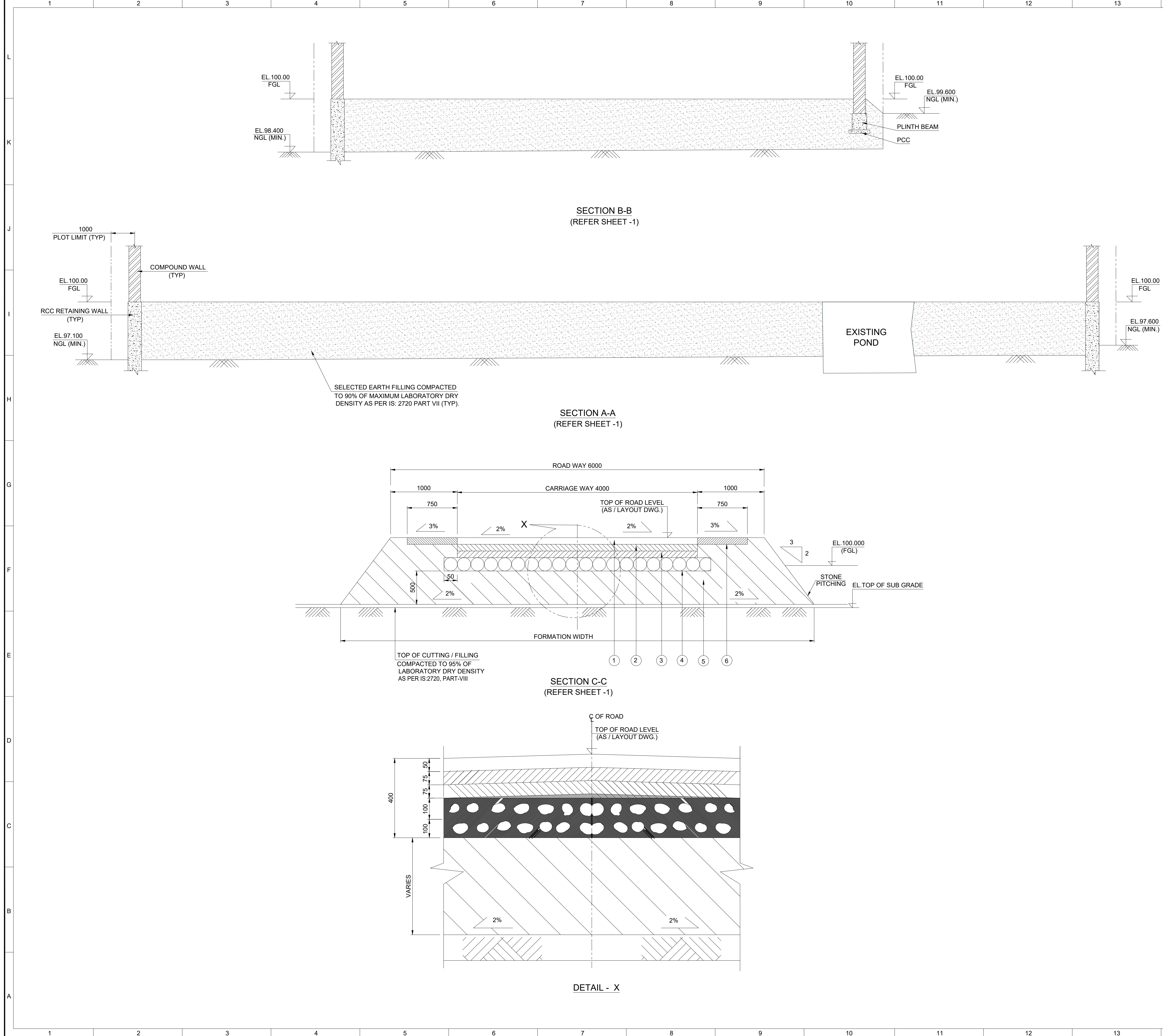
OWNER: ASSAM GAS COMPANY LTD COMPANY LTD. ENGINEERING CONSULTANT: PIPELINE ENGINEERING CONSULTANTS PVT. LTD.

PROJECT: EPMC SERVICES FOR DEVELOPMENT OF RUPKHELIA PIPELINE TERMINAL

DWG. TITLE: SITE GRADING / ROADS & STORM WATER DRAIN LAYOUT FOR RUPKHELIA (GOLAGHAT) STATION

SCALE.	JOB NO.	DRAWING NUMBER	REV.
1:500	P168	P168-00-DWG-C002 (SHEET 1 OF 2)	TA

SITE GRADING LAYOUT



REFERENCE DRAWINGS	
DRAWING TITLE	DRAWING NUMBER
TOPOGRAPHICAL SURVEY DRAWING OF RUPKHELIA TERMINAL SURVEY AREA:19094.786SQM(4.718ACRES)	SKP/RUPKHELIA TERMINAL

- NOTES:-**
- ALL DIMENSION ARE IN MM AND CO-ORDINATES AND LEVELS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
 - EL.100.00 (FGL) CORRESPONDS TO R.L. 111.400.
 - THIS DRAWING SHALL BE READ IN CONJUNCTION WITH SITE GRADING LAYOUT DRAWING NO. P168-00-DWG-C002 (SHEET 1 OF 2)

SELECTED EARTH USED FOR FILLING / BACK FILLING SHALL BE AS PER GEOTECH RECOMMENDATION .

- PREMIX BITUMENOUS CARPET WITH SEAL COAT.
- SECOND LAYER WATER BOUND MACADAM COURSE WITH GRADE-II AGGREGATE.
- FIRST LAYER WATER BOUND MACADAM COURSE WITH GRADE-II AGGREGATE.
- SUB BASE COURSE TWO LAYERS OF WBM WITH GRADE-I AGGREGATE.
- APPROVED MATERIAL FROM SITE COMPACTED TO 95% OF MAXIMUM LAB. DRY DENSITY AS IS 2720 PART VIII.
- 75mm THK. WATER BOUND MACADAM COURSE WITH GRADE-II AGGREGATE.

LEGEND:-

FGL	FINISHED GROUND LEVEL
NGL	NATURAL GROUND LEVEL
	BOUNDARY WALL
	FILLING
MIN	MINIMUM
	HOLD (NOT PART OF THIS TENDER)

TA	30.11.23	ISSUED WITH TENDER	YS	SS	RBS
IA	27.10.23	ISSUED FOR IDC	YS	SS	RBS

REV	DATE	DESCRIPTION	BY	CHKD	APPD
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OWNER: ASSAM GAS COMPANY LTD. ENGINEERING CONSULTANT: PLECO PIPELINE ENGINEERING CONSULTANTS PVT. LTD.

PROJECT: EPMC SERVICES FOR DEVELOPMENT OF RUPKHELIA PIPELINE TERMINAL

DWG. TITLE: SITE GRADING & ROADS CROSS SECTIONAL DETAILS FOR RUPKHELIA (GOLAGHAT) STATION

SCALE	JOB NO.	DRAWING NUMBER	REV.
1:400	P168	P168-00-DWG-C002 (SHEET 2 OF 2)	TA

