

**Name of work :- Construction of CD Works at Various Village of
Junagadh District Package NO.RPC-
2/JND/MMGSYSTRCSCSP/PER USAL/202526/PKG
NO.6,TA.MALIYA HATINA -MENDARDA**

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

1.0 PREAMBLE:-

1.1 The Technical Specifications contained herein shall be read in conjunction with the other Bidding Documents as specified in this Volume.

1.2 Site Information:-

1.2.1 The information given here under provided elsewhere is given in good faith by the Employer but the Contractor shall satisfy himself regarding all aspects of site conditions and no claim will be entertained on the plea that the information supplied by the Employer is erroneous or insufficient.

2.0 GENERAL REQUIREMENTS:-

The technical specifications in accordance with which the entire work described herein after shall be constructed and completed by the Contractor shall comprise of the "SPECIFICATION"

2.1 Though "SPECIFICATION" for each item are attached with tender they are based on following.

(1) "SPECIFICATION FOR ROAD AND BRIDGE WORKS" (Fifth REVISION printed in year 2013) issued by the Ministry of Road Transport & Highways (MORT & H), Government of India and Published by the Indian Roads Congress, hereinafter to as MORT & H Specifications.

(2) The General Technical Specifications for Road works.

(3) The General Technical Specifications for Bridge works.

Note:- (2) To (3) are Conventional Specifications Booklets usually attached for (R&B) Works.

2.2 If, a particular clause (which is incorporated in "SPECIFICATION") of specification booklets (1) to (3) above is Amended / Modified/ Added upon then the Amendment/ Modification/Addition shall supersede the relevant clause incorporated in " SPECIFICATION"

2.3 In, so far as Amended / Modified / Added Clause may come in conflict or be inconsistent with any of the provisions of the MORT & H Specifications under reference, the Amended/Modified/ Added Clause and the additional specifications shall always prevail.

2.4 In the absence of any definite provisions on any particular issue in the aforesaid Specifications, reference may be made to the latest codes and specification, of IRC and BIS in that order. Where even these are silent, the construction and completion of the works shall conform to sound engineering practice as approved by the 'Engineer' and , in case of any dispute arising out of the interpretation of the above, the decision of the 'Engineer' shall be final and binding on the Contractor.

The Technical Specifications contained herein shall be read in conjunction with the other Bidding stipulations.

1.0 TECHNICAL SPECIFICATIONS:

The Technical Specifications in accordance with which the entire work described hereinafter shall be constructed and completed by the Contractor shall comprise of the following:

- 1.1 The General Technical Specifications shall be the "SPECIFICATIONS FOR ROAD AND BRIDGE WORKS (FIFTH REVISION, April 2013)", as corrected in the original issued by the Ministry of Road Transport & Highway, Government of India and published by the Indian Roads Congress, New Delhi.
- 1.2 In the absence of any definite provisions on any particular issue in the aforesaid Specifications, reference may be made to the latest codes and specifications of IRC and BIS in that order. Where even these are silent, the construction and completion of the works shall conform to sound engineering practice as approved by the Engineer and in case of any dispute arising out of the interpretation of the above, the decision of the Engineer shall be final and binding on the Contractor.
- 1.3 During construction of foundation, substructure and superstructure of bridge, tilt or shift occur due to high flood; contractor / agency has to rectify the same as per IRC requirement at his own cost.

2.0 GENERAL SPECIFICATIONS

- 2.1 The details of reinforcement of RCC work shall be as per design and instructions of Authority and his order will be considered final.
- 2.2 The Contractor shall have to maintain account of steel, cement and other materials that may be brought by him on site. The account shall be regularly maintained and kept open for inspection by Authority.
- 2.3 The Contractor shall remain responsible for workmen's compensation if any, when such case occurs, the Contractor shall arrange for red lamps at night and fencing and pagi and shall be responsible for any damage of life and lime or property if any happen, during the execution of work. In case of dispute for unseen or overlooked items, the decision of Authority shall be final. The Contractor shall have to give site clean of all rubbish on completion of work and hand over

the bridge with final finishing of the work as directed. All the rejected materials shall be removed from site within 24 hours by contractor at his risk and cost.

- 2.4 For mixing mortar either for masonry or for plaster or for any other purpose contractor shall have to prepare trough of bigger size and mix the mortar in required proportion. In no case he shall be allowed to mix the mortar either on floor or any finished surfaces.
- 2.5 The Contractor shall have to make his own arrangement for water required for the work and shall pay the water charges as per rules.
- 2.6 If in the interest of the Employer or site conditions it is necessary to change either any site or the design of the proposed work the Contractor shall carry out the same at his quoted rates, without charging any extra and he will be paid at the rates quoted by him and no claim for extra charges made will be entertained.
- 2.7 "Cement and Steel will not be supplied by the Employer. The Contractors have to make their own arrangements for procurement of indigenous Portland cement or imported Portland cement HYSD, TMT bars, Structural Steel and M.S. Round Bars including coils and Ribbed for Steel and prestressing strands for the entire work. The contractors shall have to give necessary test certificates as per relevant I.S Code before using the same in the work".
- 2.7.1 The Contractor will be fully responsible for compliance of the various provisions under Contract Labour Act, 1970 and the Rules framed there under.
- 2.8 All defective works are liable to be demolished, rebuilt and defective materials replaced by the Contractor at his own cost. In the event of such works being accepted by carrying out repairs etc as specified by the Engineer in charge, the cost of repairs will be borne by the Contractor and will be paid for the works actually carried out by him at reduced rates of the tendered rates, as may be considered reasonable by the Engineer in charge in the preparation of final or on account bills.

2.10 Concrete Mix Design:

It is brought to the notice of the Contractor that the concrete design mix for higher grade of controlled concrete is required for foundation, substructure and super structure of bridge and other work. This richer mix is necessary from technical considerations. The Contractor should therefore, study all the possibilities of achieving the desired results for the richer mix. He should collect the coarse and fine aggregates of the best quality. The cement used for this type of concrete should be got tested periodically and should not be more than 3 months old. The Contractor may study the possibility should of adding the necessary plasticizers and ad-mixtures to achieve this strength with desired workability and finishes without affecting durability and damaging the reinforcement and high tensile steel. The cost for any plasticizer admixtures shall be borne by contractor.

2.11 Setting out Works

The Contractor shall be responsible for the true and proper setting out of the works and for the correctness of the positions levels, dimensions and alignment of all parts of the works and for the provisions of all necessary instruments and appliances and labour in connection therewith. If at any time during the progress of works any error shall appear or arise in the positions, levels, dimensions or alignment of any part of the works, the Contractor on being required to do so by the Engineer shall at his own expenses rectify such errors to the satisfaction of the Engineer-in-Charge. The checking of any setting out or of any lines and levels by the Engineer-in-Charge or his representative shall not in any way relieve the Contractor of his responsibility for correctness thereof and the Contractor shall carefully protect, preserve and maintain all bench marks, site rails, pegs etc. used in setting out the works. The costs of providing, preserving, protecting and maintaining the site rails, pegs, benchmark etc. shall be deemed to be included in the rate quoted for various items in the schedule B and no separate payment will be made for the same.

The Contractor shall incorporate into the structure the fixtures for lighting, drainage, road markers, signals etc. as may be given to him by the Engineer-in Charge, without claiming any extra cost.

- 2.12** All permanent and temporary works shall conform to the latest specifications of Codes of Indian Road Congress, Specifications of Road & Bridge works by Ministry of Road Transport and Highways, IS Standards and code of other relevant codes and prevailing sound Engineering practices as mentioned in the contract documents or approved by the competent authority as applicable.

2.13 Formed & Unformed Surface Finishes

The surface finishes for formed and unformed surfaces are classified and defined as below. Surface irregularities permitted for the various classes of finishes are termed either 'abrupt' or 'gradual'. Fins or offsets caused by displaced or misplaced form sheeting, lining or form sections, by loose knots in form lumber or by otherwise defective form lumber are considered abrupt irregularities. All other cases are described as gradual irregularities. Gradual irregularities will be measured with a template consisting of a straight edge for plans surfaces or its equivalent for curved surfaces. The length of template for testing gradual irregularities on formed surfaces shall be 1.5 m in length, the permissible gradual irregularities being measured over this length of the template.

Finish F1, F2 and F3 shall describe formed surfaces.

Finish U1, U2 and U3 shall describe unformed surfaces.

Class F1 Finish

This class of finish shall apply to all formed surfaces for which class F2 or F3 is not specified. It shall generally be formed by sawn timber formwork/timber frame or steel frame mounted with plywood or steel sheet. It shall be so constructed that there shall be no loss of

material from the concrete during placement and compaction. After hardening, the concrete shall be in the required positions and shall have the shape and dimensions called for in the drawings. Any abrupt irregularities shall not exceed 10mm. All fins and drifts in excess of the above limits shall be made good by chipping and grinding if required by the Engineer-in-Charge. Small blemishes caused by entrapped air or water may be expected but the surface shall be free from voids, honeycombing or other large blemishes. Class F1 finish shall be generally specified for all surfaces buried in ground or not visible during service or for surfaces that are to receive further rendering treatment such as plastering etc. Unless otherwise specified in the item of Bill of Quantity the surface finish shall be understood to be Class F1.

Class F2 Finish

Class F2 finish shall be obtained by the use of properly designed forms, either close jointed wrought timber forms or with forms having plywood or steel sheet lining. The abrupt irregularities shall not exceed 5mm and gradual irregularities shall be less than 8mm. Small blemishes caused by entrapped air or water may be permitted but the surface shall be generally free from honeycombing, voids and large blemishes. Surface irregularities in excess of those stipulated shall be removed by chipping or rubbing with abrasive stone.

Class F3 Finish

Class F3 finish shall be formed by specially designed close jointed rigid forms having lining of high quality form plywood. The surface irregularities shall be limited to nil for abrupt irregularities and 3 mm for gradual irregularities. Class F3 finish may be obtained from class F2 finish by carefully removing all abrupt irregularities including fins and projections by rubbing/grinding. If steel forms are used they shall have steel sheet backing faced with plywood.

In addition, finish F3 shall include filling air holes with mortar and treatment of the entire surface with sack rubbed finish. It shall also include clean up of loose and adhering debris. For a sack rubbed finish, the surface shall be prepared within two days after removal of the forms. The surface shall be wetted and allowed to dry slightly before mortar is applied by sack rubbing. The mortar used shall consist of one part cement to one and one half parts by volume of fine (I.S. No. 16 mesh) sand. Only sufficient mixing water to give the mortar a workable consistency shall be used. The mortar shall then be rubbed over the surface with a fine burlap or linen cloth so as to fill all the surface voids. The mortar in the voids shall be allowed to stiffen and solidify after which the whole surface shall be wiped clean with clean burlap such that all air holes etc. are filled and the entire surface presents a uniform appearance without air holes, irregularities etc.

Class U1 Finish

This is the screeded finish used on surfaces over which other finishes such as wearing coats etc. are to be placed. It is also the first step in the formation of U2 and U3 finishes. The finishing operation consists of leveling and screeding the concrete to produce an even and uniform surface so that the gradual irregularities are not greater than 5 mm. Surplus concrete should be

removed immediately after consolidation by striking it off with a sawing motion of a straight edge or template across a wooden or metal strip that has been set as guide. Unless the drawings specify a horizontal surface or show the slope required, the tops of narrow surfaces, such as stair treads, walls, curbs and parapets shall be sloped approximately 10 mm per 300 mm width. Surfaces to be covered with concrete topping, terrazzo and similar surfaces shall be smooth screeded and leveled to produce even surfaces, irregularities not exceeding 5mm.

Class U2 Finish

This is a floated finish used on all outdoor unformed surfaces not prominently exposed to view such as tops of piers etc. The floating may be done by hand or power driven equipment. It should not however be started until some stiffening has taken place in the surface concrete and the moisture film or 'shine' has disappeared. The floating should work the concrete no more than is necessary to produce a surface that is free from screed marks. All joints and edges should be finished with edging tools. It shall include the repair of gradual irregularities exceeding 5 mm. All abrupt irregularities shall also be repaired unless a roughened texture is specified.

Class U3 Finish

This is a trovelled finish used on all surfaces exposed to view at close quarters such as tops of parapets and kerbs etc. Steel troveling should not be started until after the moisture film and 'shine' have completely disappeared from the floated surface and the concrete has hardened enough to prevent an excess of fine material and water from being worked to the surface. Excessive troveling, especially if started too soon, tends to produce crazing and lack of durability. Too long a delay will result in a surface too hard for proper finishing. Steel troveling should be performed with a firm pressure that will flatten and smooth the sandy surface left by floating. Troveling should produce a dense, uniform surface free of blemishes, ripples and trovel marks. It shall include the repair of all abrupt irregularities and the repair of gradual irregularities exceeding 5 mm. It shall also include finishing the joints and the edges of concrete with edging tools.

Design and Workmanship, Removal, Protection and Reuse

The design and workmanship of these formwork has to be got approved from the Engineer. The method of removing formwork without damaging the 'form-finished' surface, use of de-bonding agents, the protection and repair of forms and forms-surfaces, and limit on re-use etc. are to be as per specification/drawings in absence of which the proposed details are to be got approved from the Engineer. All such methods will have to be suitably improved based on the result of mock-up or field use. The final procedure and details shall be improved till the specified/desired architectural finish is obtained.

Mock-up

After design and before incorporation in the main work, the effectiveness and success in achieving the desired finish has to be demonstrated/ confirmed by casting the mock-up. The approved 'mock-up' surface shall be retained till the end of the project and then the 'mock-up' should be dismantled/removed from the work site and disposed off as directed by the Engineer.

Quality Control for Road Works

GENERAL

901.1 All materials to be used, all methods to be adopted and all works to be performed shall be strictly in accordance with the requirements of these Specifications. The Contractor shall set up a field laboratory at locations approved by the Engineer and equip the same with adequate equipment and personnel in order to carry out Quality Control for works and all the required tests as per Specifications and/or as directed by the Engineer. The provision and maintenance of the laboratory shall be as per Clause 120 and/or as directed by the Engineer. The list of equipment and the facilities to be provided shall be got approved from the Engineer in advance.

901.2 The Contractor's laboratory shall be manned by a qualified Materials

Engineer/Civil Engineer assisted by experienced technicians, and the set-up should be got approved by the Engineer.

901.3 The Contractor shall carry out quality control tests on the materials and work to the frequency stipulated in subsequent paragraphs. In the absence of clear indications about method and or frequency of tests for any item, the instructions of the Engineer shall be followed.

901.4 For satisfying himself about the quality of the materials and work, quality control tests will also be conducted by the Engineer (by himself, by his Quality Control Units or by any other agencies deemed fit by him), generally to the frequency set forth hereunder. Additional tests may also be conducted where, in the opinion of the Engineer, need for such tests exists.

901.5 The Contractor shall provide necessary co-operation and assistance in obtaining the samples for tests and carrying out the field tests as required by the Engineer from time to time. This shall include provision of laboratory equipment, transport, consumables, personnel including labour attendants, assistants in packing and dispatching and any other assistance considered necessary in connection with the tests.

901.6 For the work of embankment, subgrade and pavement, construction of subsequent layer of same or other material over the finished layer shall be done after obtaining permission from the Engineer. Similar permission from the Engineer shall be obtained in respect of all other items of works prior to proceeding with the next stage of construction.

901.7 The Contractor shall carry out modifications in the procedure of work, if found necessary, as directed by the Engineer. Works falling short of quality shall be rectified/ redone by the Contractor at his own cost, and defective work shall also be removed from the site of works by the Contractor at

his own cost.

901.8 The cost of laboratory building including essential supplies like water, electricity, sanitary services and their maintenance and cost of all equipment, tools, materials, labour and incidentals to perform tests and other operations of quality control according to the Specification requirements shall be deemed to be incidental to the work and no payment shall be made for the same. If, however, there is a separate item in the Bill of Quantities for setting up of a laboratory and installing testing equipment, such work shall be paid for separately.

901.9 For testing of soils/soil mixes, granular materials and mixes, bituminous materials and mixes, cement concrete materials and mixes, aggregates, cores etc., samples in the required quantity and form shall be supplied by the Contractor at his own cost.

901.10 For cement, bitumen, steel, emulsion, road marking paint, sign boards, geo-synthetics and similar other materials where essential tests are to be carried out in the presence of Engineer at the manufacturer's plants or at laboratories other than the site laboratory, the cost of samples, sampling, testing and furnishing of test certificates shall be borne by the Contractor.

Manufacturer's test certificate together with invoice or delivery challan shall be furnished for every lot of supply apart from tests to be conducted at site laboratory for prime properties of the material like cement, bitumen, etc. Where facilities for testing of materials are not available at site laboratory the same shall be tested at an outside laboratory in the presence of the Engineer. For specialized items such as sign boards, road marking paint, etc. the Engineer may order for third party test from an approved laboratory.

901.11 The method of sampling and testing of materials shall be in accordance with the requirements of the relevant Indian Standards and these Specifications. Where they are contradicting, the provisions in these Specifications shall be followed. Where they are silent, sound engineering practices shall be adopted. The sampling and testing procedure to be used shall be as approved by the Engineer and his decision shall be final and binding on the Contractor. The cost of all tests shall be borne by the Contractor.

901.12 The materials for embankment construction shall be got approved from the Engineer. The responsibility for arranging and obtaining the land for borrowing or exploitation in any other way shall rest with the Contractor who shall ensure smooth and uninterrupted supply of materials in the required quantity during the construction period.

Similarly, the supply of aggregates and other materials for construction shall be from sources approved by the Engineer. Responsibility for arranging uninterrupted supply of materials from the source shall be that of the Contractor.

901.13 Defective Materials

All materials which the Engineer has determined as not conforming to the the Contract shall be rejected whether in place or not; they shall be removed immediately

from the site as directed. Materials, which have been subsequently corrected, shall not be used in the work unless approval is accorded in writing by the Engineer. Upon failure of the Contractor to comply with any instruction of the Engineer, the Engineer shall have authority to cause the removal of rejected material and to deduct the removal cost thereof from any payments due to the Contractor.

901.14 Imported Materials

The Contractor shall furnish a list of materials/finished products manufactured, produced or fabricated outside India which he proposes to use in the work. The Contractor shall not be entitled to extension of time for acts or events occurring outside India and it shall be the Contractor's responsibility to make timely delivery to the job site of all such materials obtained from outside India.

The materials imported from outside India shall conform to the relevant Specifications of the Contract. In case where materials/finished products are not covered by the Specifications in the Contract, the details of laboratories/establishments where tests are to be carried out shall be specifically brought out and agreed to in the Contract.

The Contractor shall furnish to the Engineer a certificate of compliance of the tests carried out. In addition, certified mill test reports clearly identified in the lot of materials shall be furnished at the Contractor's cost.

ITEM WISE SPECIFICATION

Item No. 1

Excavation for foundation in sand, gravel, clay soft soils and murrum etc. including shoring, strutting dewatering as necessary and disposing of the excavated stuff as directed. (A) Depth up to 3.0 M. and lead up to 100m for 10 Cum

304 EXCAVATIONS FOR STRUCTURES

304.1 Scope

Excavation for structures shall consist of the removal of material for the construction of foundations for bridges, culverts, retaining walls, headwalls, cutoff walls, pipe culverts and other similar structures, in accordance with the requirements of these Specifications and the lines and dimensions shown on the drawings or as indicated by the Engineer. The work shall include construction of the necessary cofferdams and cribs and their subsequent removal; all necessary

sheeting, shoring, bracing, draining and pumping; the removal of all logs, stumps, grubs and other deleterious matter and obstruction, necessary for placing the foundations; trimming bottoms of excavations; backfilling and clearing up the site and the disposal of all surplus material.

304.2 Classification of Excavation

All materials involved in excavation shall be classified in accordance with Clause 301.2.

304.3 Construction Operations

304.3.1 Setting Out

After the site has been cleared according to Clause 201, the limits of excavation shall be set out true to lines, curves, and slopes to Clause 301.3.1.

304.3.2 Excavation

Excavation shall be taken to the width of the lowest step of the footing including additional width as required for construction operation. The sides shall be left plumb where the nature

of soil allows it. Where the nature of soil or the depth of the trench and season of the year do not permit vertical sides, the Contractor at his own cost shall put up necessary shoring; strutting and planking or cut slopes to a safer angle or both with due regard to the safety of personnel and works and to the satisfaction of the Engineer. The depth to which the excavation is to be carried out shall be as shown on the drawings, unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer. Propping shall be undertaken when any foundation or stressed zone from an adjoining structure is within a line of 1 vertical to 2 horizontal from the bottom of

the excavation. Where blasting is to be resorted-to, the same shall be carried out in accordance with Clause 302 and all precautions indicated therein observed. Where blasting is likely to endanger adjoining foundations or other structures, necessary precautions such as controlled blasting, providing rubber mat cover to prevent flying of debris stream flow, seepage, springs, rain or other reasons, the Contractor shall take adequate measures such as bailing, pumping, constructing diversion channels, drainage channels, bunds, depression of water level by well-point system, cofferdams and other necessary works to keep the foundation trenches dry when so required and to protect the green concrete/masonry against damage by erosion or sudden rising of water level. The methods to be adopted

in this regard and other details thereof shall be left to the choice of the Contractor but subject to the approval of the Engineer. Approval of the Engineer shall, however, not relieve the Contractor of the responsibility for the adequacy of dewatering and protection arrangements for the quality and safety of the works.

Where cofferdams are required, these shall be carried to adequate depths and heights, be safely designed and constructed and be made as watertight as is necessary for facilitating construction to be carried out inside them. The interior dimensions of the cofferdams shall be such as to give sufficient clearance for the construction and inspection and to permit installation of pumping equipment's, etc., inside the enclosed area. If it is determined beforehand that the foundations cannot be laid dry or the situation is found that the percolation is too heavy for keeping the foundation dry, the foundation concrete shall be laid under water by tremie pipe only. In case of flowing water or artesian springs, the flow shall be stopped or reduced as far as possible at the time of placing the concrete. Pumping from the interior of any foundation enclosure shall be done in such a manner as to

preclude the possibility of the movement of water through any fresh concrete. No pumping shall be permitted during the placing of concrete and for a period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a watertight wall or other similar means. At the discretion of the Contractor, cement grouting or other approved methods may be used to prevent or reduce seepage and to protect the excavation area. The Contractor shall take all precautions in diverting channels and in discharging the drained water as not to cause damage to the works, crops or any other property.

304.3.3 Preparation of Foundation

The bottom of the foundation shall be levelled both longitudinally and transversely or stepped as directed by the Engineer. Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the drawings or as otherwise ordered by the Engineer, the extra depth shall be made up with concrete as per Clause 2104.1 at the cost of the Contractor. Ordinary filling shall not be permitted to bring the foundation to the design level as shown in the drawing. When rock or other hard strata is encountered, it shall be freed of all soft and loose material, cleaned and cut to a firm surface either level or stepped as directed by the Engineer. All seams

shall be cleaned out and filled with cement mortar or grout to the satisfaction of the Engineer.

In the case of excavation in rock, annular space around footing shall be filled with lean concrete M 15 upto the top level of rock.

If the depth of fill required is more than 1.5 m in soft rock or 0.6 m in hard rock above the foundation level, the filling upto this level shall be done with M-15 concrete and portion above shall be filled by concrete or by boulders grouted with cement. When foundation piles are used, the excavation for pile cap shall be done after driving/casting of all piles forming the group. After pile driving operations in a given pit are completed, all loose and displaced materials therein shall be removed to the level of the bottom of the pile cap.

304.3.5 Slips and Slip-Outs

If there are any slips or slip-outs in the excavation, these shall be removed by the Contractor at his own cost.

304.3.6 Public Safety

Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights at night to avoid accidents. The Contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures. For safety precautions, guidance may be taken from 18:3764.

304.3.7 Backfilling

Backfilling shall be done with approved material after concrete or masonry is fully set and carried out in such a way as not to cause undue thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface in layers not exceeding 150 mm compacted thickness. The compaction shall be done with the help of suitable equipment such as trench compactor, mechanical tamper, rammer, plate vibrator etc., after necessary watering, so as to achieve the maximum dry density.

304.3.8 Disposal of Surplus Excavated Materials

Clause 301.3.11 shall apply.

304.4 Measurements for Payment

Excavation for structures shall be measured in cu.m for each class of material encountered, limited to the dimensions shown on the drawings or as directed by the Engineer. Excavation over increased width, cutting of slopes, production/support to the existing structures shoring, shuttering and planking shall be deemed as incidental to the main work and shall not be measured and paid separately. Preparation of rock foundation shall be measured in cu.m. metres.

304.5 Rates

304.5.1 The Contract unit rate for the items of excavation for structures shall be payment in full for carrying out the required operations including full compensation for:

- i. setting out;
- ii. transporting the excavated materials for use or disposal with all leads and lifts;

- iii. construction of necessary cofferdams, cribs/sheeting, shoring and bracing and their subsequent removal;
- iv. removal of all logs, stumps, grubs and other deleterious matter and obstructions, for placing
the foundations including trimming of bottoms of excavations;
- v. foundation sealing, dewatering including pumping when no separate provision for it is made in the Contract;
- vi. backfilling, clearing up the site and disposal of all surplus material with all leads and lifts or as otherwise specified; and
- vii. all labour, materials, tools, equipment, safety measures, diversion of traffic and incidentals necessary to complete the work to Specifications.

The Contract unit rate for preparation of rock foundation shall be full compensation for cutting, trimming, and cleaning the foundation surface and filling/sealing of all seams with cement grout or mortar including all materials, labour and incidentals required for completing the work.

304.3.8 Disposal of Surplus Excavated Materials

Clause 301.3.11 shall apply.

304.4 Measurements for Payment

Excavation for structures shall be measured in cu.m for each class of material encountered, limited to the dimensions shown on the drawings or as directed by the Engineer. Excavation over increased width, cutting of slopes,

production/support to the existing structures shoring, shuttering and planking shall be deemed as incidental to the main work and shall not be measured and paid separately.

Excavation of foundation shall be measured in Cu.m. metres.

Item No. 02

Excavation in large boulders and soft rock by welding including shoring, strutting and dewatering as necessary and disposing of the excavated stuff as directed.

304 Para of the **Item No. 01** for foundation in all sorts of soil shall apply.

1. Excavation shall be in soft rock or such as lime stone, sand stone, laterite, hard conglomerate or other soft or disintegrate rock which may be quarried or spilt with crowbars, boulders which do not require blasting having diameter in any direction of more than 300 mm and any rock which in dry state may be hard, requiring blasting but which when wet become soft and manageable by means other than blasting. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor.

Payment shall be made on Cu.m. Basis.

Item No. 03

Excavation in hard rock by dry-wet blasting and chiselling including dewatering preparing foundation base by proper benching and stepping and disposing of the excavated stuff as directed. (A) General blasting

304 Para of the **Item No. 1** of excavation for foundation in all sorts of soil shall apply.

1. Excavation shall be in any rock or boulders having diameter in any one direction of more than 300 mm. for which the use of mechanical plant or blasting is required. The classification of excavation shall be decided by the Engineer-in-charge and his decision shall be final and binding on the contractor. Merely the use of explosive in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer-in-charge.

2. Where blasting is prohibited for any reason, excavation shall be carried out by chiselling, wedding or any other approved method.

3. Blasting shall be carried out only with the written permission of the Engineer-in-charge. All the statutory laws, regulations, rules etc pertaining to be acquisition transport, storage, handling and use of explosive shall be strictly followed.

4. The contractor may adopt any method or methods of blasting consistent with the safety and job requirements, after approval from the Engineer-in-charge.

5. the magazine for the storage of explosive shall be built to the design and specifications of the Explosives Department concerned and located at the approved site. No un authorised person shall be admitted into the magazine which when not use shall be kept securely located. No matches or inflammable materials shall be allowed in the magazine.

The magazine shall have any effective lightening conductor. The following shall be hung in the lobby of magazine.

(a) A copy of the relevant rules regarding safe storage both in English and in the language with which the workers concerned are familiar.

(b) A statement of up-to-date stock in the magazine.

(c) A certificate showing the last date of testing of the lightening conductor.

(d) A notice that smoking is strictly prohibited.

6. IN addition to these, the contractor shall also observe the following instructions and any further additional instructions which may be given by the Engineer-in-charge and shall be responsible for damage to property and any accident which may occur to workmen or the public on account of any operations connected with the storage handling of use of explosive and blasting. The Engineer-in-charge shall frequency check the contractor compliance with these precautions.

7. All the materials, tools and equipment used for blasting operations shall be approved type. The Engineer-in-charge may specify the type of explosive to be allowed in special cases. the fuse to be used in wet locations shall be sufficiently water-resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and definitely known to permit such a safe length being cut as will permit sufficient time to time firer tom reach to place of safety before explosion takes place.

(a) Detonators shall be capable of giving effectives blasting of the explosives. The blasting powder, explosive detonators, fuses, etc. shall be fresh and not damaged due to damp, moisture or, any other cause. They shall be inspected totally and removed immediately if found unsuitable.

8. The blasting operation shall remain in charge of competent and experienced supervisory

staff and worker who are thoroughly acquainted with the details of handling explosives and blasting operators.

9. The blasting shall be carried out during fixed hours of the day preferably during the midday luncheon hour or at the close of the work as ordered in writing by the Engineer-incharge. The hours shall be made known to the people in the vicinity. All the charges shall be prepared by the man in charge only.

10. Red danger flags shall be displayed permanently in all directions during the blasting operations. People, except those who actually light the fuse, shall be prohibited from entering this area. The flags shall be planted 200 meters from the blasting site in all directions and all persons including workmen shall be excluded from the flagged area at least 10 minutes before the firing a warning whistle being sounded for the purpose.

11. The charge holes shall be drilled in suitable places to required depths. Blasting should be as light as possible consistent with thorough breakage of the materials necessary for economic loading and hauling. Any method of blasting which leads to over-shooting shall be discontinued.

12. When blasting is done with powder, the fuse cut to the required length shall be inserted into the hole and the powder dropped in. The powder shall be gently tamped with copper rods with rounded ends. The explosive powder shall then be covered with tamping materials which shall be tamped light but firmly.

13. When blasting is done with dynamite and other high explosives, dynamite, cartridges shall be prepared by inserting the square cut end of a fuse into the detonator and finishing it with nippers at the open end., the detonator gently pushed into the primer leaving 1/3rd of copper tube exposed outside. The paper of the cartridge shall then be closed up and securely bound with wire, or twine. The primer shall be housed into the explosive. Bore holes shall be of such size that the cartridge can easily go down. The holes shall be cleared of all debris and explosive inserted. The space of about 20 cm. above the charge shall

then be gently filled with dry clay, passed home & the rest of the temping formed of any convenient materials gently packed with a wooden rammer.

14. At a time, not more than 10 such charges will be prepared and fired. The man in charge shall blow a whistle in a recognized manner or cautioning the people. All the people shall

then be required to move to safe distance. The charge shall be lighted by the man in charge only, the man in charge shall count the number of explosions. He shall satisfy himself that all the charges have been exploded before allowing the workmen to go back to the work site.

15. In case of a misfire, the following procedure shall be observed:

(1) sufficient time shall be allowed to account for the delayed blast. The man in charge shall inspect all the charges and determine the missed charges.

(2) If it is blasting powder charge it shall be completely flooded with water. A new hole shall be drilled at about 45cm. from the old hole and fired. This should be repeated till the old charge is blasted.

(3) In case of charges of gelatine, dynamite etc. the man in charge shall gently remove the tamping and the primer with the detonator. A fresh detonator and primer shall then be used to blast the charge. Alternatively, the hole may be cleared of 30cm. of tamping and the direction then ascertained by placing a stick in the hole. Another hole may then be drilled 15cm. away and parallel to it. This hole shall then be charged and fired when the misfired hole should explode at the same time. The man in charge shall at once report to the contractor's Officer and Engineer-in-charge all cases of misfire, the cause of the same and what steps were taken in connection therewith.

16. If a misfire has been found to be due to defective detonator or dynamite the whole quantity in the box from which defective article was taken must be sent to the authority directed by the Engineer-in-charge for inspection to ascertain whether all the remaining materials in the box are also defective

17. A careful and day to day account of the explosive shall be maintained by the contractor in an approved manner in a register which shall be open to inspection by the Engineer-in-charge, at all times.

18. Excavation shall be measured after removal of over burden by taking cross-sections at suitable intervals in the original position before the work starts and after its completion and computing the volumes in cubic metres by the method of average end areas. Where it is not feasible to compute volumes by this method because of erratic location of isolated deposits, the volumes shall be computed by other accepted methods. At the option of the

Engineer-in-charge, the contractor shall leave depth indicators during excavations of such shape and size, and in such positions as directed so as to indicate the original ground level as accurately as possible. The contractor shall see that these remain intact till the final measurements are taken. Where cross-sectional measurements, could not be taken due to irregular configuration, or where the rock is admired with other classes of materials, the volumes shall be computed on the basis of stacks of excavated rubble after making 40 per cent deduction there from.

19. The Payment shall be made on Cu.m. Basis

Item No. 04

Providing and fixing mild steel dowel bars of minimum 32mm dia. for anchoring by drilling holes in foundation strata including necessary bending, hooking of dowel bars and grouting the holes complete as per detailed drawing and as directed.

This item provides for necessary mild steel bar of 32 mm. dia. for anchoring in foundations strata as per detailed drawings and as directed by Engineer-in-charge. For this purpose, 100 mm holes shall be kept in staining itself at regular intervals as shown in drawing or as directed by Engineer in-charge. Mild steel bars shall be supplied by the department at the rate and place showing schedule B of the tender. The item includes transporting the bars to the site of work, handling, cutting, bending, hooking and placing the same in position as required as per drawing. The grout holes shall be not less than 100 mm. dia. The anchorage length of bars shall not be less than 60 times dia. of bar. Grouting of grout hole shall be of 1:2 proportion (1 part of cement, 2 parts of sand) and shall be done under pressure as directed. These dowel bars shall be inserted through holes kept in the well staining to the bottom of the grout holes. Grout holes shall not be less than 1 Mt. in depth. In case, no dowel bars are ultimately decided to be provided in the holes of the staining kept for the purpose, the same shall be filled with the concrete of the same proportion as of well staining at the cost of the contractor.

1. Mode of measurement will be per number of dowel bar considered as one number from bottom of grout hole to the top of staining,
2. Unit rate includes cost of material, labour, tools and plant and grouting the staining holes to complete the work. The dowel bar fixed in position shall be **measured in running meter**. Unit rate includes cost of material, labour, tools and plant and grouting the holes to complete the work.

Item No. 5

Providing & Casting in situ ordinary cement concrete M100 for RCC Raft and cutoff walls including necessary shuttering, laying, vibrating, ramming and curing complete.

1. Materials

- 1.1. Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6. Grit shall conform to M-8. Coarse aggregate shall conform M-12.
- 1.2. The shuttering to be provided shall be of ordinary timber plank and shall conform to M-26.
- 1.3. The dimensions of scantlings and battens shall conform to the design. The strength of the wood shall not be less than that assumed in the design.

2. General

- 2.1. The concrete mix shall be designed from preliminary tests. The proportion of the concrete mix shall be 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm. nominal size) by weight of concrete work shall have exposed concrete surface or as specified in the item.
- 2.2. The proportioning of cement and aggregates shall be done by weight and necessary precautions shall be taken in the production to ensure that the required work cube strength is attained and maintained. The controlled concrete shall be in grades of M-100, M-150, M-200, M-250, M-300, M-350 & M-400 with prefix controlled added to it. The letter M refers to mix and the numbers specify 28 days works cube compressive strength of 150 mm. cubes of the mix expressed in Kg./cm.
- 2.3. The proportion of cement, sand and coarse aggregate shall be determined of weight. The weight batch machine shall be used for maintaining proper control over the proportion of aggregates as per mix design. The strength requirements of different grades of concrete shall be as under:

Grade of Concrete	Compressive works test strength in kg/cm ² 20mm 150mm. cubes, conducted in accordance with IS.: 516	
	Min. at 7 days	Min. at 28 days
M 100	70	100
M 150	100	150
M 200	135	200
M 250	170	250
M 300	200	300
M 350	235	350
M 400	270	400
M 450	300	450

3. In the designation of concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cubes compressive strength of that mix on 150 mm. cubes, expressed in kg/cm² where ordinary Portland cement conforming to IS: 269 or Portland blast furnace cement Conforming to IS: 455 is used, the compressive strength requirements for various grades of concrete shall be as given below on the next page :-

NOTE:- In all cases the in all cases, the 28 days compressive strength specified in the above Table shall along be the criterion for acceptance or rejection of the concrete.

Where the strength of a concrete mix, as indicated by tests, lies in between the strength for any two grades specified in the above Table such concrete shall be classified for all purposes as concrete belonging to the lower or the two grades between which its strength lies.

4. Concrete mix shall be designed on the basis of preliminary test so as attain a strength at least 33 per cent higher than that required on work tests. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the means available, Except where it can be shown to the satisfaction of the Engineer-in-charge that supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be controlled by containing the coarse aggregates in different sizes and blending them in the right proportions as required aggregates of different sizes shall be stocked in separate stock piles. Required quantity of material shall be stock piled several hours, preferable a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible, frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in preliminary tests.
5. In proportioning concrete, the quantity of both cement and aggregate shall be determined reasonable number of bags shall be weighed separately to check the net weight. Where cement is weighted from bulk stocks at site and not by bags it shall be weighed separately from the aggregates. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean, and serviceable condition. Their accuracy shall be periodically checked.
6. It is most important to keep the specified water-cement ratio constant and at its correct value, To this end, moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates, IS L 2386 (part-III) shall be referred to Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content. Minimum quantity of cement to be used in controlled concrete shall not be less than 210 kg. per cubic meter in plain concrete and not less than 300 kg/per cubic meter in reinforced concrete structural members. The minimum quantity of cement for prestressed concrete work shall not less than 360 kg/per cubic meter of concrete nor shall it more than 540 kg/per cubic Meter of concrete
7. Following shall be the maximum nominal size of coarse aggregate for the different items of work.

No.	Item of Construction	Max nominal size of coarse aggregate
1	RCC well curb, well steining	40 mm
2	Well cap solid type piers	63 mm
3	Abutment, wing wall, pier cap	40
4	RCC in cross girder, desk slab, wearing coarse, kerb, approach slab	20 mm
5	RCC pearing	As specified on drawing or as desired by Engineer in charge.
6	For any other item not covered in 1 to 5	-- do --

For heavily reinforced concrete members as in the case of ribs of main beams, nominal maximum size of aggregate shall usually be restricted to 5 mm. less than the minimum lateral clear distance between the main bars or 5 mm. less than the minimum cover to the reinforcement whichever is the smaller.

8. Fine aggregate shall be clean, hard, coarse sand. It shall be free dust and such other substances. The sand be get approved by the Engineer-in-charge.
9. All materials shall be stored as to prevent deterioration of there quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in charge .shall not be used in the works.
10. Cement shall be stored above the ground level in perfectly dry and watertight sheds
Wherever bulk storage containers are used their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months.
The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of fine or coarse intermixing the materials.
11. The water for mixing shall be potable water to satisfaction of the Engineer-in-charge
The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.
12. For all work concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working' condition and so, maintained

throughout the construction Mixing shall be continued till materials are uniformly distributed uniform colour of the entire mass is obtained and each individual particle of the 'coarse aggregate shows complete coating of .mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

13. Mixers which have been out of use more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to be the Engineer-in-charge, the first batch of concrete from the mixer shall contain only two thirds of normal quantity of coarse aggregate Mixing plant shall be thoroughly cleaned before enhancing from one type of cement to another.
14. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be transported and placed that no contamination, segregation or loss of its constituent materials takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust snow or ice immediately before placing of concrete. No. concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.
15. If concreting is not started within 24 hours of the approval being given. It shall have to be obtained again from the Engineer-in-charge. Concreting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer-unless carried in properly design agitators, operating continuously when this time shall be within 3 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator Except where otherwise agreed to be the Engineer-in-charge Concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 meter when internal vibrator are used not exceeding 0.30 meter in all other cases.
16. Unless otherwise agreed to be Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 meters. When trunking or chutes are used they shall be kept clean and used in such a way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened swept clean

thoroughly wetted and covered with a 13 mm, thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be *removed* by scrubbing the wet surface with wire or bristle brushes care being taken to *avoid* dislodgment of particles of coarse aggregate. The surface shall then be throughout wetted all free water *removed* and then coated with neat cement grout. The first layers of concrete to be placed on this surface shall not exceed 150 mm. in thickness and shall be well rammed against old particular attention being given to corners and close sports.

17. All concrete shall be compacted to produce a dense homogeneous mass with the assistance of Vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases such concreting under water, where vibrators cannot be used. Sufficient *vibrator* in serviceable condition shall be kept at site so that spare equipment is always available in the event of break downs.
18. Immediately after compaction, concrete shall be protected against harmful effects of weather including rain, running water, shocks, *vibration*, traffic, rapid temperature changes, frost and drying out process. It shall be covered with wet sacking, Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work *over* the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days,
19. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Formwork shall however be delivered into following two district categories:-
I Shuttering i.e. formwork required for forming the concrete.

II Scaffolding i.e. formwork required for supporting shuttering.

Forms for shuttering shall be constructed only, in metal suitably lined. Forms for scaffolding construction and shuttering shall be true to shape and dimensions show

on the drawings. All bolts and reverts shall be counter-sunk and well ground to provide a smooth, plane surface.

20. Forms shall be mortar-tight and shall be made sufficiently rigid by the use of the ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks or hardwood wedges where required shall be provided to make up any settlement in the formwork either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure specially in long spans to counteract the effects of any deflection. The formwork shall be so fixed as to provide for such camber, Forms shall be so constructed as to be removable in sections in the desired sequence. Without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed, chamfers or fillets of sizes 25 mm x 25 mm shall be provided at all angles of formwork to *avoid* sharp corners.
21. The inside surface of shuttering shall; except in the case of permanent form work or where otherwise agreed to be the Engineer-in-charge be coated with an approved materials to prevent adhesion of concrete to the form work. Release agents shall be applied strictly in accordance with the manufacturer's Instructions and shall not be allowed to come into contact with any reinforcement or pre-stressing tendons and anchorages. Different release agent shall not be used in form work for concrete which will be visible' in the finished works.
22. Special measure shall be taken to ensure that the form does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Wherever applicable arrangement must be made to ensure that the form work does not restrain the shortening and hogging of the beams or slabs during tensioning of the tendons. The formwork should take due account of the calculated amount of positive or negative camber so also ensure the correct final shape of the structure having regard to the deformation due of false work, scaffolding or propping and the instantaneous or deferred deformation due to various causes affecting pre-stressed structures. Where they are re-entrant angles in the concrete sections the form work should be removed at these sections as soon as possible after the concrete has

set in order to avoid cracking due to shrinkage of concrete. Form work shall be tight enough to prevent any appreciable loss of cement during vibrations Suitable tolerance should be provided in the formwork. Immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength, alignment and general fitness but such inspection shall not relieve the contractor of his responsibility for safety of men, machinery, materials and for results obtained.

23. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formwork, due consideration shall be given to local conditions that influence the setting of Concrete and of concrete and of the materials used in the mix. Where field operations are controlled by strength tests of concrete the removal of the load supporting of soffit forms may commence when concrete has attained strengthening props including the effect of any further additional loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and wall may be removed after 2 days, Tile props of slabs and beams may be removed after 14 and 21 days respectively. All formwork shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to permit the concrete to take stresses due to its own weight uniformly and gradually, Where internal metal ties are permitted, they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortar No. permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to be cleaned and made good to the satisfaction of the Engineer-in-charge.
24. Immediately after the removal of forms, all exposed *parts* or bolts passing through the Cement Concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes be filled by cement mortar. All fins caused by form joints all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregated mixed in the proportions used in the grade of

concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been pointed shall be kept moist for a period of twenty four hours. If rock pockets/ honeycombs, in the opinion of the Engineer-in-charge are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

- 25.** In the case of reinforced concrete work, workability shall be such that the concrete surrounds and properly grips all reinforcement. The degree of consistency, which shall depend upon the nature of work and methods of vibration of concrete shall be determined by regular slump test. Following slump shall be adopted for different types of works.

	Type of Work	Slump where vibrator is used	Slump where vibrator is not used
1	Mass conc. In RCC, foundation footing and retaining wall	10 to 25 mm	80 mm
2	Beam slab and column with simply reinforced	25 to 40 mm	100 to 120 mm
3	Thin RCC section or congested steel	40 to 50 mm	125 to 150 mm

- 26.** For controlled concrete preliminary tests shall consist of three sets of separate tests and in each set, tests shall be conducted on six specimens, Not more than one set of six specimens shall be made on any particular day of the six specimens in each set, three shall be tested at seven days and the remaining three at 28 days. The preliminary tests at 28 days are intended only to indicate the strength likely to be attained at 28 days. Work strength tests shall be made in accordance with IS : 516. EACH test shall be conducted on ten specimens five of which shall be tested at seven

days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting and, cubes shall be made at the rate of one for every 5 cubic meter of concrete or a part thereof. However if concreting done in a day is than 15 cubic meter, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works tests shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured, The number of specimens may be suitable increased as deemed necessary by the Engineer-in-charge when procedure to tests given above reveals a poor quality of concrete and in other special cases.

27. The average strength of the group of cubes cast for each day shall not be less than the specified works cube strength. 20 per cent of the cubes cast each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.
28. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall be approved by the Engineer-in- charge. One carpenter with helper will invariably be kept throughout the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different parts, suitable mobile platforms shall be provided so that steel reinforcement in position as not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapachi or metal pieces shall not be used for this purpose. Concreting of important structural members shall always be done in the presence and under the supervision of departmental person not below the rank of Asstt. Engineer/Addl. Asstt. Engineer/Overseer or as instructed by the Engineer-in-charge, After removal of 'form work and suturing, the executive Engineer shall inspect the work and satisfy by random checks that concrete produced is of good quality. Plastering shall not be allowed to the exposed faces of concrete.
29. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the been as the portion below the slab.
30. All necessary labour, materials, equipment, etc., for sampling, preparing test cubes, curing etc., shall be provided by the Contractor. Testing of the materials and concrete

may be arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.

31. The payment will be made on cu.m Basis of the finished work.

32. The unit rate for concrete shall include the cost of all materials, labour, tools and plant required for mixing, placing in position, vibrating and compacting finishing as per directions of the Engineer-in-charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown on the drawings and according to these specifications. The rate shall also include the cost of making ·fixing and removing of all centers and forms required for the work.

Item No. 6

Providing and Casting in situ controlled Cement Concrete M-200 for R.C.C. Raft and cutt-off walls including necessary shuttering laying, vibrating , ramming and curing complete.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **casting in situ-controlled cement concrete M-200 for R.C.C. Raft and cutt-off walls** etc. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 7

Providing and casting in situ controlled cement concrete M-200 for R.C.C. return as per drawings including centering shuttering, scaffolding where necessary, laying vibrating, curing and finishing complete. (A)Height from 0.0 to 5.0M. (1)Piers (2)Abutment (3)RCC return.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **casting in situ-controlled cement concrete M-200 for Pier, Abutment & Return Wall Height From 0.0 to 5.0m** etc. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 8

Providing and casting in situ controlled cement concrete M-200 for R.C.C. return as per drawings including centering shuttering, scaffolding where necessary, laying vibrating, curing and finishing complete. (A)Height from 5.0 to 10.0M. (1)Piers (2)Abutment (3)RCC return.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **casting in situ-controlled cement concrete M-200 for Pier, Abutment & Return Height from 5.0 to 10.0m** etc. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 09

Providing and casting in-situ Reinforced Cement Concrete M25 grade controlled cement concrete in piercap, abutment cap & dirt wall etc. using 6mm to 20mm machine crushed well graded stone aggregate, sand of approved quality, OPC-53 grade cement with contractor's own concrete mix design as approved by client, etc. complete. The rate is inclusive of all materials, including necessary mixing in fully automatic batch mix plant, transport, curing, vibrating, placing in position, scaffolding, staging, shuttering, formworks, deshuttering carefully, making good the damages,fixing embedment, inserts, pockets, wherever necessary, with all lead and lift with contractor's labour,tools & plants, machineries, as required, with F3 type exposed concrete finish and form mark.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **casting in-situ Reinforced Cement Concrete M25 grade controlled cement concrete in pier cap, abutment cap & dirt wall etc.** instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 10

Providing and casting in-situ Reinforced Cement Concrete M25 grade controlled cement concrete in Solid Slab using 6 mm to 20 mm machine crushed well graded stone aggregate, sand of approved quality, OPC 53 grade cement with contractor's own concrete mix design as approved by client, etc. Complete as per specification.

The rate is inclusive of all materials, including necessary mixing in fully automatic batch mix plant, transport, curing, vibrating, placing in position, scaffolding, staging, shuttering,

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **casting M25 grade controlled cement concrete in Solid Slab etc.** instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 11

Construction of R.C.C. railing of M 25 grade in cast-in-situ with 20 mm nominal size aggregate, true to line and grade, tolerance of vertical railing post not to exceed 1 in 500, centre-to-centre spacing between vertical posts not to exceed 2000 mm as per drawing and technical specifications Clauses 800, 900 and 1208.3

1. For concrete and steel, specifications of the items of controlled concrete and reinforcement shall apply.
2. The Railing shall be Truly and correctly aligned in line and level, along the centre line of the Railing over the top rail. All edge's and corners shall be straight and finished in true line and level. Forms shall either be of single width boards or shall be lined with suitable material duly approved by the Engineer-in-charge. Form joints in plain surface will not be permitted. All mouldings, panel work and level strips shall be constructed according to the details shown on the drawings.
3. Railing shall be measured in running metres. Reinforcement in the Railing shall not be paid separately.
4. Unit rate includes cost of all materials including steel, form work, labour, tools and plants to complete the job.

Item No. 12

Providing and casting situ controlled cement concrete M-20 For Approach slab including formwork curring and finishing complete.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **casting situ controled cement concrete M-20 For Approach slab** etc. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 13

Providing and casting in-situ Reinforced controlled Cement Concrete M 25 grade for average 100 mm thick Wearing Coat with 20mm down coarse aggregate at any level including shuttering, mixing with batching plant, placing in position, consolidating with mechanical vibrators, curing, deshuttering carefully, making good the damages, fixing embedment, inserts, pockets, wherever necessary as directed for wearing course including all leads and lifts etc. complete as per specification and drawing.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **casting in-situ Reinforced controlled Cement Concrete M 25 grade for average 100 mm thick Wearing Coat any level.** instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 14

Providing and laying in position FE 500D TMT bar reinforcement including cutting, bending, hooking and tying complete as per detailed drawings for the following. (A) Piers (B) Abutments (C) R.C.C. Returns

1. GENERAL

1.1. This work shall consist of furnishing and placing coated, or uncoated or high strength deformed reinforcement, bars (intentioned) of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer in charge.

2. MATERIAL

2.1. TMT Bars Reinforcements may be either T.M.T. Fe-550 Grade tensile steel, high strength deformed bars. They may be uncoated or coated 'with epoxy or with approved protective coatings.

2.2. T.M.T. bars reinforcement for R C C work shall conform IS 432 (Part II) 1966 and shall be of tested quality. It shall also comply with relevant part of IS 456-1966.

2.3. All reinforcement shall be clean and free from dirt, paint, grease or oil, all scale or loose or thick rust at the time of placing.

2.4. All steel shall be procured from original producers no re-rolled steel shall be incorporated in the work.

2.5. Only new steel shall be delivered to the site every bar shall be inspected before placing to its position and defective brittle or burnt bar shall be discarded cracked ends of bars shall be discarded

3. PITCH

3.1 Distance between bars shall be as specified in drawings and as directed by the Engineer in Charge all bars shall be placed at an accurate distance from each other and shall be bind tightly to maintain the desired pitch Suitable means shall be provided for holding bars securely in position

4. BINDING WIRE

- 4.1 Mild steel binding wire shall be of 1.63 mm or 1.22 mm (16 to 18 gauge diameter and shall conform IS 280-1972.
- 4.2 The use of black wire will be permitted for binding reinforcement bars. It shall be free from dirt, paint, grease or oil, oil scale or loose or thick rust and any other undesirable coating which may prevent adhesion of cement mortar at the time of binding
- 4.3 Only new binding wire shall be delivered to the site all binding wire shall be inspected before binding to its position and defective brittle, rusted, used wire, shall be discarded

5. PROTECTION OF REINFORCEMENT

- 5.1 Uncoated reinforcing steel shall be protected from rusting or chloride contamination. Reinforcements shall be free from rust, mortar, loose mill scale, grease, oil or paints. This may be ensured either by using reinforcement fresh from the factory or thoroughly cleaning all reinforcement to remove rust using any suitable method such as sand blasting, mechanical wire brushing, etc. as directed by the Engineer. Reinforcements shall be stored on bricks, racks or platforms and above the ground in a clean and dry condition and shall be suitably marked to facilitate inspection and identification.
- 5.2 Portions of uncoated reinforcing steel and dowels projecting from concrete shall be protected within one week after initial placing of concrete with a brush coat of neat cement mixed with water to a consistency, of thick paint. This coating shall be removed by lightly tapping with a hammer or other tool not more than one week before placing of the adjacent pour of concrete. Coated reinforcing steel shall be protected against damage to the coating. If the coating on the bars is damaged during transportation or handling and cannot be repaired, the same shall be rejected.

6. WORKMANSHIP

- 6.1 The work shall consist of furnishing and placing reinforcement to the shape and dimensions shown as on the drawings or as directed by The Engineer in charge.

- 6.2 Reinforcing steel shall conform accurate to the dimensions given in the bar bending schedules shown on relevant drawing

7. BENDING OF REINFORCEMENT

- 7.1 Bar bending schedule shall be furnished by the Contractor and got approved by the Engineer before start of work.
- 7.2 Reinforcing steel shall conform to the dimensions and shapes given in the approved bar bending Schedules.
- 7.3 Bars shall be bent cold to the specified shape and dimensions or directed by the Engineer using a proper bar bender operated by hand power to obtain the correct radius of bends and shape.
- 7.4 Bars shall not be bent or straightened in a manner that will damage parent material or the coating bars bent during transport or handling shall, be straightened before being used on work and shall not be heated to facilitate straightening.

8. PLACING OF REINFORCEMENT

- 8.1 The reinforcement cage should generally be fabricated in the yard at ground level, and then shifted and placed in position. The reinforcement shall be placed strictly, in accordance with the drawings and shall be assembled in position, only when structure is otherwise ready for placing of concrete. Prolonged time gap, between assembling of reinforcements and casting of concrete, which may result in rust formation on the surface, shall not be permitted.
- 8.2 Reinforcement bars shall be placed accurately in position as shown on the drawings. The bars, crossing one another shall be tied together at every intersection with binding wire (annealed), conforming to IS:280 to make the skeleton of the reinforcement rigid such that the reinforcement does not get displaced during placing of concrete, or any other operation. The diameter of binding wire shall not be less than 1 mm.
- 8.3 Bars shall be kept in position usually by the following methods:

In case of beam an slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover shall be placed between the bars and

formwork subject to Satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.

- 8.4 In case of dowels for Columns and walls the vertical reinforcement shall be kept in position by means of timber templates with slots in them accurately, or with cover blocks tied to the Reinforcement Timber templates shall be removed after the concreting has progressed up to a level just below their location.
- 8.5 Layers of reinforcements shall be separated by spacer bars at approximately One meter intervals. The minimum diameter of spacer bars shall be 12 mm or: equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcement shall not be, allowed to sag between supports.
- 8.6 Necessary stays, blocks, metal chairs, spacers, metal hangers supporting wires etc, or other subsidiary, reinforcement shall be provided to fix the reinforcements firmly in its correct position.
- 8.7 Use of pebbles, broken stone, metal pipe, brick, mortar or wooden blocks etc as devices for positioning reinforcement shall not be permitted.
- 8.8 Bars coated with epoxy or any other approved protective coating shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that planes of weakness are not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic or plastic coated binding wires especially manufactured for the purpose.
- 8.9 Placing and fixing of reinforcement shall be inspected and approved by the Engineer before concrete is deposited.

9. LAPPING

9.0 All reinforcement shall be furnished in full lengths as indicated on the drawing.

No splicing of bars, except where shown on the drawing; will be permitted without approval of the Engineer. The lengths of the splice shall be as indicated

on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25 mm or 1 1/4 times the maximum size of coarse aggregate, whichever is greater,

If this is not feasible, overlapping bars shall be bound with annealed steel binding wire, not less than 1 mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points, along the span where stresses are low.

10. WELDING

10.1 Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved by the Engineer. Weld shall develop an ultimate strength equal to or greater than that of the bars connected.

10.2 While welding may be permitted for T.M.T. reinforcing bars conforming to IS:432, welding of deformed bars conforming to IS: 1786 shall in general be prohibited. Welding may be permitted in case of bars of other than S 240 grade including special. Welding grade of S 415 grade bars conforming to IS:1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula:

$$CE=C+Mn/6+(Cr+Mg+V)/5+(Ni+Cu)/15\leq 0.4$$

10.3 The method of welding shall conform to IS:2751 and IS:9417 and to any supplemental specifications to the satisfaction of the Engineer

10.4 Bars shall be bent cold to the specified shape and dimensions or as directed by Engineer in charge using the proper bender tool, operated by hand or power to attain proper radius of bends. Bars shall not be bend or straightened in a manner that will injure the material. Bars bent during transport or handling shall be straightened before being used in the work. Bars shall not be heated to facilitate bending

10.5 Unless otherwise specified a 'U' type hook at the end of each bar shall invariably be provided to main reinforcement. The radius of the bane shall not be less then twice the diameter of the round bar and the length of the straight part of the bar beyond the end of the curve shall be at least four times of the diameter of the round bar. In case of bars which are not round and in case of deformed bars, the diameter shall be taken as the diameter of circle having an equivalent *effective area*. The hooks shall be suitably encased to prevent any spiting of the concrete

10.6 All reinforcement bars shall be accurately placed in exact position shown on the drawings and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size and by using say blocks or metal chairs spacers, metal hangers, supporting wires or other approved devices at sufficiently close intervals, Bars shall not be allowed to sag between supports not displaced during concreting or any other operations of the work All devices used for positioning shall be of not corrodible material wooden and metal supports shall not extended to the surface of the concrete, except where shown in drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing shall not be allowed. Pieces of broken stone or brick and wooden blocs shall not be used Layers of bars shall be separated by spacer bars pre-cast mortar blocks or other approved devices. Reinforcement after bending placed in position shall be maintained in a clean condition until completely embedded in concrete, Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed.

To prevent reinforcement form corrosion, concrete cover shall be provided as indicated on drawings. All bars protruding from concrete and to which other bars are to be sliced and which are likely to be exposed for a period exceeding 10 days shall be protected by a thick coat of neat cement grout

10.7 Bars crossing each other where required shall be secured by binding wire (annealed) of size not less than 1 mm in such a manner that they do not slip over at the time of fixing and concreting

As far possible bars of full length shall be used in case this is not possible, overlapping of bars shall be done as directed by the Engineer in charge When

practicable overlapping bars shall not touch each other, but be kept apart by 25 mm Where no feasible overlapping bars shall be bound with annealed wires not less than 1 mm thick twisted tight The overlaps shall be staggered for different bars and located at points along the span where neither sheer not bending moments is maximum.

10.8 Whenever indicated on drawing or desired the Engineer in charge bars shall be jointed by coupling which shall have a cross section sufficient to transmit the full stresses of bars The end of the bars that are jointed by coupling shall be upset for sufficient length so that the effective cross section at the base of threads is not less than the normal cross section of the bar. Threads shall be standards threads Steel for coupling shall conform to IS 226

10.9 When permitted or specified on the drawings joints of reinforcement bars shall butt-welded so as to transmit their full stresses Welded joints shall preferably be located at points when steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded Only electric are welding using a process which excludes air form the molten metal and conforms to any or other special provisions for the work shall be accepted Suitable means shall be provided for holding bars securely in position during welding It shall be ensured that no voids are left in welding and when welding is done in two or three stages previous surface shall be cleaned properly Ends of bars shall be cleaned of all loose scale rust stages paint and other foreign matter before welding Only competent welders shall be employed on the work. The M S electrodes used for welding shall conform IS 814 Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number shall frequency to test shall be as directed by the Engineer in charge.

11. MODE OF MEASUREMENTS & PAYMENT

For the purpose of payment the bar shall be measured correct up to 10 mm length and weight payable works out at the rate specified below Excess consumption over 5% will be charged at penal rate.

Sr. No	Diameter of steel	weight of steel per running meter	Sr. No	Diameter of steel	weight of steel per running meter
1	6 mm	0.22 Kg / Rmt	8	20 mm	2.47 Kg / Rmt
2	8 mm	0.39 Kg / Rmt	9	22 mm	2.98 Kg / Rmt
3	10 mm	0.62 Kg / Rmt	10	25 mm	3.85 Kg / Rmt
4	12 mm	0.89 Kg / Rmt	11	28 mm	4.83 Kg / Rmt
5	14 mm	1.21 Kg / Rmt	12	32 mm	6.31 Kg / Rmt
6	16 mm	1.58 Kg / Rmt	13	36 mm	7.99 Kg / Rmt
7	18 mm	2.00 Kg / Rmt	14	40mm	9.86 Kg / Rmt

11.1 Reinforcement shall be measured in length including hooks, if any, separately for different diameters as actually used in work, **excluding overlaps**. From the length so measured, the weight of reinforcement shall be calculated in tonnes on the basis of IS: 1732. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement..

11.2 The contract unit rate for coated/uncoated reinforcement shall cover the cost of material, fabricating, transporting, storing, bending, placing, binding and fixing in position as shown on the drawings as per these specifications and as directed by the Engineer, including all labour, equipment, supplies, incidentals, sampling, testing and supervision.

The unit Rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation and expertise required to carry out the work. The rate shall also cover sampling, testing and supervision required for the work.

The rate shall be for a unit of M.TONNE basis.

Item No. 15

Providing and placing in position FE 500D TMT bar reinforcement including cutting, bending, hooking, and tying complete as per detailed drawing.(A) Solid Slab.

The work shall be executed as per specification of **Item No. 14** except that the **TMT Fe500D Grade (HYSD) bars reinforcement for Solid slab.** instead of T.M.T bar reinforcement **Grade Fe-500D for (A) Piers (B) Abutments (C) R.C.C.** Returns including curing bending hooking and tying compete as per detailed drawing shall be considered.

The Payment shall be made on M.Tonne. Basis of the finished work.

Item No. 16

Providing, fabricating and fixing in position GI Drainage Spout arrangements having 100 mm dia. Pipe B class with necessary bend, fixing to GI chamber, GI grating, providing and applying one coat of primer & two coat of anticorrosive paint, etc. complete as per drawing and as per specifications.

1. MATERIAL

Galvanized mild steel tubes of 150mm dia nominal bore shall conform to I.S. 12391968. The galvanised fitting, clamps, etc required for specified dia. Bore pipes shall be of best quality and make as approved by the Engineer – in – Charge.

2. WORKMANSHIP

2.1. Cutting, Laying and Jointing:

2.1.1. When the tubes are to be cut or rethreaded, the end shall be carefully field out so that no obstruction to bore in offered. The ends of the tubes shall than be threaded conforming to the requirements of I.S. 554-1955 with pipe dies and taps carefully in such a manner as will not result in slackness of joints when the two pipes are screwed together.

2.1.2. The taps and dies shall be used only for straightening screw threads which have become bent or damaged and dies shall not be used for turning of the threads so as to make them stacks as the latter procedure may not result in a watertight joints. The screw threads for tube and fitting shall be protected from edge unit they are fitted.

2.1.3. In jointing the tubes, the inside of the socket and the screwed end of the tubes shall be oiled and smeared with white or red lead and wapping around with a few turns of fine spun yarn round the screwed end of the tube. The end shall then be tightly screwed in the socket tees, etc. with a pipe wrench. Care shall be taken that all pipes and fitting are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burr joints shall be removed after screwing. After laying the open ends of the pipes shall be temporarily plugged to prevent access of water, soil, or any other foreign matter.

2.1.4. Any threads exposed after jointing shall be painted or in the case underground piping thickly coated with approved anti-corrosive paint to prevent corrosion.

2.2. Fixing of the tube fitting to wall ceiling and floor:

2.2.1. In case of fixing of tubes and fittings to the walls or ceiling these shall run on the surface of the wall or ceiling (not in change) unless otherwise specified. The fixing shall be done by means of standard pattern, holder clamps keeping the pipes about 1.5mm. clear of the wall. When it is found necessary to conceal the pipes and when specified so, chasing may be adopted or pipes fixed in ducts or reassesses etc. provided that there is sufficient space to work on the pipe with usual tools. The pipe shall not ordinarily be buried in walls or solid floors, where unavoidable, pipes may be buried for short distance provided that adequate protection is given against damage and where so required joints are not buried. Where required M.S. tube sleeve shall be fixed at a place a pipe is passing through a wall or wall or floor for expansion and contraction and other movements. In case the pipes is embedded in walls or floors, it should be painted with anti-corrosive bitumastic paint of approved quality. The pipe should not come in contact with lime mortar or lime concrete as the pipe is affected by lime. Under the floors, the pipe shall be laid in layer of sand filling.

2.2.2. All pipes and fittings shall be fixed vertical and horizontal unless unavoidable. The pipes shall be fixed to walls with standards pattern clamps of required size and shape, one end of which shall be properly plugged or cemented into walls with cement mortar 1:3 (1 Cement : 3 Coarse Sand) and the other tightened round the pipes to hold it securely. These clamps shall be spaced at

regular intervals in straight length at 2 M.C/C interval in horizontal run and 2.5M interval in vertical run. For pipe of 15 mm dia. upto 25 mm dia. The holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work or concrete. However for bigger diameter pipes, the holes shall be carefully made of the smallest required size. After fixing the pipe the holes shall be made good with cement mortar 1:3(1 cement : 3 coarse sand) and properly finished to match the adjacent surface.

2.3. Testing of Joints :

2.3.1. After laying and jointing, the fitting shall be inspected under working conditions of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost.

2.3.2. The pipes and fittings as they are laid shall be tested to hydraulic pressure of 6kg./sq.cm. The pipe shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock and water hammer. The draw off tacks and stop cock shall then be closed and specified hydraulic pressure shall be applied gradually. The pressure gauge must be accurate. The pipes and fitting shall be tested in sections as the work of laying proceeds keeping the joints exposed for inspection during the testing.

2.3.3. Testing of pipe lines fitting sand joints includes for providing all plant and appliance necessary for obtaining access to the work to be tested and carrying out the tests.

3. MODE OF MEASUREMENTS & PAYMENT :

3.1. The description of each item shall unless otherwise stated, be held to include where necessary conveyance and delivery, handling, unloading, storing fabrication hosting, all labour for finished to required shape and size, testing fitting in position straight, cutting and waste, return of packing etc.

3.2. The length shall be measured on running meter basis of finished work. The length shall be taken along the centre line of the pipe and fittings. The pipes fixed to walls, ceiling, floors, etc. shall be measured and paid under this item.

3.3. All the work shall be measured in decimal system as fixed in its place, subject to tolerance given below unless otherwise stated:

I Dimension shall be measured to the nearest 0.01 meter.

II Area shall be worked out to the nearest 0.01 sq. metre.

3.4. All measurements of cutting shall unless otherwise stated be held to include the consequent waste.

3.5. In case fitting of unequal bore, the largest bore shall be measured for the test.

4. RATE :

The rate includes galvanized steel tubing with screwed socket joints, together with all fitting (such as bends, sockets, springs, elbows, tees, crosses, short pieces, clamps and plugs unions etc.) and fixing complete with clamping wall-hooks, wooden plugs etc and also cutting, screwing and for making forged (or hand made) bends on piping as required. Contractor shall be inserted, where required or directed. The rate also including cutting through walls, floors etc. and their making good and painting exposed threads with anti-corrosive paint as above testing. Where tubes are to be fixed to wall, ceiling and flooring, the rate shall not include painting of pipes, providing sleeves and sand filling under floor for which separate payment shall be made.

The rate shall be paid on Each Number basis.

Item No. 17

Providing and fixing in position Mild steel dowel bars in pier caps or abutment caps for anchorage in fixed end as per detailed drawings including cutting, bending and welding complete.

1. This item provides for necessary mild steel bars of 32 mm. dia. in Pier Caps or Abutment Caps for anchorage in fixed end as per Detail drawing and as directed by Engineer-in-charge. For this purpose, 100 mm. holes shall be kept in Pier Caps or Abutment Caps at regular intervals as shown in drawing or as directed by Engineer-in-charge. The item includes cost of steel bar, transporting the bars to the site of work, handling, cutting, bending, hooking and placing the same in position as required as per drawing. The grout holes shall be not less than 100 mm. dia. The anchorage length

of bars shall not be less than 60times dia. Of bar. Grouting of groutholes shall be of 1:2 proportion (1 part of cement, 2 parts of sand) and shall be done under pressure as directed. These dowels bars shall be inserted through holes and shall be projected and embedded in foundation concrete. Groutholes shall not be less than 1 Mt. in depth. In case, no dowel bars are ultimately decided to be provided in the holes kept for the purpose, the same shall be filled with the concrete of the same proportion as of Pier Caps or Abutment Caps concrete at the cost of the contractor.

2. The dowel bar fixed in position shall be measured in Number.
3. Unit rate includes cost of material, labour, tools and plant and grouting the holes to complete the work.

Item No. 18

Providing and fixing in position Mild steel dowel bars in pier caps or abutments caps for anchorage in free end as per detailed drawing including cutting, bending and welding complete.

1. This item provides for necessary mild steel bars of 32 mm. dia. in Pier Caps or Abutment Caps for anchorage in free end as per Detail drawing and as directed by Engineer-in charge. For this purpose, 100 mm. holes shall be kept in Pier Caps or Abutment Caps at regular intervals as shown in drawing or as directed by Engineer-in-charge. The item includes cost of steel bar, transporting the bars to the site of work, handling, cutting, bending, hooking and placing the same in position as required as per drawing. The grout holes shall be not less than 100 mm. dia. The anchorage length of bars shall not be less than 60 times dia. of bar. Grouting of grout hole shall be of 1:2 proportion (1 part of cement, 2 parts of sand) and shall be done under pressure as directed. These dowels bars shall be inserted through holes and shall be projected and embedded in foundation concrete. Grout holes shall not be less than 1 Mt. in depth. In case, no dowel bars are ultimately decided to be provided in the holes kept for the purpose, the same shall be filled with the concrete of the same proportion as of Pier Caps or Abutment Caps concrete at the cost of the contractor.
2. The dowel bar fixed in position shall be measured in Number.
3. Unit rate includes cost of material, labour, tools and plant and grouting the holes to complete the work.

Item No. 19

Providing Weep holes in RCC abutment, Return wall and retaining wall with 100 mm dia PVC pipe and non-corrodible grating and geotextile, extending through the full width of the structure with slope of 1V:20H etc. complete as per drawing and technical specification.

The weep holes in the masonry / mass cement concrete of abutment and returns shall be provided of the PVC 100 mm dia. pipe. The pipe shall be fixed of suitable length & in full thickness of the masonry / concrete work. Necessary i.e. grating shall be provided on back side of abutment & returns on the inlet of opening of weep holes.

Materials The PVC pipes 100mm dia.

The Asbestos cement pipe of diameters specified in description of the item shall conform to relevant I.S. code. The interior of pipe shall have a smooth finish, regular surface & regular internal diameter.

The tolerance in all dim. shall be as per IS 1926-Part-I 1980.

The grating shall be of PVC. 100 mm. dia. & per IRC specification.

The weep holes shall be provided 1 meter C/C shall be placed in staggered. After laying weep holes, it shall be clear of earth and other materials from its complete length.

The rate shall be paid on Each Number basis.

Item No. 20

Providing and laying filter media 600mm thick as directed at the back of abutments, returns and retaining wall as per detailed specifications.

1. Well graded pebbled or metal of 40 mm to 63 mm. size shall be used. The grading and tolerances of metal of pebbles shall be as under:-

Sr. No.	No. of Size Range	Sieve Sieve designation	Percentage by weight
1.	63 mm. to 40 mm	passing through the Sieve	
		90 mm.	100-00
		63 mm.	85-100
		50 mm.	35-70
		40 mm.	00-15
		20 mm.	00-05

The size shall be 40 mm. to 63 mm. where in tolerance limit for oversize shall be up to 15% and that for lower size should be up to 15% and below 20 mm. it shall be allowable up to 5% the filter Materials shall be tightly placed to a thickness of not less than 600 mm. and provided over the entire surface behind abutments, wings or return walls to the full height.

2. Materials shall be first stacked in boxed of 2 m. 1. 1/2 m. X 0.5 m. size on fairly level ground and measured.
3. **The measurement for payment shall be made on Sq.m. basis** of boxes. No deduction shall be made for voids.
4. The unit rate includes the cost of materials, scaffolding labour and tools to complete the work.

2504.2.2Filter Medium

The material for the filter shall consist of coarse sand, gravel or stone. One or more layers of graded materials, to act as a filter medium, shall be provided underneath the pitching, to prevent loss of the embankment material and build up of uplift head on the pitching.

The gradation of the filter material shall satisfy the following requirements:

D 15 (Filter)

_____ < 5

D 85 (Base)

D 15 (Filter)

4 < _____ < 20

D 15 (Base)

D 50 (Filter)

_____ < 25

D 50 (Base)

Notes:

1. Filter design may not be required if embankment consists of CH or CL soils with liquid limit greater than 30, resistant to surface erosion. In this case, if a layer of material is used as bedding for pitching, it shall be well graded and its D 85 size shall be at least twice the maximum void size in pitching
2. In the foregoing, D 15 means the size of that sieve which allows 15 percent by weight of the filter material to pass through it and similar is the meaning of D 50 and D 85 (15 being replaced with 50 and 85 respectively).
3. If more than one filter layer is required, the same requirement as above shall be followed for each layer. The finer filter shall be considered as base material for selection of coarser filter.
4. The filter shall be compacted to a firm condition. The thickness of filter is generally of the order of 200 mm to 300 mm. Where filter is provided in two layers, thickness of each layer shall be 150 mm.

Notes:

1. Filter design may not be required if embankment consists of CH or CL soils with liquid limit greater than 30, resistant to surface erosion. In this case, if a layer of material is used as bedding for pitching, it shall be well graded and its D 85 size shall be at least twice the maximum void size in pitching

2. In the foregoing, D 15 means the size of that sieve which allows 15 percent by weight of the filter material to pass through it and similar is the meaning of D 50 and D 85(15 being replaced with 50 and 85 respectively)
3. If more than one filter layer is required, the same requirement as above shall be followed for each layer. The finer filter shall be considered as base material for selection of coarser filter.
4. The filter shall be compacted to a firm condition. The thickness of filter is generally of the order of 200 mm to 300 mm. Where filter is provided in two layers, thickness of each layer shall be 150 mm.

The payment shall be made on Sq.m. basis of finished work

Item No. 21

Providing Asphalt filler joint with required holes and holding arrangement & with necessary asphalt pad sealing as directed by engineer in charge.

1. Marble plate shall be white and of approved quality and shall be of size as mentioned in the item. Lettering shall be done by V-shape engraving and shall be filled with black paint of approved quality, letting shall be done as directed by the Engineer-in-charge. The Marble plate shall be fixed in neat cement at a place as directed by the Engineer-in-charge. Cement shall conform to relevant IS Specification.

2. Measurement shall be per each number of marble plate fixed.

3. Unit rates include cost of all material labour and tools to complete the work.

Item No. 22

Providing flood gauge marks on substructure as per design including painting complete.

The width of the flood gauge shall be 60cm and will have caneri yellow background colour. The flood gauge marking will be in 10cm. thick strip of alternative black & white colour. The width of the strip shall be as under:

- a. At every 10cm 15cm width
- b. At every 1/2m 25cm width in black
- c. At every meter 35cm width in white

The lattering shall be in black colour of 10cm height. The lattering shall show every meter and ½ meter. The lattering shall show levels based on either GST BM or arbitrator BM as furnished by Engineer in charge.

1. All the painting work shall be done in 3 coats. The paint shall be of approved Make.
2. The measurement for payment shall be on running meter basis measured vertically in height.
3. The unit rate includes the cost of materials, labour, painting, equipment if any to complete the work.

Measurement of payment shall be made on Rmt. basis.

Item No. 23

Back filling behind Abutment, wing wall and return wall with selected granular material of approved quality including all the materials, compacting, labour, equipment charges, etc. all complete as per drawing and Technical Specification Section 300 (Percentage of fine content maximum 15%, Backfill soil phi 30°, Density 20 kN/m³, Field compaction 95±2% modified proctor density.

1. The sand to be used for filling shall be coarse, granular, clean, free from dust and deleterious matters obtained from a source as approved by the Engineer-in charge. Sand between returns shall conform to I.S.: 383.
2. The space between returns and behind abutment shall be filled with sand under in suitable layers not exceeding 30 cm. at a time and each layer well compacted to maximum density up to the level as per detailed drawing or as directed by the Engineer-in-charge.
3. Mode of measurement shall be the total cubical content (in Cum.) of the area covered by sand filling.
4. Unit rate includes the cost of material, labour and tools and plant to complete the work.

The payment shall be made on Cu.m. basis of finished work.

Item No. 24

Dismantling the existing structure including removing and stacking the dismantled materials as and where directed. (A) R.C.C. work.

This work shall consist of dismantling and removing existing culverts, bridges, pavements, kerbs and other structures like guard-rails, fences, utility services, manholes, catch basins, inlets, etc., from the right of way which in the opinion of the Engineer interfere with the construction of road or are not suitable to remain in place, disposing of the surplus/unsuitable materials and backfilling to after the required compaction as directed by the Engineer.

Existing culverts, bridges, pavements and other structures which are within the highway and which are designated for removal, shall be removed upto the limit and extent specified in the drawings or as indicated by the Engineer.

Dismantling and removal operations shall be carried out with such equipment and in such a manner as to leave undisturbed, adjacent pavement, structures and any other work to be left in place. All operations necessary for the removal of any existing structure which might endanger new construction shall be completed prior to the start of new work.

202.2 Dismantling Culverts and Bridges

The structures shall be dismantled carefully and the resulting materials so removed as not to cause any damage to the part of the structure to be retained and any other properties or structures nearby.

Unless otherwise specified, the superstructure portion of culverts/bridges shall be entirely removed and other parts removed up to at least 600 mm below the sub-grade, slope face or original ground level whichever is the lowest or as necessary depending upon the interference they cause to the new construction. Removal of overlying or adjacent material, if required in connection with the dismantling of the structures, shall be incidental to this item. Where existing culverts/bridges are to be extended or otherwise incorporated in the new work, only such part or parts of the existing structure shall be removed as are necessary and directed by the Engineer to provide a proper connection with the new work. The connecting edges shall be cut, chipped and trimmed to the required lines and grades without weakening or damaging any part of the structure to be retained. Due care should be taken to ensure that reinforcing bars which are to be left in place so as to project into the new work as dowels or ties are not injured during removal of concrete. Pipe culverts shall be carefully removed in such a manner as to avoid damage to the pipes.

Steel structures shall, unless otherwise provided, be carefully dismantled in such a manner as to avoid damage to members thereof. If specified in the drawings or directed by the Engineer that the structure is to be removed in a condition suitable for re-erection, all members shall be match-marked by the Contractor with white lead paint before dismantling; end pins, nuts, loose plates, etc. shall be similarly marked to indicate their proper location; all

pins, pin holes and machined surfaces shall be painted with a mixture of white lead and tallow and all loose parts shall be securely wired to adjacent members or packed in boxes.

Timber structures shall be removed in such a manner as to avoid damage to such timber or lumber having salvage value as is designated by the Engineer.

202.3 Dismantling Pavements and Other Structures

In removing pavements, kerbs, gutters, and other structures like guard-rails, fences, manholes, catch basins, inlets, etc., where portions of the existing construction are to be left in the finished work, the same shall be removed to an existing joint or cut and chipped to a true line with a face perpendicular to the surface of the existing structure. Sufficient removal shall be made to provide for proper grades and connections with the new work as directed by the Engineer.

All concrete pavements, base courses in carriageway and shoulders etc., designated for removal shall be broken to pieces whose volume shall not exceed 0.02 cu.m and used with the approval of the Engineer or disposed of.

202.4 Back-filling

Holes and depressions caused by dismantling operations shall be backfilled with excavated or other approved materials and compacted to required density as directed by the Engineer.

202.5 Disposal of Materials

All dismantled materials shall be taken over by the Contractor.

202.6 Measurements for Payment

The work of dismantling shall be paid for in units indicated below by taking measurements before and after, as applicable:

- | | | |
|------|---|----------|
| i) | Dismantling brick/stone masonry/
concrete (plain and reinforced) | cu.m |
| ii) | Dismantling flexible and cement
concrete pavement | cu.m |
| iii) | Dismantling steel structures | tonne |
| iv) | Dismantling timber structures | cu.m |
| v) | Dismantling pipes, guard rails, kerbs,
gutters and fencing | linear m |
| vi) | Utility services | No. |

202.7 Rates

The Contract unit rates for the various items of dismantling shall be paid in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment, safeguards and incidentals necessary to complete the work. The rates will include excavation and backfilling to the required compaction and for handling, giving credit towards salvage value disposing of dismantled materials with all lifts and leads.

Item No. 25

Dismantalling the existing structure including removing and stacking the dismantled materials as and where directed. (B) Rubble Masonry.

The work shall be executed as per specification of **Item No. 24** except that the **Dismantalling of Existing Structure of Rubble Masonary** instead of **Dismantalling of Existing Structure of R.C.C. work.**

The Payment shall be made on M.Tonne. Basis of the finished work.

Item No. 26

Earth work for embankment including breaking clods, dressing with all lead and lift including watering, rolling and consolidation of sub grade in layers at O.M.C to required dry density including filling the depression which occur during the process using vibratory roller 8 to 10 Tonne (c) From Borrow area within 3.0 KM Lead

1. The land width on which the earth work is to be done shall be cleared of all trees having a girth of 30cm and loss, loose stones, vegetation, bushes, stumps and all other objectionable materials. All the materials cleared will be the property of Government. Useful material shall be arranged in convenient stack the road boundary or as directed at places within 50 metres lead, and handed over to the department in convenient section. Unsuitable material shall be brunt or other wise disposed off by the contractor at own cost without causing any nuisance inconvenience or damage to the works property or people in the neighborhood. In all cases the materials shall be disposed off in a neat manner.

2. After cleaning the site, the alignment of the road shall be properly set out true to line, curves, slopes grade and sections as shown on then plan or directed by the Engineer-in-charge. The contractor shall provide all labors and materials such as lime, string, pegs, nails, bamboos, stones, mortar, concrete etc. Required for setting out, establishing. Bench Marks and giving profiles. The contractor shall be responsible for maintaining the B.M.S. profiles alignment and other marks long they are required for the work in the opinion of the Engineer-in-charge. If the contractor defaults in this respect they may be restored by the department at the cost of the contractor.

3. When an existing embankment is to be widened, continuous, horizontal benches, each at least 0.3 metre wide shall be cut into the existing slope for ensuring adequate bond with the fresh embankment materials to be added. The material obtained from the cutting of benches

can be utilized in the widening of the embankment. The dumping of material from trucks for widening operation shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other type of hauling equipment.

4. The soil to be used for embankment shall be free from trees, stumps, root, rubbish or any other objectionable materials. Only materials considered suitable by the Engineer-in-charge shall be used for the construction and that considered unsuitable shall be disposed off as directed by him. The selection of materials to be used in the construction of embankment shall be made after soil survey and investigations are carried out by the Department. The embankment shall consist of earth available from road-side borrow pits on either side with all lead and lifts. And within land width in the manner specified in Para 11. Below. The road, if any required for the purpose of haulage of earth by men, animals or vehicles will be constructed. (If not existing) and maintained by the contractor at his own cost.

5. Department is extended all necessary co-operations in helping contractor to get borrow from near by Government or Panchayat land, if available. However department is not responsible if not such area is made available to the contractor and in the case, contractor will have to make his own arrangement to get borrow area for borrowing earth of the quantity even by making temporary arrangement with the private land owners.

6. The Embankment shall be constructed in uniform layer not exceeding 250mm in loose thickness. The soil shall be spread uniformly over the entire width of the embankment unless otherwise directed by the Engineer-in-charge. All clods of hard lumps of earth shall be broken to have maximum size of 15 cm. When being placed in the embankment a maximum of size 5 cm when being placed in the top 45 cm. of embankment. The work of next layer shall be allowed only after the first layer has been thoroughly compacted.

7. Where an embankment is to be placed on sloping ground shall be balanced in the step of trenches of broken up in such a manner that the new material shall have perfect bond with the existing surface. Where the embankment is to be placed over an existing road surface, the surface shall be scarified to minimum depth of a 5 cm. so as to provide ample bond between the old and new material. However when the embankment is to be placed over and old concrete pavement and lies within 1 metre of new sub grade level, the pavement shall be broken up in pieces not to exceed 0.1 m and may be metre of new sub grade left under the new embankment. If the existing road surface is of granular or bituminous type and lies within 1 mt. of the new sub grade level, the same shall be scarified to a depth of minimum 50mm. so as to provide ample bond between the old and the new material.

8. To avoid interference with contraction of abutment, wing walls or return walls of culvert/bridge structures, the contractor shall at point to be determined by the Engineer-in-charge, suspend work on embankment forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of interference of damage to the bridge work, unless directed otherwise the filling around culverts, bridge and other structures upto a distance of twice the height of the embankment from the back of the embankment shall be carried out independent

of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall unless permission has been given by the Engineer-in-charge but in any case not until the concrete or masonry has been in position for 14 days, the embankment shall be brought up simultaneously in equal layer on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer-in-charge. Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers with the laying of fill material. The material used for the filter shall conform to the requirements for filter medium and will be paid extra in the relevant item.

9. The embankment shall be finished in conformity with the alignment, level, cross section and dimensions shown on the plans or as directed by the Engineer-in-charge. Where the alignment of the road is in a curve, the top of the embankment shall be formed with the super elevation and the increased width shown on the drawing or as the Engineer-in-charge may direct. Finishing operation shall include the work of shaping and dressing the shoulder, road bed and the slopes to conform to the cross section.

10. **The earthwork measurement shall be paid on cross sectional measurements and computing the volumes of earth work in cubic metres by average area method.** The contractor shall sign day to day leveling work and also original cross sections, longitudinal section etc. in token of his acceptance. The working section both longitudinal and cross of the ground shall be taken by the Engineer-in-charge before the actual work has started. The contractor or his authorized representative shall attend day to day leveling work and sign with date the field book daily, in token of his acceptance, if there is any disagreement, the contractor shall inform of it in writing to the officer concerned with specific reference to the sections before starting further work. Once the work is started, no cognizance of any complaint will be taken merely not signing to level book shall not be deemed as disagreement. The Executive Engineer shall also verify leveling work to the extent of 5% before commencement of earth work and on finalization. The contractor shall maintain the embankment by filling in ruts, rain cuts, depression due to shrinkage etc. to proper formation and grade till this item is finally measured and accepted by the Department. The measurements shall be on compacted earth work. Deduction of 15% for shrinkage shall be made from gross measured quantity if measured before first monsoon and 10% if measured after one or more monsoon have been passed over the earth embankment. However the contractor shall have to bear loss of deformation etc. If any due to all settlements as well as other type of deformation etc. if any, that might have taken place at the time of taking measured of the item.

11. If usable approved material is available within the land width of road, the same shall be permitted for use in the road embankment subject to the following conditions:-

(i) The borrow pits will be so excavated as to form a road side longitudinal gutter to drain the water, interrupted by such gutter.

(ii) The width of the drain shall be restricted to 1.5mts. only the depth will be restricted to such grade so as to drain the water efficiently. All balance quantity of earth shall be brought from distant borrow areas only.

(iii) If there is top layer of black cotton or other objectionable soils, the same shall be removed and disposed off elsewhere and usable material found at the lower level will only be used in the earthen embankment, if the contractor choose to utilize this material.

(iv) the drain should be aligned along the boundry of the land width of the road. Not pit, other than this drain shall be dug within 5 metres of the toe to the final section of the road embankment.

(v) No borrow pits shall be allowed in the length in which earth obtained for cutting from cutting is specified to be used in embankment.

12 The rate of earthwork includes cleaning jungles, dog belling fixing profiles, erecting necessary pillars or stones for bench mark for leveling purpose, excavating earth from borrow pits, bracking clods, conveying and spreading earth in layers with all lead and lift, finishing the entire embankment and incidentals necessary to complete the work to the specifications. The cutting stuff of cutting in ordinary soil, soft murrum, soft rock, hard murrum and hard rock shall utilised in embankment costruction under this item within the lead specified in the particulars item. No Payment shall be made under this item for the cutting stuff used in embankment but labour for cutting will be paid as per specifications in the particulars item, and only balance quantity of earthwork from borrow areas will be pain in this item.

13. This Item payment shall be made in Cum.

Item No. 27

Granular Sub Base with Black trap crushed stone well graded material (Table 400.1) By Mix in place Method Construction of Granular Sub Base by providing black trap crushed stone well graded material, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotovator at OMC , and compacting with vibratory roller to achieve the desired density complete as per technical specification clause 401. For Grading I Material

401. GERANULAR SUB-BASE

401.1. Scope

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base here-in-after) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

401.2. Materials

401.2.1. The material to be used for the work shall be natural sand, gravel, crushed stone, depending upon the grading required. The material shall be free from organic or other deleterious constituents and conform to one of the three gradings given in Table 400.1. The grading to be adopted for a project shall be as specified in the Contract.

TABLE 400.1 : GRADING FOR GRANULAR SUB-BASE MATERIALS

IS Sieve Designation	Per cent by Weight Passing the IS Sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm	-	100	-
26.5 mm	55-75	50-80	100
9.50 mm	-	-	-
4.75 mm	10-30	15-35	25-45
2.36 mm	-	-	-
0.425 mm	-	-	-

0.075 mm	<10	<10	<10
----------	-----	-----	-----

Notes: (1) The material passing 425 micron (0.425 mm) sieve for all the three gradings when tested according to IS:2720 (Part 5) shall have liquid limit and plasticity index not more than 25 and 6 per cent respectively.

(2) On clayey subgrades, the per cent passing IS Sieve 0.075 mm shall not exceed 5.

401.3. Strength of Sub-base

When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remoulded at field dry density and moisture content and any other tests for the “quality” of materials, as may be necessary.

401.4. Construction Operations

401.4.1. Preparation of subgrade: Immediately, prior to the laying of sub-base, the subgrade already finished to Clause 303 shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80-100 kN smooth wheeled roller.

The sequence of construction operations shall be such that the construction of granular subbase layer shall match the construction of the adjoining layer in the shoulders, as per Clause 407.4.1.

401.4.2. Spreading and compacting: The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of suitable tractor-towed appliances, for maintaining the required slope and grade during the operation or other means as approved by the Engineer.

When the sub-base material consists of combination of materials mentioned in Clause 401.2.1, mixing shall be done mechanically by the mix-in-place method or by an approved mixing plant.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a tractor-towed rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.

Moisture content of the loose material shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to

variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above to 2 per cent below the optimum moisture content corresponding to IS:2720 (Part 7). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means, like, tractor-towed disc harrows, rotavators until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall and superelevation and shall commence at the edges and progress towards the centre for portions having crossfall on both sides.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked, with the help of templates and straight edge, and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is atleast 100 per cent of the maximum dry density for the material determined as per IS:2720 (Part 7). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

401.5. Aggregate Plugs

When the granular sub-base is extended over the full formation, as shown on the drawings, the exposed edges shall be protected with suitable aggregate plugs, 200 to 300 mm wide, as specified on the drawings.

401.6. Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 1802. Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 1800.

401.7. Arrangements for Traffic

During the period of construction, arrangement of traffic shall be maintained in accordance with Clause 111.

401.8. Measurements for Payment

Granular sub-base shall be measured as finished work in position in cubic metres.

The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

401.9. Rate

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for:

- (i) making arrangements for traffic to Clause 111 except for initial treatment to verges, shoulders and construction of diversions;
- (ii) furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts;
- (iii) all labour, tools, equipment and incidentals to complete the work to the Specifications;
- (iv) carrying out the work in part widths of road where directed; and
- (v) carrying out the required tests for quality control.

Item No. 28

Providing and filling in foundation with ordinary cement concrete M-150 mix and providing necessary vertical pin headers including formwork, vibrating, ramming and curing complete.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **M-150 mix and providing necessary vertical pin headers formwork, vibrating, ramming and curing complete** etc. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 29

Construction of concrete road using trimix system with 15cm thick CC M 300 Concrete mixing conplast P-211 water reduction admixture @ 100 ml/bag of cement and harder 62.50ml/bag using fixing and removing 'C' Channels of required road depth leveling if placed concrete with surface vibrator, finishing the surface with power floter and towel tight brooming as directed with providing expansion joints 20 x 200mm and construction joint 20 x 20 mm using concrete cutter machine etc. complete.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **M 300 Concrete for Bridge Approach Road** etc. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 30

Road marking with hot applied thermoplastic paints with reflectorizing glass beads on bitumen surface. Providing and laying a hot applied thermoplastic compound 2.5 mm thick include lng reflectorizing glass beads@ 250gms per sqm area, thickness of 2.5mm is excluding of surface applied, glass beads as per IRC:35-2015. The finished surface to be level, uniform and free from streaks and holes. zebra Patta /bump Patta lane/center line/ edge line/cut Patta. The white color marking should provide luminance coefficient on cement road shall be min 130 mcd/m²/lux and Asphalt road shall be min 100 mcd/m²/lux during the service life during the day time. The marking should meet the performance criteria for night time reflectivity, wet reflectivity and skid resistance as mentioned In the section-15 of IRC 35-2015 Warranty for reflectivity shall be for two years.

803 ROAD MARKINGS

803.1 Scope

The work shall consist of providing road markings of specified width, layout and design using paint of the required specifications as given in the Contract and as per guidelines contained in from IRC:35-1997.

803.2 Materials:- Road markings shall be of ordinary road marking paint hot applied thermoplastic compound, reflectorised paint or cold applied reflective paint as specified in the item and the material shall meet the requirements as specified in these Specifications.

803.3 Ordinary Road Marking Paint

803.3.1 Ordinary paint used for road marking shall conform to Grade I as per IS:164.

803.3.2 The road marking shall preferably be laid with appropriate road marking machinery.

803.4 Hot Applied Thermoplastic Road Marking

803.4.1 Thermoplastic Material

803.4.1.1 General

The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorizing beads. The colour of the compound shall be white or yellow (IS colour No. 356) as specified in the drawings or as directed by the Engineer.

803.4.1.2 Requirements :

- i) Composition: The pigment, beads, and aggregate shall be uniformly dispersed in the resin.

The material shall be free from all skins, dirt and foreign objects and shall comply with requirements indicated in Table 800-9.

Table 800-9 : Proportions of Constituents of Marking Material (Percentage by Weight)

Component	White	Yellow
Binder	18.0 min	18.0 min.
Glass Beads	30-30	30-30
Titanium Dioxide	10.0 min	--
Calcium Carbonate and Inert Fillers	42.0 max.	See Note below
Yellow Pigments	- -	See Note below

Note : Amount of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, provided all other requirements of this Specification are met.

- ii) Properties: The properties of thermoplastic material, when tested in accordance with ASTM D36/BS-3262-(Part 1), shall be as below:

- a) Luminance:

White: Daylight luminance at 45°-65 percent min. as per AASHTO M 249

Yellow: Daylight luminance at 45°-45 percent min. as per AASHTO M 249

- b) Drying time : When applied at a temperature specified by the manufacturer and to the required thickness, the material shall set to bear traffic in not more than 15 minutes.

- c) Skid resistance: not less than 45 as per BS:6044.
 - d) Cracking resistance at low temperature: The material shall show no cracks on application to concrete blocks.
 - e) Softening point: $102.5^{\circ}\text{C} \pm 9.5^{\circ}\text{C}$ as per ASTM D 36.
 - f) Yellowness index (for white thermoplastic paint): not more than 0.12 as per AASHTO M 249
- iii) Storage life : The material shall meet the requirements of these Specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for the one year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/ Contractor.
 - iv) Reflectorisation : Shall be achieved by incorporation of beads, the grading and other properties of the beads shall be as specified in Clause 803.4.2.
 - v) Marking : Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:
 - 1) The name, trade mark or other means of identification of manufacturer
 - 2) Batch number
 - 3) Date of manufacture
 - 4) Colour (white or yellow)
 - 5) Maximum application temperature and maximum safe heating temperature.
 - vi) Sampling and Testing : The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Engineer a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

803.4.2 Reflectorizing Glass Beads

803.4.2.1 General

This Specification covers two types of glass beads to be used for the production of reflectorised pavement markings.

Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800-9 and Type 2 beads are those which are to be sprayed on the surface vide Clause 803.6.4.

803.4.2.2 The glass beads shall be transparent, colourless and free from milkiness, dark particles and excessive air inclusions.

These shall conform to the requirements spelt out in Clause 803.4.2.3.

803.4.2.3 Specific Requirements

- a) Gradation : The glass beads shall meet the gradation requirements for the two types as given in Table 800-10.

Table 800-10 : Gradation Requirements for Glass Beads

Sieve Size	Percent Retained	
	Type 1	Type 2
1.18 mm	0 to 3	
850 micron	5 to 20	0 to 5
600 micron	--	5 to 20
425 micron	65 to 95	--
300 micron	--	30 to 75
180 micron	0 -10	10 to 30
Below 180 micron	--	0 to 15

- b) Roundness: The glass beads shall have a minimum of 70 percent true spheres.
- C) Refractive index: The glass beads shall have a minimum refractive index of 1.50.
- d) Free flowing properties: The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paint striping. They shall pass the free flow-test.

803.4.2.4 Test Methods

The specific requirements shall be tested with the following methods:

- i) Free-flow test: Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter dessicator which is filled within 25 mm of the top of a dessicator plate with sulphuric acid water solution (specific gravity 1.10). Cover the dessicator and let it stand for 4 hours at 20°C to 29°C. Remove sample from dessicator, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100 mm stem and 6 mm orifice. If necessary, initiate flow by lightly tapping the funnel. The glass spheres shall be free of lumps and clusters and shall flow freely through the funnel.

- ii) The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS:6088 and BS:3262 (Part I).
- iii) The Contractor shall furnish to the Engineer a copy of certified test reports from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified herein and shall certify that the material meets all requirements of these Specifications. However, if so required, these tests may be carried out as directed by the Engineer.

803.4.3 Application Properties of Thermoplastic Material

803.4.3.1 The thermoplastic material shall readily get screeded/extruded at temperatures specified by the manufacturers for respective method of application to produce a line of specified thickness which shall be continuous and uniform in shape having clear and sharp edges.

803.4.3.2 The material upon heating to application temperatures shall not exude fumes, which are toxic, obnoxious or injurious to persons or property.

803.4.4 Preparation

- i) The material shall be melted in accordance with the manufacturer's instructions in a heater with a mechanical stirrer to give a smooth consistency to the thermoplastic material to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.
- ii) After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

803.5 Reflectorized Paint

Reflectorized paint, if used, shall conform to the Specification by the manufacturers and approved by the Engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirements of Clause 803.4.2.

803.6 Application

803.6.1 Marking shall be done by machine. For locations where painting cannot be done by machine, approved manual methods shall be used with prior approval of the Engineer. The

Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

803.6.2 Where the compound is to be applied to cement concrete pavement, a sealing primer as recommended by the manufacturer, shall be applied to the pavement in advance of placing of the stripes to ensure proper bonding of the compound. On new concrete surface any laitance and/or curing compound shall be removed before the markings are applied.

803.6.3 The thermoplastic material shall be applied hot either by screeding or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.

803.6.4 The pavement temperature shall not be less than 10°C during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint.

The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line. Such new material shall so bond itself to the old line that no splitting or separation takes place.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed. In addition to the beads included in the material, a further quantity of glass beads of Type 2, conforming to the above noted Specification shall be sprayed uniformly into a mono-layer on to the hot paint line in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square metre area.

803.6.5 The minimum thickness specified is exclusive of surface applied glass beads. The method of thickness measurement shall be in accordance with Appendices B and C of BS:3262 (Part 3).

803.6.6 The markings shall be done to accuracy within the tolerances given below:

- i) Width of lines and other markings shall not deviate from the specified width by more than 5 percent.
- ii) The position of lines, letters, figures, arrows and other markings shall not deviate from the position specified by more than 20 mm
- iii) The alignment of any edge of a longitudinal line shall not deviate from the specified alignment by more than 10 mm in 15 m.
- iv) The length of segment of broken longitudinal lines shall not deviate from the specified length by more than 150 mm.

In broken lines, the length of segment and the gap between segments shall be as indicated on the drawings; if these lengths are altered by the Engineer, the ratio of the lengths of the painted sections shall remain the same.

803.6.7 Properties of Finished Road Markings

The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks.

- a) The stripe shall not be slippery when wet.
- b) The marking shall not lift from the pavement in freezing weather.
- c) After application and proper drying, the stripe shall show no appreciable deformation or discoloration under traffic and under road temperatures upto 60°C.
- d) The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil dripping from traffic.
- e) The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.
- f) The colour of yellow marking shall conform to IS Colour No. 356 as given in IS:164

803.6.8 Measurements for Payment

803.6.8.1 The painted markings shall be measured **in sq. metres** of actual area marked (excluding the gaps, if any).

803.6.8.2 In respect of markings like directional arrows and lettering, etc., the measurement shall be by numbers.

803.6.9 Rate

The Contract unit rate for road markings shall be payment in full compensation for furnishing all labour, materials, tools, equipment, including all incidental costs necessary for carrying out the work at the site conforming to these Specifications complete as per the approved drawing(s) or as directed by the Engineer and all other incidental costs necessary to complete the work to these Specifications.

Item No. 31

Cat Eye/ Road Stud/ RPM:- Supplying Raised Pavement Markers made of polycarbonate and ABS molded body and reflective panels with Micro compressed molding with micro prismatic lens (No Glass bead lens) capable of providing total internal reflection of the light entering the lens face and shall support a load of 13635 kgs. Tested in accordance to ASTM D,4280 Type H and complying to Specifications of Category A of MORTH Circular No RW/NH/33023/10-97 - DO III Dt 11.06. 1997. The height, width and length shall not exceed 20 mm, 130 mm and 130 mm and with minimum reflective area of 13 Sqcm on each side and the slope to the base shall be 35 +/- 5 degree. The body of the marker should having finger grip for easy and accurate placement and application with epoxy / bituminous Adhesive as recommended by the manufacturer of the marker. The color of the marker should be as per the IRC 35-2015 and as directed by Engineer-In-charge.

804.1 Scope

The work shall cover the providing and fixing of reflective pavement marker (RPM) or road stud, a device which is bonded to or anchored within the road surface, for lane marking and delineation for night-time visibility, as specified in the Contract.

804.2 Material

804.2.1 Plastic body of RPM/road stud shall be moulded from ASA (Acrylic Styrene Acrylonitrile) or HIPS (Hi-impact Polystyrene) or Acrylonitrile Butadiene Styrene (ABS) or any other suitable material approved by the Engineer. The markers shall support a load of 13,635 kg tested in accordance with ASTM D 4280.

804.2.2 Reflective panels shall consist of number of lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face Lenses shall be moulded of methyl methacrylate conforming to ASTM D 788 or equivalent.

804.3 Design

The slope or retro-reflecting surface shall preferably be $35 \pm 5^\circ$ to base and the area of each retro-reflecting surface shall not be less than 13.0 sq.cm.

804.4 Optical Performance

804.4.1 Unidirectional and Bi-directional Studs

Each reflector or combination of reflectors on each face of the stud shall have a Coefficient of Luminous Intensity (C.I.L). not less than that given in Tables 800-13 or 800-14 as appropriate.

804.4.2 Omni-directional Studs

Each Omni-directional stud shall have a C.I.L. of not less than 2 mcd/lx.

Table 800-13 : Minimum C.I.L. Values for Category 'A' Studs

Entrance Angle	Observation Angle	C.I.L. in mcdllx		
		White	Amber	Red
0° U 5° L &R	30°	220	110	44
0° U 10° L &R	0.5°	120	60	24

Table 800-14: Minimum C.I.L. Values for Category 'B' Studs

Entrance Angle	Observation Angle	C.I.L. in mcdllx		
		White	Amber	Red
0° U 6° L &R	30°	20	10	4
0° U 10° L &R	0.5°	15	7.5	3

Note :

- 1) The entrance angle of 0° U corresponds to the normal aspect of the reflectors when the reflecting road stud is installed in horizontal road surface.
- 2) The stud incorporating one or more corner cube reflectors shall be included in Category 'A'. The stud incorporating one or more bi-convex reflectors shall be included in Category 'B'.

804.5 Tests

804.5.1 Co-efficient of luminance intensity can be measured by procedure described in ASTM E 809 "Practice for Measuring Photometric Characteristics" or as recommended in BS:873-Part 4: 1973.

804.5.2 Under test conditions, a stud shall not be considered to fail the photometric requirements if the measured C.I.L. at any one position of measurement is less than the

values specified in Tables 800-13 or 800-14 provided that

- i) the value is not less than 80 percent of the specified minimum, and
- ii) the average of the left and right measurements for the specific angle is greater than the specified minimum.

804.6 Solar Powered Road Markers (Solar Studs)

The solar studs shall be made of Aluminium alloy and poly carbonate material which shall be absolutely weather resistant and strong enough to support a load of 13,635 kg tested in accordance with ASTM D4280. Its colour may be white, red, yellow, green or blue or combination as directed by the Engineer. Its water resistance shall meet the requirements of IP 65 in accordance with IS:12063:1987 Category 2 for protection against water ingress. The dimensions of solar studs shall not be less than 100 mm x 100 mm x 10 mm. It shall have super bright LEDs so as to provide long visibility from a distance of more than 800 m. Its flashing rate shall not be less than 1 Hz. It should be able to give the prescribed performance in the temperature range of -40°C to +55°C. Its life shall be not less than 3 years.

804.7 Fixing of Reflective Markers

804.7.1 Requirements

The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic. The reflecting portions of the studs shall be free from crevices or ledges where dirt might accumulate. Marker height shall not be less than 10 mm and shall not exceed 20 mm, and its width shall not exceed 130 mm. The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured, the outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface. All road studs shall be legibly marked with the name, trade mark or other means of identification of the manufacturer.

804.7.2 Placement

The reflective marker shall be fixed to the road surface using the adhesives and the procedure recommended by the manufacturer. No nails shall be used to affix the marker so that they do not pose safety hazard on the roads. Regardless of the type of adhesive used, the markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surfacing until the surfacing has been opened to traffic for a period of not less than 14 hours. The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oil, moisture, loose or unsound layers, paint and any other material which would adversely affect the bond of the adhesive.

The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the of the marker in a quantity sufficient to result in complete coverage of the area of contract of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place. For epoxy installations, excess adhesive around the edge of the marker, excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed.

804.7.3 Warranty and Durability

The contractor shall submit a two year warranty for satisfactory field performance including stipulated retro-reflectance of the reflecting panel, to the Engineer. In addition, a two year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carries out the work of fixing

of reflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer, at his own cost.

804.8 Measurement for Payment

The measurement of reflective road markers/solar powered road studs shall be in **numbers** of different types of markers supplied and fixed.

804.9 Rate

The contract unit rate for reflective road markers/solar powered road studs shall be payment in full compensation for furnishing all labour, material, tools, equipment including incidental costs necessary for carrying out the work at site conforming to the specification complete as per approved drawings or as directed by the Engineer.

Item No. 32

Regulatory / Mandatory Sign :-Providing and fixing sign boards made out of 2mm aluminum sheet / 4mm ACP (Aluminum composite Panel); size 60 cms. Dia Circle as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflective sheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T. Specifications; 3.6mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms. for each leg including excavation, curing etc. complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting.

801 TRAFFIC SIGNS

801.1 Scope

The work shall consist of the fabrication, supply and installation of ground mounted traffic signs on roads. The details of the signs shall be as shown in the drawings and in conformity with the Code of Practice for Road Signs, IRC:67-2010.

801.2 Materials

The various materials and fabrication of the traffic signs shall conform to the following requirements:

801.2.1 Concrete

Concrete for foundation shall be of M 15 Grade as per Section 1700 or the grade shown on the drawings or otherwise as directed by the Engineer.

801.2.2 Reinforcing Steel

Reinforcing steel shall conform to the requirement of IS: 1786 unless otherwise shown on the drawing.

801.2.3 Bolts, Nuts, Washers

High strength bolts shall conform to IS:1367 whereas precision bolts, nuts, etc., shall conform to IS:1364.

801.2.4 Plates and Supports

Plates and support sections for the sign posts shall conform to IS:226 and IS:2062 or any other relevant IS Specifications.

801.2.5 Substrate

Sign panels shall be fabricated on aluminium sheet, aluminium composite panel, fibre glass sheeting, or sheet moulding compound. Aluminum sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminium alloy conforming to IS:736-Material Designation 24345 or 1900. Aluminium Composite Material (ACM) sheets shall be sandwiched construction with a thermoplastic core of Low Density Polyethylene (LDPE) between two thick skins/sheets of aluminium with overall thickness and 3 mm or 4 mm (as specified in the Contract), and aluminium skin of thickness 0.5 mm and 0.3 mm respectively on both sides.

The mechanical proportion of ACM and that of aluminium skin shall conform to the requirements given in Table 800-1, when tested in accordance with the test methods mentioned against each of them.

Table 800-1 : Specifications for Aluminium Composite Material (ACM)

S. No.	Description	Specification	
		Standard Test	Acceptable Value
A	Mechanical Properties of ACM		
1)	Peel off strength with retro reflective sheeting (Drum Peel Test)	ASTM D903	Min. 4 N/mm
2)	Tensile strength	ASTM E8	Min. 40 N/mm ²
3)	0.2% Proof Stress	ASTM E8	Min. 34 N/mm ²
4)	Elongation	ASTM E8	Min. 6%
5)	Flexural strength	ASTM 393	Min. 130 N/mm ²
6)	Flexural modulus	ASTM 393	Min. 44.00 N/mm ²
7)	Shear strength with Punch shear test	ASTM 732	Min. 30 N/mm ²

B	Properties of Aluminium Skin		
1)	Tensile strength (Rm)	ASTM E8	Min. 65 N/mm ²
2)	Modulus of elasticity	ASTM E8	Min. 70,000 N/mm ²
3)	Elongation	ASTM E8	A50 Min. 2%
4)	0.2% Proof Stress	ASTM E8	Min. 10 N/mm ²

801.2.6 Plate Thickness

Shoulder mounted ground signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick with Aluminium and 3 mm thick with Aluminium Composite Material. All other signs be at least 2 mm thick with Aluminium and 4 mm thick with Aluminium Composite Material. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under prevailing wind and other loads.

801.2.7 In respect of sign sizes not covered by IRC:67, the structural details (thickness, etc.) shall be as per the approved drawings or as directed by the Engineer.

801.3 Traffic Signs having Retro-Reflective Sheeting

801.3.1 General Requirements

The retro-reflective sheeting used on the sign shall consist of the white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface.

It shall be weather-resistant and show colour fastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for co-efficient of retro-reflection, day/night time colour luminous, shrinkage, flexibility, linear removal, adhesion, impact resistance, specular gloss and fungus resistance and its having passed these tests shall be obtained from a Government Laboratory/Institute, by the manufacturer of the sheeting. The retro-reflective sheeting shall be either of Engineering Grade material with enclosed lens, High Intensity Grade with encapsulated lens or Micro-prismatic Grade retro-reflective element material as given in Clauses 801.3.2 to 801.3.7.

Guidance on the recommended application of each class of sheeting may be taken from IRC:67.

801.3.2 High Intensity Grade Sheeting

801.3.2.1 High Intensity Grade (Type III)

This high intensity retro reflective sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent waterproof plastic having a smooth surface or as an unmetallised micro prismatic reflective material element. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM D:4956-09) as indicated in Table 800-2

Table 800-2 : Acceptable Minimum Co-efficient of Retro-Reflection for High

Intensity Grade Sheeting (Type III) (Encapsulated Lens Type)

(Candelas Per Lux Per Square Metre)

Observation Angle in Dehrees	Entrance Angle in Degrees	White	Yellow	Orange	Green	Red	Blue	Brown
0.1 ^{0B}	-4 ⁰	300	200	120	54	54	24	14
0.1 ^{0B}	+30 ⁰	180	120	72	32	32	14	10
0.2 ⁰	-4 ⁰	250	170	100	45	45	20	12
0.2 ⁰	+30 ⁰	150	100	60	25	25	11	8.5
0.5 ⁰	-4 ⁰	95	62	30	15	15	7.5	5.0
0.5 ⁰	+30 ⁰	65	45	25	10	10	5.0	3.5

A minimum of Coefficient of Retro-reflection (RA) cd/fc/ft2 (cd-Ix-1 m2).

B Values for 0.11 observation angles are supplementary requirements that shall apply only when specified by the purchaser in the Contract or order. When totally wet, the

sheeting shall show not less than 90 percent, of the values of retro reflectance indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

801.3.3 High Intensity Micro-Prismatic Grade Sheeting (HIP) (Type IV)

This sheeting shall be of high intensity retro-reflective sheeting made of micro-prismatic retro-reflective element material coated with pressure sensitive adhesive. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM D:4956-09) as indicated in Table 800-3.

Table 800-3 : Acceptable Minimum Co-efficient of Retro-Reflection for High
Intensity Micro-Prismatic Grade Sheeting (Type IV)
(Candelas Per Lux Per Square Metre)

Observation Angle in Dehrees	Entrance Angle in Degrees	White	Yellow	Orange	Green	Red	Blue	Brown
0.1 ^{0B}	-4 ⁰	500	380	200	70	90	42	25
0.1 ^{0B}	+30 ⁰	240	175	94	32	42	20	12
0.2 ⁰	-4 ⁰	360	270	145	50	65	30	18
0.2 ⁰	+30 ⁰	170	135	68	25	30	14	8.5
0.5 ⁰	-4 ⁰	150	110	60	21	27	13	7.5
0.5 ⁰	+30 ⁰	72	54	28	10	13	6	3.5

A Minimum Coefficient of Retro reflection (RA) cd/fc/ft2 (cd-lx-1 m2).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent of the values of retro reflection indicated in above Table . At the end of 7 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

801.3.4 Prismatic Grade Sheeting

801.3.4.1 Prismatic Grade Sheeting (Type VIII)

The reflective sheeting shall be retro reflective sheeting made of micro prismatic retro reflective material. The retro reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro reflection (determined in accordance with ASTM E 810) as indicated in Table 800-4.

801.3.4.2 Prismatic Grade Sheeting (Type IX)

The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro-reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM E 810) as indicated in Table 800-5.

Table 800-4: Acceptable Minimum Co-efficient of Retro-Reflection for Prismatic Grade Sheeting (Type VIII) (Candelas Per Lux per Square Metre)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluore scent Yello w// Green	Fluore scent Yello w/ w/	Fluore scent Orang e
0.1 ^{0B}	-4 ⁰	1000	750	375	100	150	45	30	800	600	300
0.1 ^{0B}	+30 ⁰	460	345	175	46	69	21	14	370	280	135
0.2 ⁰	-4 ⁰	700	525	265	70	105	32	21	560	420	210
0.2 ⁰	+30 ⁰	325	245	120	33	49	15	10	260	200	95
0.5 ⁰	-4 ⁰	250	190	94	25	38	11	7.5	200	150	75
0.5 ⁰	+30 ⁰	115	86	43	12	17	5	3.5	92	69	35

A Minimum Coefficient of Retro reflection (RA) cd/fc/ft2 (cd-lx-1 m2).

B Values for 0.1 ° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the

sheeting shall show not less than 90 percent of the values of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

Table 800-5 : Acceptable Minimum Co-efficient of Retro-Reflection for Prismatic Grade

Sheeting (Type IX) (Candelas Per Lux per Square Metre)

Observation	Entrance	White	Yellow	Orange	Green	Red	Blue	Fluorescent Yellow w// Green	Fluorescent Yellow w/	Fluorescent Orange
0.1 ^{0B}	-4 ⁰	600	500	250	66	130	130	530	400	200
0.1 ^{0B}	+30 ⁰	370	280	140	37	74	17	300	220	110
0.2 ⁰	-4 ⁰	380	285	145	38	76	17	300	230	115
0.2 ⁰	+30 ⁰	215	162	82	22	43	10	170	130	65
0.5 ⁰	-4 ⁰	240	180	90	24	48	11	190	145	72
0.5 ⁰	+30 ⁰	135	100	50	14	27	6.0	110	81	41
1.0 ⁰	-4 ⁰	80	60	30	8.0	16	3.6	64	48	24
1.0 ⁰	+30 ⁰	45	34	17	4.5	9.0	2.0	36	27	14

A Minimum Coefficient of Retro reflection (RA) cd/fc/ft2 (cd-Ix-1m2).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent of the values of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

801.3.4.3 Prismatic Grade Sheeting (Type X!)

A Retro-reflective sheeting typically manufactured as a cube corner. The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro-reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM E 810) as indicated in Table 800-6.

Table 800-6 : Acceptable Minimum Co-efficient of Retro-Reflection for Prismatic Grade
Sheeting Type A (Type XI) (Candelas Per Lux per Square Metre)

Observation	Entrance	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow w/ Green	Fluorescent Yellow w/ Green	Fluorescent Orange
0.1 ^{0B}	-4 ⁰	830	620	290	83	125	37	25	660	500	250
0.1 ^{0B}	+30 ⁰	325	245	115	33	50	15	10	260	200	100
0.2 ⁰	-4 ⁰	580	435	200	58	87	26	17	460	350	175
0.2 ⁰	+30 ⁰	220	165	77	22	33	10	7.0	180	130	66
0.5 ⁰	-4 ⁰	420	315	150	42	63	19	13	340	250	125
0.5 ⁰	+30 ⁰	150	110	53	15	23	7.0	5.0	120	90	45
1.0 ⁰	-4 ⁰	120	90	42	12	18	5.0	4.0	96	72	36
1.0 ⁰	+30 ⁰	45	34	16	5.0	7.0	2.0	1.0	36	27	14

A Minimum Coefficient of Retro-reflection (RA) cd/fc/ft² (cd-Ix-1 m²).

B Values for 0.1° observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent of the values of retro reflection indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

801.3.5 Adhesives

The sheeting shall have a pressure-sensitive adhesive of the aggressive-tack type requiring no heat, solvent other preparation for adhesion to a smooth clean surface, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. The sheeting shall be applied in accordance with the manufacturer's specifications.

801.3.6 Fabrication

Surface to be reflectorised shall be effectively prepared to receive the retro-reflective sheeting. The aluminium sheeting shall be de-greased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting. Complete sheets of the material shall be used on the signs except where it is unavoidable. At splices, sheeting with pressure-sensitive adhesives shall be overlapped not less than 5 mm. Where screen printing with transparent colors is proposed, only butt joint shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

801.3.7 Messages/Borders

The messages (legends, letters, numerals etc.) and borders shall either be screen-printed or of cut out from durable transparent overlay or cut out from the same type of reflective sheeting for the cautionary/mandatory sign boards. Screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. For the informative and other sign boards, the messages (legends, letters, numerals etc.) and

borders shall be cut out from durable transparent overlay film or cut-out from the same reflective sheeting only. Cut-outs shall be from durable transparent overlay materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer. For screen-printed transparent coloured areas on white sheeting, the co-efficient of retro-reflection shall not be less than 50 percent of the values of corresponding colour in Tables 800-2 to 800-8 as applicable. Cut-out messages and borders, wherever used, shall be either made out of retro-reflective sheeting or made out of durable transparent overlay except those in black which shall be of non-reflective sheeting or opaque in case of durable transparent overlay.

801.3.8 Colour for Signs

801.3.8.1 Signs shall be provided with retro-reflective sheeting and/or overlay film/screening ink. The reverse side of all signs shall be painted grey.

801.3.8.2 Except in the case of railway level crossing signs the sign posts shall be painted in 250 mm side bands, alternately black and white. The lowest band next to the ground shall be in black.

801.3.8.3 The colour of the material shall be located within the area defined by the chromaticity coordinates in Table 800-7 and comply with the luminance factor when measured as per ASTM D-4956.

Table 800-7: Colour Specified Limits (Daytime)

Colour	1		2		3		4		Daytime Luminance Factor (Y%)	
	X	y	x	Y	x	y	x	y	Min	Max
White	0.303	0.300	0.368	0.366	0.340	0.393	0.274	0.329	15	--
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472	24	45
Green	0.026	0.399	0.166	0.364	0.286	0.446	0.207	0.771	2.5	11
Red	0.648	0.351	0.735	0.265	0.629	0.281	0.565	0.346	2.5	11
Blue	0.140	0.035	0.244	0.210	0.190	0.255	0.065	0.216	1	10
Orange	0.558	0.352	0.636	0.364	0.570	0.429	0.506	0.404	12	30
Brown	0.430	0.340	0.610	0.390	0.550	0.450	0.430	0.390	1	6
Fluorescent Yellow-Green	0.387	0.610	0.369	0.546	0.425	0.496	0.460	0.540	60	--
Fluorescent Yellow	0.479	0.520	0.446	0.483	0.512	0.421	0.557	0.442	45	--
Fluorescent Orange	0.583	0.416	0.535	0.400	0.595	0.351	0.645	0.355	25	--

The colours shall be durable and uniform in acceptable hue when viewed in day light or under normal headlights at night.

801.3.8.4 The Regulatory/Prohibitory and warning signs shall be provided with white background and red border. The legend/ symbol for these signs shall be in black colour. The Mandatory sign shall be provided with Blue background and white Symbol/letter.

801.3.8.5 The colours chosen for informatory or guide signs shall be distinct for different classes of roads. For National Highways and State Highways, these signs shall be of green background and for Expressways these signs shall be of blue background with white border, legends and word messages.

801.3.9 Refurbishment

Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminium backing or materials as per Clause 801.2.5, pre-coated with aggressive-tack type pressure sensitive adhesive. The adhesive shall be suitable for the type of material used for the sign and should thoroughly bond with that material.

801.3.10 Sizes of Letters

801.3.10.1 Letter size should be chosen with due regard to the speed, classification and location of the road, so that the sign is of adequate size for legibility but without being too large or obtrusive. The size of the letter, in terms of x-height, to be chosen as per the design speed is given in Table 800-8.

Table 800-8 : Acceptable Limits for Sizes of Letters

Design Speed (Km./hr.)	Minimum 'x' Height of the Letters (mm)	Minimum Sight Distance/ Clear Visibility Distance (m)	Maximum Distance from Centre Line (m)
40	100	45	12
50	125	50	14
65	150	60	16
80	250	80	21
100	300	90	24
120	400	115	32

The thickness of the letters and their relation to the x-height, the width, the heights are indicated in Table IV (a) of the Annexure-4 of IRC:67 to facilitate the design of the informatory signs and definition plates.

801.3.10.2 For advance direction signs on non-urban roads, the letter size ('x' height) should be minimum of 150 mm for Expressway, National and State Highways and 100 mm for other roads. In case of overhead signs, the size ('X' height) of letters may be minimum 300 mm. Thickness of the letter could be varied from 1/6 to 1/5 of the letter 'x' size. The size of the initial uppercase letter shall be 1-1/3 times x-height. In urban areas, letter size shall be 100 mm on all directional signs. For easy and better comprehension, the word messages shall be written in upper case letters only.

801.3.10.3 Letter size on definition plates attached with normal sized signs should be 100 mm or 150 mm. In the case of small signs, it should be 100 mm. Where the message is long, as for instance in "NO PARKING" and "NO STOPPING" signs, the message may be broken into two lines and size of letters may be varied in the lines so that the definition plate is not too large. The lettering on definition plates will be all in upper case letters.

801.3.11 Warranty and Durability

The Contractor shall obtain from the manufacturer a ten year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of micro-prismatic sheeting and a seven-year warranty for high intensity grade and submit the same to the Engineer. The warranty shall be inclusive of the screen printed or cut out letters/legends and their bonding to the retro-reflective sheeting. The Contractor/supplier shall also furnish the LOT numbers and certification that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty and that the contractor/supplier is the authorized converter of the particular sheeting.

All signs shall be dated during fabrication with indelible markings to indicate the start of warranty. The warranty shall also cover the replacement obligation by the sheeting manufacturer as well as contractor for replacement/repair/restoration of the retro-reflective efficiency.

A certificate in original shall be given by the sheeting manufacturer that its offered retro-reflective sheeting has been tested for various parameters such as co-efficient of retro-reflection, day/night time colour and luminance, shrinkage, flexibility, linear removal, adhesion, impact resistance, specular gloss and fungus resistance; the tests shall be carried out by a Government Laboratory in accordance with various ASTM procedures and the

results must show that the sheeting has passed the requirements for all the above mentioned parameters. A copy of the test reports shall be attached with the certificate.

801.4 Installation

801.4.1 The traffic signs shall be mounted on support posts, which may be of GI pipes conforming to IS:1239, Rectangular Hollow Section conforming to IS:4923 or Square Hollow Section conforming to IS:3589. Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally, signs with an area up to 0.9 sq.m shall be mounted on a single post, and for greater area two or more supports shall be provided. Post-end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant Specifications as specified.

801.4.2 All components of signs (including its back side) and supports, other than the reflective portion and G.I. posts shall be thoroughly de-scaled, cleaned, primed and painted with two coats of epoxy/ fibre glass/ powder coated paint. Any part of support post below ground shall be painted with protective paint.

801.4.3 The signs shall be fixed to the posts by welding in the case of steel posts and by bolts and washers of suitable size. After the nuts have been tightened, the tails of the bolts shall be furred over with a hammer to prevent removal.

801.5 Measurement for Payment

The measurement of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed, while for direction and place identification signs, these shall be measured by area in square metres.

801.6 Rate

The Contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site furnishing of necessary test certificates, warranty and incidentals to complete the work in accordance with these Specifications.

. The measurement shall be **in numbers** of Informatory sign board supplied and fixed in position

Item No. 33

Providing and fixing 'W' type safety barrier using M.S. iron channel 150mm x 75mm x 5mm size erected at 2.0 Mt. center to center and providing 'W' shaped galvanised steel sheet guard rail 3mm thick for crash barrier in single row as per detailed drawing with fabrication and installation charges including providing foundation block of size 0.60 x 0.60 x 0.75 Mt. in C.C. 1:2:4 and oil painting two coats with one coat of red oxide etc complete.

The work shall consist of furnishing and erection of metal crash barrier of dimensions and at locations as shown on the drawing, 'or' as directed by the Engineer-in-charge.

2.0 Materials

2.1 Metal beam rail shall be corrugated sheet of galvanized iron of the class, type section and thickness and shall be provided in one row as indicated in the item and shown on plan. Railing post shall be of steel section 150 mm x 75 mm x 5 mm. All complete steel rail elements, terminal sections, bolts, nuts, hardware and other fittings shall be galvanized. All elements of the railing shall be free from abrasion, rough or sharp edges and shall not be kinked twisted or bent, and shall conform to the IS 1367 and LS 1364.

2.2 Concrete for anchor assembly shall be in proportion of M-25 which includes concrete foundation block of size 35 x 35 x 12 cm for each post. The concrete work shall be carried out in accordance with the relevant MORT&H specifications

3.0 Construction Operation:

3.1 Installation of posts :

3.1. Workmanship

3.1.1. The ground shall be roughly leveled and after making the position of post, at **2.0 mt. C/C** the foundation pit shall be excavated in true line and level as shown on drawing or as directed by the Engineer in charge.

3.2 The Pit shall be back filled with R.C.C. M-30 as shown on drawing or as directed.

3.3 While casting foundation concrete, steel post shall be embedded in concrete work at **2.0 mt C/C** with necessary hold fast. The line and grade of railing shall be true to that shown on the plan. The railing shall be carefully adjusted to fixing in place to ensure proper matching at abutting joints and correct alignments and carry throughout their length. Holes for field connection shall be drilled with the railing in place in the structure at proper grade and alignment.

3.4 Railing steel post shall be given one coat of primer and two coats of paint on structural steel after erection if the sections are not galvanized. Any part of assembly below ground shall be painted with two coats of red lead paint.

4.0 Erection :

4.1 All ground rail anchors shall be set and attachment made and placed as indicated in the item and shown on the plan or as directed by the Engineer-in-charge.

4.2 All bolts or clips used for fastening the guard rail or fittings to the posts shall be drawn up tightly, Each bolt shall have sufficient length to extend at least 6 mm through and beyond the full nut, except where such extensions might interfere with or endanger traffic in which case the bolts shall be cut off flush with the nut.

4.3 All railings shall be erected, drawn and adjusted so that the longitudinal tension will be uniform throughout the entire length of the rail.

4.4 The post shall be vertical with a tolerance not exceeding 6 mm in a length of 3 meter. The railing barrier shall be erected true to line and grade.

5.0 Measurement for payment:

5.1 Meal beam crash barrier will be measured and paid by liner meter of completed length as per plans and accepted in place.

5.2 No measurement for payment shall be made for excavation, back filling with concrete etc. performed in connection with this construction.

5.3 The contract unit rate shall include full compensation for furnishing of labour, material, tools, equipment works involved in constructing the “W” type crash barrier complete in place in all respect as per this specification.

Measurement of payment shall be made on running metres basis

Item No. 34

Providing and laying 22.5 CMS thick dry stone pitching including preparing the surface with 15 CMS thick murrum bedding and including watering and providing 30 CMS x 30cms panel in cement concrete 1:3:6 at 3.0 meter center to center vertically & Horizontally and filling the voids of rubble with quarry spalls and murrum including ramming and watering with flush pointing on dry stone pitching and uncoursed stone masonry with C.M. 1:3 (1 Cement:3 Sand) etc. complete.(Including Supplying and Spreading Murram)

2504.2.1 Pitching

The pitching shall be provided with stones of thickness and shape as indicated on the drawings. The stones shall be obtained from quarries and shall be sound, hard, durable and fairly regular in shape. Round boulders shall not be allowed. Stones showing marked deterioration by water or weather shall not be accepted.

The size and weight of stone shall conform to Clause 5.3.5.1 of IRC: 89. No stone, shall weigh less than 40 kg. The size of spalls shall be a minimum of 25 mm and shall be suitable to fill the voids in the pitching. Where the stones of required size are not economically available, cement concrete blocks in minimum M 15 grade concrete conforming to Section 1700 of these Specifications or stones in wire crates, shall be used. 2504.3 Construction Operations Before laying the pitching, the side of banks shall be trimmed to the required slope and profiles by means of lines and pegs at intervals of 3 m. Depressions shall be filled and thoroughly compacted. The filter granular material shall be laid over the prepared base and compacted to the thickness specified on the drawings by means of suitable equipment. The lowest course of pitching shall be started from the toe wall and built up in courses upwards. The toe wall shall be in dry rubble masonry (uncoursed) conforming to Clause 1405.3, of these Specifications in case of dry rubble pitching. It shall be in nominal mix cement concrete (M 15) conforming to Clause 1704.3, of these Specifications in case of cement concrete block pitching. The stone pitching shall commence in a trench below the toe of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the drawings. Stones shall be set normal to the slope, and placed so that the largest dimension is perpendicular to the face of the slope, unless such dimension is greater than the specified thickness of pitching.

The largest stones shall be placed in the bottom courses and for use as headers for subsequent courses.

In hand placed pitching, the stone of flat stratified nature should be placed with the principal bedding plane normal to the slope. The pattern of laying shall be such that the joints are broken and voids are minimum by packing with spalls, wherever necessary, and the top surface is as smooth as possible. When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interstices between adjacent stones shall be filled in with spalls of the proper size wedged in with hammers to ensure tight packing. When two or more layers of stones must be laid to obtain the design thickness of pitching, dry masonry shall be used and stones shall be well bonded. To ensure regular and orderly disposition of the full intended quantity of stone as shown, template cross walls in dry masonry shall be built about a metre wide and to the full height of the specified thickness at suitable intervals all along the length and width of the pitching. Within these walls the stones shall be hand packed as specified.

The stone pitching shall be measured separately in square metres unless otherwise specified.

Item No. 35

Clearing and grubbing road land including uprooting rank vegetation grass bushes, shrubs, sapling and trees girth up to 300 mm removal of stumps of trees cut earlier and disposal of unserviceable materials (C) By mechanical means in area of light jungle

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc., which in the opinion of the Engineer are unsuitable for incorporation in the works, from, the area of road land containing road embankment, drains, cross-drainage structures and such other areas as may-be specified on the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

201.2. Preservation of Property/Amenities

Roadside trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all highway facilities within or adjacent to the highway which are not

to be disturbed shall be protected from injury or damage. The Contractor shall, provide and install at his own expense, suitable safeguards approved by the Engineer for this purpose.

During clearing and grubbing, the Contractor shall take all adequate precautions against soil erosion, water pollution, etc., and where required, undertake additional works to that effect vide Clause 306. Before start of operations, the Contractor shall submit to the Engineer for approval, his work plan including the procedure to be followed for disposal of waste materials, etc., and the schedules for carrying out temporary and permanent erosion control works as stipulated in Clause 306.3.

201-3. Methods, Tools and Equipments

Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the Work. If the area has thick vegetation/roots/trees, a crawler or pneumatic tyre dozer of adequate capacity may be used for clearance purposes. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc., falling within excavation and fill lines shall be cut to such depth below ground level that in no case foil within 500 mm of the subgrade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/subgrade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present an unsightly appearance.

All branches of trees extending above the trimmed as directed by the Engineer.

All excavations below the general ground level arising out of the removal of trees, stumps, etc., shall be filled with suitable material and compacted thoroughly so as to make the surface at these points conform to the surrounding area.

Ant-hills both above and below the ground, as are liable to collapse and obstruct free subsoil water flow shall be removed and their workings, which may extend to several metres, shall be suitably treated.

201.4. Disposal of Materials

All materials arising from clearing and grubbing operations shall be the property of Government and shall be disposed of by the Contractor as hereinafter provided or directed by the Engineer.

Trunks, branches and stumps of trees shall be cleaned of limbs and roots and stacked. Also boulders, stones and other materials usable in road construction shall be neatly stacked as directed by the Engineer. Stacking of stumps, boulders, stones etc., shall be done at specified spots with all lead and lift.

All products of clearing and grubbing which, in the opinion of the Engineer, cannot be used or auctioned shall be cleared away from the roadside in a manner as directed by the Engineer. Care shall be taken to see that unsuitable waste materials are disposed of in such a manner that there is no likelihood of these getting mixed up with the materials meant for embankment, subgrade and road construction.

201.5. Measurements for Payment

Clearing and grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis **in terms of hectares**. Clearing and grubbing of borrow areas shall be deemed to be a part of works preparatory to embankment construction and shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same. Cutting of trees upto 900 mm in girth including removal of stumps and roots, and trimming of branches of trees extending above the roadway shall be considered incidental to the cleaning and grubbing operations. Removal of stumps left over after trees have been cut by any other agency shall also be considered incidental to the clearing and grubbing operations.

201.6. Rates

201.6.1. The Contract unit rates for the various items of clearing and grubbing shall be payment in full-for carrying out, the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 900 mm in girth as well as stumps left over after cutting of trees carried out by another agency, excavation and back-filling to required density, where necessary, and handling, salvaging, piling and disposing of the cleared materials with all lead and lifts.

Item No. 36

Providing and Casting in situ controlled Cement Concrete M-250 for R.C.C. Raft and Cutt-off walls including necessary shuttering laying, vibrating, ramming and curing complete.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **Casting in situ-controlled Cement Concrete M-250 for R.C.C. Raft and Cutt-off walls** etc. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 37

Providing and casting in situ controlled cement concrete M-250 for R.C.C. return as per drawings including centering shuttering, scaffolding where necessary, laying vibrating, curing and finishing complete.(A) Height from 0.0 to 5.0 M. (1) Piers (2) Abutment (3) RCC return

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **casting in situ-controlled cement concrete M-250 for R.C.C. return Height from 0.0 to 5.0 M. (1) Piers (2) Abutment (3) RCC return as per drawings** etc. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 38

Providing and casting in-situ ordinary cement concrete M-250 for approach slab including formwork curing and finishing complete

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **casting in-situ ordinary cement concrete M-250 for approach slab** etc. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 39

Providing PVC 100 mm diameter water spouts including necessary iron grating as per drawings. PVC 100 mm diameter water spouts including necessary iron grating as per drawings.

The weep holes in the masonry / mass cement concrete of abutment and returns shall be provided of the PVC 100 mm dia. pipe. The pipe shall be fixed of suitable length & in full thickness of the masonry / concrete work. Necessary i.e. grating shall be provided on back side of abutment & returns on the inlet of opening of weep holes.

Materials The PVC pipes 100mm dia.

The Asbestos cement pipe of diameters specified in description of the item shall conform to relevant I.S. code. The interior of pipe shall have a smooth finish, regular surface & regular internal diameter.

The tolerance in all dim. shall be as per IS 1926-Part-I 1980.

The grating shall be of PVC. 100 mm. dia. & per IRC specification.

The weep holes shall be provided 1 meter C/C shall be placed in staggered. After laying weep holes, it shall be clear of earth and other materials from its complete length.

The rate shall be paid on Each Number basis.

Item No. 40

Providing and laying rubble for apron (each stone weighting not less than 40Kg.) including and packing and filing in the interstices with quarry-spalls.

1. The work shall consist of laying boulders directly on the prepared surface for protection against scour.

2. The stones used in apron shall be sound, hard, durable & fairly regularly in shape. Stone subject to marked deterioration by water or weather shall not be used. The thickness and shape of apron shall be as indicated on the drawings or as directed by the Engineer-in-charge. The surface on which the apron is to be laid shall be levelled and prepared for the length and width as shown on the drawings. The size of stone shall be as large as possible & weight shall be as specified in the

item but in no case any fragment shall weight less than 40 Kg. The specific gravity of stone shall be as high as possible and it shall not be less than 2.50. To ensure regular and orderly disposition- of the full intended quantity of stone in the apron, template cross walls in dry masonry shall be built about a meter wide and to the full height of the specified thickness of the apron at intervals of 30 metres and all along the length and width of the apron. Within these walls, the stone then shall be hand-packed.

3. Payment shall be made on CMT basis. The materials shall have to be stacked at site before laying. Preparation of base, or laying bedding shall be deemed incidental to the work Nothing shall deducted for voids.

4. The rate shall include cost of materials, labour & tools to complete the job.

.Item No. 41

Providing & casting in situ ordinary cement concrete M-150 mix and providing necessary pin headers including shuttering, scaffolding, laying, vibrating, curing and finishing complete with V-Groves.(A) Height from 0.0 M. to 5.0 M.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **casting in situ ordinary cement concrete M-150 mix and providing necessary pin headers** etc. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 42

Construction of granular sub-base 150 mm thick by providing machine crushed B.T. material satisfying MORT&H specification (Fifth revision) of grading III including spreading in uniform layer with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density etc. complete.

The work shall be executed as per specification of **Item No. 29** except that **Construction of granular sub-base 150 mm thick by providing machine crushed B.T. material satisfying MORT&H specification (Fifth revision) of grading III.** instead of **Construction of Granular Sub Base by providing black trap crushed stone well graded material Grading I.**

Item No. 43

Water Bound Macadam Grading-II (By Manual Means) Providing, laying, spreading and compacting stone aggregates of 63 to 45mm sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with smooth wheel roller 80-100 kN in stages to proper grade and camber, applying and brooming, stone screening/binding materials to fill up the interstices of coarse aggregate, watering and compacting to the required density.

404.1. Scope

404.1.1. This work shall consist of clean, crushed aggregates mechanically interlocked by rolling and bonding together with screening, binding material where necessary and water laid on a properly prepared sub-grade/ sub- base/ base or existing pavement, as the case may be and finished in accordance with the lines, cross-sections and thickness as per approved plans or as directed by the Engineer.

404.2.Materials

404.2.1. Coarse aggregates:

Coarse aggregate shall be crushed stone The aggregate shall conform to the physical requirements set forth in Table 400-6. The type and size range of the aggregate shall be as specified in the contract or shall be as specified by the Engineer. If the water absorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS : 2386 (Part5).

404.2.2 Crushed stone :

The crushed stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other deleterious material.

TABLE 400-6. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WATER BOUND MACADAM FOR SUB-BASE/ BASE COURSES.

Test		Test Method	Requirements
1	* Los Angeles abrasion value	IS : 2386 (Part-4)	40 per cent (Max)
	Or * Aggregate Impact value	IS : 2386 (Part-4) or IS : 5640	30 per cent (Max)
2	Combined Flakiness and Elongation Indices (Total)***	IS : 2386 (Part-I)	30 per cent (Max)

* Aggregate may satisfy requirements of either of the two tests.

*** The requirements of flakiness index and elongation index shall be enforced only in the case of crushed broken stone and crushed slag.

404.2.3. Grading requirement of coarse aggregates: The coarse aggregates shall conform to Gradings given in Table 400-7 as specified.

TABLE 400-7. GRADING REQUIREMENTS OF COARSE AGGREGATES

Grading No.	Size Range	IS Sieve Designation	Per cent by weight passing
1.	90 mm to 45 mm	125 mm	100
		90 mm	90-100
		63 mm	25-60
		45 mm	0-15
		22.4 mm	0-5
2.	63 mm to 45 mm	90 mm	100
		63 mm	90-100
		53 mm	25-75
		45 mm	0-15
		22.4 mm	0-5

Note : The compacted thickness for a single layer shall be 75 mm.

404.2.4. Screenings :

404.2.5. Screenings to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate. However, where permitted, predominantly non-plastic material such as moorum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material are below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 per cent.

Screenings shall conform to the grading set forth in Table 400-8. The consolidated details of quantity of screenings required for various grades of stone aggregates are given in Table 400-9. The table also gives the quantities of materials (loose) required for 10 Sqm for sub-base/ base compacted thickness of 100/75 mm.

The use of screenings shall be omitted in the case of soft aggregates such as brick metal, kankar, laterites etc. as they are likely to get crushed to a certain extent under rollers.

TABLE 400-8, GRADING FOR SCREENINGS

Grading Classification	Size of Screenings	IS Sieve Designation	Per cent by weight passing the IS sieve
A	13.2 mm	13.2 mm	100
		11.2 mm	95-100
		5.6 mm	15-35
		180 micron	0-10
B	11.2 mm	11.2 mm	100
		5.6 mm	90-100
		180 micron	15-35

TABLE 400-9, APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS REQUIRED FOR 100/75 MM COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SUB-BASE/ BASE COURSE FOR 10 SQM AREA.

Classifi- cation	Size Range	Comp. thick- ness	Loose Qty.	Screenings			
				Stone Screening		Crushed type such as murrum or gravel	
				Grading classifi- cation and size	For, WBM Sub-base/ base course (Loose Qty.	Grading classifi- cation and size	Loos e Qty.
Grading 1	90 mm to 45 mm	100 mm	1.21 to 1.43m ³	Type A 13.2mm	0.27 to 0.30 m ³	Not uniform	0.30 to 0.30 m ³
Grading 2	63 mm to 45mm	75 mm	0.91 to 1.07 m ³	Type A 13.2mm	0.12 to 0.15 m ³	-do	0.22 to 0.24 m ³
-do-	-do-	-do-	-do-	Type B 11.2mm	0.20 to 0.22 m ³	-do-	-do-

404.2.6. Binding material :

Binding material to be used for water bound macadam as a filler material meant for preventing raveling shall comprise of a suitable material approved by the Engineer having a Plasticity Index (PI) value of less than 6 as determined in accordance with IS: 2720 (Part-5).

The quantity of binding material where it is to be used, will depend on the type of screenings. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be 0.06-0.09 Cum/10 Sqm and 0.08-0.10 Cum/10 Sqm for 100 mm compacted thickness.

The above mentioned quantities should be taken as a guide only, for estimation of quantities for construction etc.

Application of binding materials may not be necessary when the screenings used are of crushable type such as moorum or gravel.

404.3. Construction Operations

404.3.1. Preparation of base:

The surface of the sub grade/ sub-base/ base to receive the water bound macadam course shall be prepared to the specified lines and cross fall (camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained if necessary by sprinkling water. Any sub base/ base/ surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (leveling course) to Clause 501 of MORT&H specifications.

404.3.2 Spreading coarse aggregate:

The coarse aggregates shall be spread uniformly and evenly upon the prepared sub-grade/ sub base/ base to proper profile by using templates placed across the road about 6 mt. apart, in such quantities that the thickness of each compacted layer is not more than 100 mm for Grading 1 and 75 mm for Grading 2 and 3, as specified in Clause 404.2.3. Wherever possible, approved mechanical devices such as aggregate spreader shall be used to spread the aggregates uniformly so as to minimize the need for manual rectification afterwards. Aggregates placed at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any approved means so as to achieve the specified results.

The spreading shall be done from stockpiles along the side of the roadway or directly from vehicles. No segregation of large or fine aggregate shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material.

The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved drawings.

The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operations.

403.3.4. Rolling:

Immediately following the spreading of the coarse aggregates rolling shall be started with vibratory rollers of 80 to 100 kN static weight. The type and capacity of the roller to be used shall be approved by the Engineer based on trial run.

Except on super elevated portions where the rolling shall proceed from inner edge to outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to center line of the road, in successive passes uniformly lapping preceding tracks by at least one half the width.

Rolling shall be discontinued when the aggregates are partially compacted with sufficient void space in them to permit application of screenings. However, where screenings are not to be applied, as in the case of crushed aggregates like brick metal, laterite and kankar, compaction shall be continued until the aggregates are thoroughly keyed. During rolling, slight sprinkling of water may be done, if necessary. Rolling shall not be done when the sub grade is soft or yielding or when it causes a wave-like motion in the sub-grade or sub base course.

The rolled surface shall be checked transversely and longitudinally, with templates and any irregularities corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to desired camber and grade. In no case shall the use of screenings be permitted to make up depression.

Material which gets crushed excessively during compaction or becomes segregated shall be removed and replaced with suitable aggregates.

It shall be ensured that shoulders are built up simultaneously along with water bound macadam courses as per Clause 407.4.1 of MORT&H specifications.

404.3.5 Application of screenings:

After the coarse aggregate has been rolled to Clause 404.3.4, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motions of hand shovels or by mechanical spreaders, or directly from tipper with suitable grit spreading arrangement. Tipper operating for spreading, the screenings shall be so driven as not to disturb the coarse aggregate.

The screenings shall be applied at a slow and uniform rate (in three or more application) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These

operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.

The spreading, rolling, and brooming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation.

404.3.6. Sprinkling of water and grouting :

After the screenings have been applied, 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 operation shall be continued, with additional screenings applied as necessary until the coarse aggregate has been thoroughly keyed, well- bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or sub-grade does not get damaged due to the addition of excessive quantities of water during construction.

404.3.7. Application of binding material:

After the application of screenings in accordance with Clause 404.3.5 and 404.3.6. the binding material where it is required to be used (Clause 404.2.7) shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms, or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, form a wave ahead of the wheels of the moving roller.

404.3.8. Setting and drying:

After the final compaction of water bound macadam course the pavement shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding materials as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer-in-charge shall have the discretion to stop hauling traffic from using the completed water bound macadam course if in his opinion it would cause excessive damage to the surface.

The compacted water bound macadam course should be allowed to completely dry and set before the next pavement course is laid over it.

404.4.Surface finish and quality control:

404.4.1 The surface finish of construction shall conform to the requirements of clause-901 of MORT&H specifications

404.4.2 Control on the quality of materials and works shall be exercised by the Engineer-in-charge in accordance with section 900. of MORT&H specifications

404.4.3 The water bound macadam work shall not be carried out when the atmospheric temperature is less than 0°C in the shade.

404.4.4. Reconstruction of defective macadam:

The finished surface of water bound macadam shall conform to the tolerance of surface regularity as prescribed in clause 902 of MORT&H specifications. However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to sub-grade soil mixing with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and recompact. In no case shall depressions be filled up with screenings or binding material.

404.5 Arrangement for Traffic :

During the period of construction the arrangement of traffic shall be done as per Clause – 112 of MORT&H specifications.

404.6.Measurement for Payment:

Water bound macadam shall be paid as finished work in position on cross sectional measurements and computing the volume of WBM work in **cubic meters** by average area method.

404.7 RATES:

The contract unit rate for water bound macadam shall be payable in full for carrying out the required operations including full compensation for all components listed above including arrangement of water used in the work as approved by the Engineer.

Item No. 44

Providing and applying priming coat with emulsion SS1 grade at the rate of 7.50 kg/ 10 Sq.mt. including cost of asphalt and preparing the surface heating, and applying etc. complete.

502 PRIME COAT OVER GRANULAR BASE**502.1 Scope**

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to a porous granular surface preparatory to the superimposition of bituminous treatment or mix. The work shall be carried out on a previously prepared granular/ stabilized surface to Clause 501.8.

502.2 Materials

502.2.1 The primer shall be cationic bitumen emulsion SS 1 grade conforming to IS:8887 or medium curing cutback bitumen conforming to IS:217 or as specified in the Contract.

502.2.2 Quantity of SS 1 grade bitumen emulsion for various types of granular surface shall be as given in Table 500-3.

Table 500-3: Quantity of Bitumen Emulsion for Various Types of Granular Surfaces

Type of Surface	Rate of Spray (kg/sq.m)
WMM/WBM	0.7-1.0
Stabilized soil bases/Crusher Run Macadam	0.9-1.2

502.2.3 Cutback for primer shall not be prepared at the site. Type and quantity of cutback bitumen for various types of granular surface shall be as given in Table 500-4.

Table 500-4 : Type and Quantity of Cutback Bitumen for Various Types of Granular Surface

Type of Surface	Type of Cutback	Rate of Spray (kg/sq.m)
WMM/WBM	MC 30	0.6-0.9
Stabilized soil bases/Crusher Run Macadam	MC 70	0.9-1.2

502.2.4 The correct quantity of primer shall be decided by the Engineer and shall be such that it can be absorbed by the surface without causing run-off of excessive primer and to achieve desired penetration of about 8-10 mm.

502.3 Weather and Seasonal Limitations

Primer shall not be applied during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. Cutback bitumen as primer shall not

be applied to a wet surface. Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present. Surface can be just wet by very light sprinkling of water.

502.4 Construction

502.4.1 Equipment

The primer shall be applied by a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at specified rates and temperatures. Hand spraying shall not be allowed except in small areas, inaccessible to the distributor, or in narrow strips where primer shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

502.4.2 Preparation of Road Surface

The granular surface to be primed shall be swept clean by power brooms or mechanical sweepers and made free from dust. All loose material and other foreign material shall be removed completely. If soil/ moorum binder has been used in the WBM surface, part of this should be brushed and removed to a depth of about 2 mm so as to achieve good penetration.

502.4.3 Application of Bituminous Primer

After preparation of the road surface as per Clause 502.4.2, the primer shall be sprayed uniformly at the specified rate. The method for application of the primer will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

No heating or dilution of SS1 bitumen emulsion and shall be permitted at site. Temperature of cutback bitumen shall be high enough to permit the primer to be sprayed effectively through the jets of the spray and to cover the surface uniformly.

502.4.4 Curing of Primer and Opening to Traffic

A primed surface shall be allowed to cure for at least 24 hours or such other higher period as is found to be necessary to allow all the moisture/volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with a light application of sand, using the minimum quantity possible. A primed surface shall not be opened to traffic other than that necessary to lay the next course.

502.5 Quality Control of Work

For control of the quality of materials and the works carried out, the relevant provisions of Section 900 shall apply.

502.6 Arrangements for Traffic

During construction operations, arrangements for traffic shall be made in accordance with the provisions of Clause 112 as per MORTH SPECIFICATION 5th Revision.

502.7 Measurement for Payment

Prime coat shall be measured in terms of surface area of application in square metres.

502.8 Rate

The contract unit rate for prime coat shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.7 (i) to (v) as per MORTH SPECIFICATION 5th Revision and as applicable to the work specified in these Specifications. Payment shall be made on the basis of the provision of prime coat at an application rate of quantity at 0.6 kg per square metre or at the rate specified in the Contract, with adjustment, plus or minus, for the variation between this quantity and the actual quantity approved by the Engineer after the preliminary trials referred to in Clause 502.4.3 as per MORTH SPECIFICATION 5th Revision.

Item No. 45

Providing & Laying 20mm thick mix seal surfacing using stone chipping and aggregate as per MORT&H specification and asphalt grade VG-30 for mixing at the rate of 4.5% of total mix including heating the aggregate and asphalt by drum mixing plant and including using asphalt grade VG-30 for tack coat at the rate of 2.5kg/10sq.mt. spreading with vibratory roller including providing all materials equipment's tools and plants oil, kerosene, firewood , labour charges etc. complete

SEAL COAT

Scope

This work shall consist of the application of a seal coat for sealing the voids in a bituminous surface laid to the specified levels & grade and cross fall (camber).

Seal coat shall be Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder.

Materials

Binder: The quantity of bitumen VG-10 grade to be used shall be 4.5% by weight of total mix.

Stone chips for seal coat : The stone chips shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They should be free of soft or disintegrated stone, organic or other deleterious matter. Stone chips shall be of 6.7mm size defined as 100 per cent passing through 11.2 mm sieve and retained on 2.36 mm sieve. The quantity used for spreading shall be 0.18 cubic metre per 10 square

metre area. The chips shall satisfy the quality requirements in Table 500-3 except that the upper limit for water absorption value shall be 1 per cent

Table 500.3 Physical, Requirements for Coarse aggregate

Property	Test	Specification
Cleanliness	Grain Size analysis	Max. 5% passing 0.075 mm sieve.
Particle shape	Flakiness and Elongation Index (Combined)	Max. 30%
Strength	Los Angeles Abrasion Value	Max. 40%
	Aggregate Impact Value	Max. 30%
Durability	Soundness	
	Sodium Sulphate	Max. 12%
	Magnesium Sulphate	Max. 18%
Water Absorption	Water Absorption	Max. 2%
Stripping	Coating and stripping of Bitumen aggregate Mixtures.	Minimum retained coating 95%
Water Sensitivity	Retained Tensile Strength	Minimum 80%

Notes :-

[1] IS : 2386 Part – 1

[2] IS : 2386 Part – 1 [the elongation test to be done only on non-flaky aggregate in the sample] [3] IS : 2386 Part – 4 [4] IS : 2386 Part – 5

[5] IS : 2386 Part – 3 [6] IS : 6241

[7] The water sensitivity test is only to be carried out if the minimum retained coating in the stripping test is less than 95 %

*** Aggregate may satisfy requirements of either of these two tests.

Where crushed gravel is proposed for use as aggregate not less than 90% by weight of the crushed material retained of the 4.75 mm sieve shall have at least two fractured faces.

Preparation of base :-

The surface on which the bituminous concrete is to be laid shall be prepared in accordance with Clause 501 and 902 as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In location where a mechanical broom can not access, other approved methods shall be used as directed by the Engineer.

Mixing and transportation of the mixture. :-

Mixing: Pre-mixed bituminous materials including semi dense bituminous concrete, shall be prepared in a **Drum mix** plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates. Appropriate mixing temperatures shall be as per Table 500-5

Table 500.5 Manufacturing and Rolling Temperatures.

Penetration	Bitumen Mixing [C]	Aggregate Mixing [C]	Mixed Material [C]	Rolling [C]	Laying [C]
35	106-170	160-175	170 Max.	100 Max.	130 Max.
65	150-165	150-170	165 Max.	90 Max.	125 Max.
90	140-160	140-165	155 Max.	80 Max.	115 Max.

The difference in temperature between the binder and aggregate should at no time exceed 140°C. In order to ensure uniform quality of the mix and better coating of aggregate, the hot mix plant shall be calibrated from time to time.

Transporting

Bituminous material shall be transported in clean insulated vehicles, and unless otherwise agreed by the Engineer, shall be covered while in transit or awaiting tipping. Subject to the approval of the Engineer, a thin coating of diesel or lubricating oil may be applied to the interior of the vehicle to prevent sticking and to facilitate discharge of the material.

Spreading

The premixed material shall be spread by suitable means to the desired thickness grades and cross-fall. Except in areas where a mechanical paver cannot access, bituminous materials shall be spread, leveled and tamped by an approved self propelled paving machine. As soon as possible after arrival at site, the materials shall be supplied continuously to the paver and laid without delay

The rate of delivery of material to the paver shall be regulated to enable the paver to operate continuously. The travel rate of paver, and its method of operation, shall be adjusted to ensure an even and uniform flow of bituminous material across the screed, free from dragging, tearing and segregation of the material. In areas with restricted space where a mechanical paver cannot be used, the material shall be spread, raked and leveled with suitable hand tools by experienced staff, and compacted to the satisfaction of the Engineer.

The minimum thickness of material laid in each paver pass shall be in accordance with the minimum values given in the relevant parts of these Specifications. When laying binder course or wearing course approaching an expansion joint of a structure, machine laying shall stop 300mm short of the joint. The remainder of the pavement up to the joint, and the corresponding area beyond it, shall be laid by hand, and the joint or joint cavity shall be kept clear of surfacing material.

Bituminous material, with a temperature greater than 145°C, shall not be laid or deposited on bridge deck waterproofing systems, unless precautions against heat damage have been approved by the Engineer.

Hand placing of pre-mixed bituminous materials shall only be permitted in the following circumstances:

1. For laying regulating courses of irregular shape and varying thickness.
2. In confined spaces where it is impracticable for a paver to operate.

3. For footways,
4. At the approaches to expansion joint at bridges, viaduct or other structures,
5. For filling of pot holes
6. Where directed by the Engineer.

Manual spreading of pre-mixed wearing course material or the addition of such material by hand spreading to the paved area, for adjustment of level, shall only be permitted in the following circumstances:

- i. At the edges of the layers of material and at gullies and manholes
- ii. At the approaches to expansion joints at bridges, viaducts or other structures.
- iii. As directed by the Engineer.

Rolling

As soon as sufficient length of bituminous material has been laid, rolling shall commence with 8-10 tonne rollers smooth wheel tandem type or other approved equipment. Rolling shall begin at the edge and progress toward the center longitudinally except that on super elevated and unidirectional cambered portions it shall progress from the lower to upper edge parallel to the center line of the pavement.

When the roller has passed over the whole area once any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled and all the roller marks eliminated. In each pass of the roller the proceeding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels. In no case shall fuel, lubricating oil be used for this purpose. Excess use of water for this purpose shall also be avoided.

Rollers shall not stand on newly laid material. Rolling operations shall be completed in every respect before the temperature of the mix falls below the minimum rolling temperature stated in the relevant part of these Specifications.. Joints along and transverse to the surfacing laid and compacted earlier shall be cut vertically to their full depth so as to expose fresh surface which shall be painted with a thin coat of appropriate binder before the new mix is placed against it.

Opening to Traffic

Traffic shall not be permitted to run on any newly sealed area until the following day. In special circumstances, however, the Engineer may open the road to traffic immediately after rolling, but in such cases traffic speed shall be rigorously limited to 16 km per hour until the following day.

Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902 of MORT&H. For control on the quality of materials supplied and the works carried out, the relevant provisions of Section 900 of MORT&H. shall apply.

Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112 of MORT&H

Measurement for Payment

The payment shall be made on the basis of the weight of mix aggregates and bitumen. For this purpose, the contractor shall have to install **tonnage** a weigh-bridge of suitable capacity for the purpose of weighing dumpers at suitable place at his cost as directed. Weight of empty dumpers and weight of loaded dumper will be recorded in bound and numbered register on plant site.

Department will be free to get some loaded dumpers test checked at other weigh bridge. Weigh bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat, if the theoretical area as per sanctioned estimate for basis of tonne differs with the actual area of work done in the field then the reduction in or addition to payment shall have to be effected to the contractor on pro-rate basis depending upon the area reduced or exceeded respectively.

Weight of mix materials will be done in presence of responsible person, not less than the rank of Supervisor of Department and the measurements shall be recorded by the Deputy Executive Engineer or Assistant Engineer or Additional Assistant Engineer, if so authorized. Record of each dumper will be mentioned separately in bound and numbered register which will be maintained by the Department representatives and signed by the contractor. Proper gate pass system shall be established for the vehicle coming to the plant site and going from the site. The location of the K.M. hectometer and meter in which individual dumpers are unloaded shall be recorded carefully.

Rate :- The contract unit rate for Open graded premix carpet shall be payment in full for carrying out the required operations as specified. The rate shall include for all components listed below.

- Making arrangements for traffic to clause 112 except for initial treatment to verge, shoulders and construction of diversions.
- Preparation of the surface to revive the materials.
- Providing all materials to be incorporated in the work including arrangement for stock yards. All royalties, fees rents where necessary and all leads and lifts.
- Mixing transporting, laying and compacting the mix as specified.
- All labour, tools equipment, plant including installation of hot mix plant, power supply units and all machinery incidental to complete the work to these specification.
- Carrying out the work in part widths of the road where directed.
- Carrying out all tests for control of quality, and
- The rate shall cover the provision of bitumen at the rate specified in the contract, with the provision that the variation in actual percentage of bitumen used will be assessed and the payment adjusted accordingly.
- The rate for premixed material are to include for all wastage in cutting of joints etc.
- The rates are to include for all necessary testing mix design transporting and testing of samples, and cores. If there is not a project specific : laboratory, the contractor must arrange to carry out all necessary testing at an outside laboratory approved by the Engineer, and all costs incurred are deemed to be included in the rate quoted for the material.
- The cost of all plant and laying trials as specified to prove the mixing and laying methods is
- deemed, to be included in the contractor's rates for the materials.

Item No. 46

Men at work (Heavy) sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 120cm x 90cm as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorised with High Intensity Prismatic Grade retro reflectivesheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T.Specifications; 3.6 mtr long stand post (2 Nos.) of Iron Angle 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 50x50x5mm; painted with bestquality epoxy coatings in black and white bends. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting

The work of providing and fixing **Men at work (Heavy) Sign** shall be executed as per relevant specifications of **Item No. 32** of this contract. The measurement shall be in numbers of board supplied and fixed in position.

Payment shall be made on Number Basis

Item No. 47

Diversion Ahead Sign :-Providing and fixing sign boards made out of 2mm aluminium sheet / 4mm ACP (Aluminum composite Panel); size 180x60 CMS. rectangular as per design of IRC-67-2012. Pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ; reflectorized with High Intensity Prismatic Grade retro reflective sheeting of Type-4 as per ASTM D-4956 and latest M.O.S.T. Specifications; 3.1 mtr long stand post (2 Nos.) of Iron Angle 50 x 50 x 5mm / 50NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 CMS. for each leg including excavation, curing etc. complete under the supervision of engineer in charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. **(B) Class-B Type-4 Retro Reflective sheeting**

The work of providing and fixing **Diversion Ahead Sign** shall be executed as per relevant specifications of **Item No. 32** of this contract. The measurement shall be in numbers of board supplied and fixed in position.

Payment shall be made on Number Basis.

Item No. 48

Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts including setting and joining the pipes in C.M. 1:2 watering and laying (To level of slops of I.S. 458 / 1971 Class NP3 casted by vertically vibrated technology of following internal diameter. (v) 900 mm dia.

1. The work shall consist to furnishing and installing reinforced cement concrete pipe of the type dia metre and length required at the location shown on the drawings or as ordered by the Engineer in charge.

2. Reinforced concrete pipe shall be NP3 type conforming to the requirements of IS : 458 and shall be of dia as specified in the item each consignment of cement concrete pipes shall be inspected. If necessary and approved by the engineer in charge, either at the place of manufacture or at the site before their incorporation in the works.

NP3 , NP3 , NP1 pipes are used for RCC pipes where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.

Production of such certificate will not however relieve the contractor from this responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work in account of defects found subsequently during the execution It will also be necessary to purchase these pipes from manufacturer having standard equipments for carrying out various test as per IS : 458 at his factory.

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

We..... manufacture of RCC pipes produce RCC pipes as per the requirement of IS : 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carry out test at our factory sites.

We have experience of manufacturing of pipes of
years The pipes supplied by us to M/s Satisfy the
requirement of IS " 458.

Date

Place

Manufacturer;s sign.

.....

3. No pipe shall be placed in position until the foundations have been approved by the engineer in charge, Where two or more pipes are to be laid adjacent to each other they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed toward the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at the cost of contractor.

4. The pipes shall be jointed either by collar joint or by flush joint in the former case the collars shall be of RCC 150 to 200 mm wide and having the same strength as the pipes to be jointed . Caulking space shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joint space 13 cm wide, The joining space shall be filled with cement mortar, 1 cement 2. sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer, Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four days.

5. RCC pipe shall be measured along their centre between their inlet and outlet ends in linear metres.

6. The rate for the pipes shall include the cost of pipe including loading unloading handling storing laying in position and joining complete.

7. Payment shall be made on Running metre basis.

Item No. 49

Demolition of Brick work and stone masonry including stacking of serviceable materials and disposal of unserviceable materials with all lead and lift.(ii) In Cement Mortar.

The work shall be executed as per specification of **Item No. 24** except that the **Demolition of Brick work and stone masonry of In Cement Mortar.** instead of **Dismantalling of Existing Structure.**

The Payment shall be made on Cum. Basis of the finished work.

Item No. 50

Providing and laying cement concrete (M10) 1:3:6 (1- Cement : 3-Coarse sand: 6- Graded brick bat aggregate 40mm normalize) and curing complete excluding cost of formwork in (A) Foundation and Plinth.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **cement concrete (M10) 1:3:6 (1- Cement : 3-Coarse sand: 6- Graded brick bat aggregate 40mm normalize)** etc. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 51

Providing and laying cement concrete (M15) 1:2:4 (1- Cement : 2- Coarse sand : 4- graded stone aggregates 20 mm nominal size) and curing complete excluding cost of formwork for retaining earth

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **cement concrete (M15) 1:2:4 (1- Cement: 2- Coarse sand: 4- graded stone aggregates 20 mm nominal size)** etc. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 52

Providing and placing in position CRS FE 550D TMT bar reinforcement for following items including cutting bending hooking and tying complete as per detailed drawing. For well :- curb, staining, cap and RCC Raft.

The work shall be executed as per specification of **Item No. 14** except that the **CRS FE 550D TMT bar reinforcement for following items curb, staining, cap and RCC Raft. instead of T.M.T bar reinforcement Grade Fe-500D for (A) Piers (B) Abutments (C) R.C.C. Returns** including curing bending hooking and tying compete as per detailed drawing shall be considered.

The Payment shall be made on M.Tonne. Basis of the finished work.

Item No. 53

Providing and laying in position CRS FE 550D TMT bar reinforcement including cutting, bending, hooking and tying complete as per detailed drawings for the following.(A) Piers (B) Abutments (C) R.C.C. Returns

The work shall be executed as per specification of **Item No. 14** except that the **CRS FE 550D TMT bar reinforcement. (A) Piers (B) Abutments (C) R.C.C. Returns instead of T.M.T bar reinforcement Grade Fe-500D for (A) Piers (B) Abutments (C) R.C.C. Returns** including curing bending hooking and tying compete as per detailed drawing shall be considered.

The Payment shall be made on M. Tonne. Basis of the finished work.

Item No. 54

Providing and laying in position CRS FE 550D TMT bar reinforcement including cutting, bending, hooking and tying complete as per detailed for the following. (A) Abutment cap & Dirt wall. (B) Pier Cap.

The work shall be executed as per specification of **Item No. 14** except that the **CRS FE 550D TMT bar reinforcement. (A) Abutment cap & Dirt wall. (B) Pier Cap. instead of T.M.T bar reinforcement Grade Fe-500D for (A) Piers (B) Abutments (C) R.C.C. Returns** including curing bending hooking and tying compete as per detailed drawing shall be considered.

The Payment shall be made on M. Tonne. Basis of the finished work.

Item No. 55

Providing and placing in position CRS FE 550D TMT bar reinforcement including cutting, bending, hooking, and tying complete as per detailed drawing. (A) Solid Slab.

The work shall be executed as per specification of **Item No. 14** except that the **CRS FE 550D TMT bar reinforcement. (A) Solid Slab.** instead of T.M.T bar reinforcement **Grade Fe-500D for (A) Piers (B) Abutments (C) R.C.C.** Returns including curing bending hooking and tying compete as per detailed drawing shall be considered.

The Payment shall be made on M. Tonne. Basis of the finished work.

Item No. 56

Providing and casting in situ controlled cement concrete M-20 for R.C.C. work in pier cap, abutment cap and dirt wall including controlled cement concrete M-250 bed blocks or pedestals of required size below bearings as per detailed drawings, centering, shuttering, scaffolding, wherever necessary, laying vibrating, curing and finishing complete.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **casting in situ-controlled cement concrete M-200 for pier cap, abutment cap and dirt wall** etc. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

The Payment shall be made on Cu.m. Basis of the finished work.

Item No. 57

Providing Pre-moulded asphalt filler joints as per drawings.

The work of **Providing Pre-moulded asphalt filler joints** shall be executed as per relevant specifications of **Item No. 21** of this contract. The measurement shall be in Runing Meter of Filler Joint as per drawing..

Payment shall be made on Runing Meter Basis

Item No. 58

Back filling behind Abutment, wing wall and return wall with selected granular material of approved quality including all the materials, compacting, labour, equipment charges, etc all complete as per drawing and Technical Specification Section 300 (Percentage of fine content maximum 15%, Backfill soil phi 30°, Density 20 kN/m³, Field compaction 95±2% modified proctor density.

The work of **Back Filling Behind Abutment, Wing Wall & Return Wall etc** shall be executed as per relevant specifications of **Item No. 23** of this contract. The measurement shall be in Running Meter of Filler Joint as per drawing..

Payment shall be made on Running Meter Basis

Item No. 59

Providing parapet of ordinary cement concrete M-200 as per detailed drawings with necessary reinforcement including, shuttering, laying vibrating and finishing to line and level complete.(ii) Cast in situ.

The work shall be executed as per specification of **Item No. 11** except that the grade and size of **casting in situ-controlled cement concrete M-200 for Parapet.** instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

Payment shall be made on Cum Basis

Item No. 60

Providing and casting in situ controlled cement concrete M-25 for average 75 mm thick wearing coat laid as directed including tamping, vibrating, finishing, curing and filling in joints with bitumen complete.

The work shall be executed as per specification of **Item No. 11** except that the grade and size of **casting in situ-controlled cement concrete M-200 for Parapet.** instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

Payment shall be made on Cum Basis

Item No. 61

Providing and fixing G.I. Rain water spout of 50mm dia. And 30cm. length.

The work of **Providing & Fixing G.I. Rain Water Spout 50mm Dia and 30cm Length** shall be executed as per relevant specifications of **Item No. 16** of this contract. The measurement shall be in Number of Rain Water Spout.

Payment shall be made on Number Basis

Item No. 62

Dismantling of flexible pavements and disposal of dismantled materials up to a lead of 1000 metres, stacking serviceable and unserviceable materials separately. (i) Dismantling of Bituminous Layer (ii) Dismantling of Granular Layer

The work shall be executed as per specification of **Item No. 24** except that the **Dismantling of Dismantling of Bituminous Layer & Dismantling of Granular Layer** instead of **dismantling of Existing Structure**.

The Payment shall be made on Cum. Basis of the finished work.

Item No. 63

Construction of sub-grade and earthen shoulders using quarry spall with all lead and lift and including watering and rolling and consolidation of sub grade in layers at OMC to required dry density including filling the depressions which occur during the process using power roller 8T to 10 T

The work shall be executed as per specification of **Item No. 28** except that the **Construction of sub-grade and earthen shoulders using quarry spall with all lead and lift** instead of **Earthwork for Embankment**.

The Payment shall be made on Cum. Basis of the finished work.

Item No. 64

Construction of granular Sub base with Coarse Graded Material (Grade II) (Table:- 400- 2) of 200 mm by providing coarse graded material Metal Crushed using size 53mm to 26.5 mm@ 27.5%, 26.5 mm to 9.5 mm @ 22.5%, 9.5mm to 4.75mm @12.50% and 4.75mm below @ 37.5% spreading in uniform layers with including and mixing the material obtained from cutting BT road by milling machine using motor grader on prepared surface mixing by mix in place method with rotavator at OMC and compacting with vibratory roller to achieve the desired density complete as per Clause 401.2 Table 400.1

The work shall be executed as per specification of **Item No. 29** except **Construction of granular Sub base with Coarse Graded Material (Grade II)**. instead of **Construction of Granular Sub Base** by providing black trap crushed stone well graded material **Grading I**.

Item No. 65

Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/ binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density.-Grading 1, Using Screening Crushable type such as Moorum or Gravel.

The work shall be executed as per specification of **Item No. 45** except **Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam Grade I**. instead of **Water Bound Macadam Grading II**.

Item No. 66

Providing and laying plain cement concrete in levelling course complete as per drawings and technical specifications as per sections 1500, 1700 and 2100 of MORTH. (M-15)

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **Providing and laying plain cement concrete in levelling course in M-15**. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

Item No. 67

Construction of un-reinforced, dowel jointed, plain cement concrete pavement (M25) over a prepared sub base with 53 grade cement @ 400 kg per cum, coarse and fine aggregate conforming to IS 383, maximum size of coarse aggregate not exceeding 25 mm, transported to site, spread, compacted and finished in a continuous operation including provision of contraction, expansion, construction and longitudinal joints, joint filler, separation membrane, sealant primer, joint sealant, debonding strip, dowel bar, tie rod, admixtures as approved, curing compound, finishing to lines and grades as per drawing.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **Construction of un-reinforced, dowel jointed, plain cement concrete pavement (M25) over a prepared sub base with 53 grade cement @ 400 kg per cum**. instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

Item No. 68

Providing and fixing sign boards made out of 2.0 mm aluminium sheet / 4 mm ACP (Aluminum composite Panel); size 90x30 cms. rectangular as per design of IRC-67-2012. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ;reflectorised with Micro Prismatic Grade retro reflectivesheeting of Type-11 as per ASTM D-4956 and latest M.O.S.T.Specifications; 1.8mtr long stand post of 75 x 75 x 6mm / 65NB Circular MS Pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with bestquality epoxy coatings in black and white bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge. A warranty for 10 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3 year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (A) Class-C Type-11 Retro Reflective sheeting.

The work of **Hazard Marker Sign** shall be executed as per relevant specifications of **Item No. 32** of this contract. The measurement shall be in Number of Sign Board.

Payment shall be made on Number Basis

Item No. 69

Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per IS 458-1991 specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slopes) of class NP3 of following internal diameters. (vii) 1200mm dia.

1. The work shall consist to furnishing and installing reinforced cement concrete pipe of the type Dia meter and length required at the location shown on the drawings or as ordered by the Engineer in charge.

2. Reinforced concrete pipe shall be NP3 type conforming to the requirements of IS: 458 and shall be of Dia as specified in the item each consignment of cement concrete pipes shall be inspected. If necessary and approved by the engineer in charge, either at the place of manufacture or at the site before their incorporation in the works.

NP3, NP3, NP1 pipes are used for RCC pipes where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.

Production of such certificate will not however relieve the contractor from this responsibility of supplying pipes of required standard and will have to bear the loss or damage caused to the work in account of defects found subsequently during the execution It will also be necessary to purchase these pipes from manufacturer having standard equipment for caring out various test as per IS: 458 at his factory.

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

We..... manufacture of RCC pipes produce RCC pipes as per the requirement of IS : 458 and also carry out the required test at our place. We have acquired equipments for carrying out test and are prepared to carryout test at our factory sites.

We have experience of manufacturing of pipes of years The pipes supplied by us to M/s Satisfy the requirement of IS " 458.

Date

Place

Manufacturer;s sign.

.....

3. No pipe shall be placed in position until the foundations have been approved by the engineer in charge, Where two or more pipes are to be laid adjacent to each other they shall be separated by a distance equal to at least half the diameter of the pipe subject to minimum of 450mm. The laying of pipes on the prepared foundation shall start from the outlet and proceed toward the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid in works they form a culvert with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at the cost of contractor.

4. The pipes shall be jointed either by collar joint or by flush joint in the former case the collars shall be of RCC 150 to 200 mm wide and having the same strength as the pipes to be jointed . Caulking space shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joint space 13 cm wide, The joining space shall be filled with cement mortar, 1 cement 2. sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer, Care shall be

taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four day.

5. RCC pipe shall be measured along thir centre between thir inlet and outlet ends in linear metres.

6. The rate for the pipes shall include the cost of pipe including loading unloading handing storing laying in position and joining complete.

7. Payment shall be made on Running metre basis.

Item No. 70

Providing and laying plain cement concrete grade M-15 PCC wall for protection i.e. to prevent the soil from sliding down, with graded machine mixed stone aggregate from 6 mm to 40 mm including tamping, vibrating, leveling and curing complete with all formwork, dewatering wherever required including all materials, labours, plants, machineries & tools, all leads and lifts, etc. complete as per specification.

The work shall be executed as per specification of **Item No. 05** except that the grade and size of **Providing and laying plain cement concrete grade M-15 PCC wall for protection.** instead of except the grade and size of ordinary cement concrete **M100 for RCC Raft and cutoff walls** including necessary shuttering, laying, vibrating, ramming and curing complete.

Payment shall be made on Cum. Basis

Item No. 71

Providing and placing in position FE 500D TMT bar reinforcement for following items including cutting bending hooking and tying complete as per detailed drawing. For well :- curb, staining, cap and RCC Raft.

The work shall be executed as per specification of **Item No. 14** except that the **FE 500D TMT bar reinforcement** for following items. curb, staining, cap and RCC Raft. instead of T.M.T bar reinforcement Grade Fe-500D for (A) Piers (B) Abutments (C) R.C.C. Returns including curing bending hooking and tying compete as per detailed drawing shall be considered.

The Payment shall be made on M. Tonne. Basis of the finished work.

Item No. 72

Providing and laying in position FE500D TMT bar reinforcement including cutting, bending, hooking and tying complete as per detailed for the following. (A) Abutment cap & Dirt wall. (B)Pier Cap.

The work shall be executed as per specification of **Item No. 14** except that **FE 500D TMT bar reinforcement. (A) Abutment cap & Dirt wall. (B)Pier Cap..** instead of T.M.T bar reinforcement Grade Fe-500D for (A) Piers (B) Abutments (C) R.C.C. Returns including curing bending hooking and tying compete as per detailed drawing shall be considered.

The Payment shall be made on M. Tonne. Basis of the finished work.