

CONSTRUCTION OF MINOR BRIDGE BOX CELL ON MANDAL- RAKHIYANA ROAD, TA VIRAMGAM, DIST AHMEDABAD.(PKG. NO. MMGSY/SCSP/STRUCTURE/03/2025-26)

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 upto 3.0 M. and lead upto 100m for 10 Cum

Excavation for structures shall consist of the removal of materials for the construction of foundations for bridges, culverts, retaining walls, head walls, cut off 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-in-charge. The work shall include all necessary sheeting, shoring, bracing, draining and pumping and the removal of all logs, stumps, scrubs and other deleterious matter and obstruction necessary for the foundations, trimming bottoms of excavations back filling and clearing up the site and the disposal of all surplus materials.

1. After the site has been cleared the limits of excavations shall be set out true to lines, curves, slopes and sections as shown on the drawings or as directed by the Engineer-in-charge. The contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboos, stones, lime, mortar-concrete etc. required in connection with the setting out of works and the establishment of bench mark, centre line stones and other marks and stakes as long as the opinion of the Engineer-in-charge, they are required for the work.
2. Excavation shall be taken to the width of the step of the footing. The contractor at his own expense shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due regard to the safety of personal and works and to the satisfaction of the Engineer-in-charge.
3. The depth to which the excavation is to be carried out shall be as shown on the drawings, unless the type of materials encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer-in-charge.
4. Where water is met with in excavation due to stream flow, seepage, rain or other reasons, the contractor shall take adequate measure such as bailing pumping, 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 method to be adopted in this regard and, other details thereof shall be left to the choice of the contractor but subject to approval of the Engineer-in-charge. Approval of the Engineer-in-charge shall however not relieve the contractor of the responsibility for the adequacy of dewatering, and production arrangements and for the quality and safety of the works.
5. Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of movement of water through any fresh concrete. No pumping shall be permitted during the placing of concrete or for any period of at least 24 hours thereafter, unless lot is done from a suitable sump separated from the concrete work by a water tight wall or other similar means.
6. The bottom of the foundation shall be leveled both longitudinally and transversely or stepped as directed by the Engineer-in-charge. 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-in-charge, the extra depth shall be made up with concrete or masonry of the foundation grade at the cost of the contractor. Ordinary filling shall not be used for the purpose to bring the foundation to level. If there are any slips or blows in the excavation, these

shall be removed by the contractor at his own cost.

7. 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.
8. Back filling shall be done with approved materials 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, making due allowance for settlement in 250 mm. loose layers, which shall be watered and compacted.
9. All the excavated materials shall be the property of the Government. Where the excavated materials is to be used in the construction of embankment, it shall be directly deposited at the required location within 100 meters lead.
10. All useful materials not intended for use in the bank, shall be stacked neatly on Government land as directed by the Engineer-in-charge within 100 meters lead. Unsuitable and surplus materials not intended for use shall be disposed off as directed by the Engineer - in - charge.
11. Excavation for structures shall be measured in Cubic Meter for each class of materials encountered, limited to the dimensions shown on the drawing or as directed by the Engineer - in - charge. Excavation over increased width cutting of slopes, shoring, shuttering and planking shall be deemed as convenience for the contractor in executing the work and shall be measured and paid for separately.
12. The contract unit rate for the items of excavation for structures shall be paid in full for carrying out the required operations including . . .
 - Settings out and fixing bench marks and center lines stones.
 - Construction of necessary shoring and bracing and their subsequent removal.
 - Removal of all logs, stumps, grubs and other deleterious matter and obstructions for placing the foundations including trimming of bottoms of excavations.
 - Foundation sealing, dewatering including pumping.
 - Foundation sealing, including necessary dewatering including pumping and making necessary cofferdam to facilitated construction work.
 - Back filling, clearing up the site and disposal of all surplus materials within all lifts and lead up to 100 meters.All labour, materials, tools, equipment, safe guards and incidentals, necessary to complete the work to the specification.
14. Excavation shall be in hard soil such as stiff heavy clay, hard shale or compact murrum requiring grafting tool or pick or both and shovel, closely applied and gravel and rubble stone having maximum diameter in any one direction between 75 and 300 mm. and soft conglomerate. The classification of excavation shall be decided by the Engineer-in-charge, and his decision shall be final and binding on the contractor.
15. Payment shall be made on Cu.m. basis.

ITEM NO: 2 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)

In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregate and coarse aggregates are specified by volume as given in table below for different four grades designated as ordinary M-100, M-150, M-200 and M-250.

1. In the designation of a concrete mix letter M refers to the mix and the number to the specified 28 days works cube compressive strength of that mix on 150 mm cubes expressed in kg. /cm.
2. The ordinary concrete mix shall generally be specified by volume for cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic meter in volume. While measuring aggregate by volume, stacking, ramming or hammering shall not be done proportioning of sand be as per its dry volume. In case it is dam, allowance for bulking shall be made as per IS: 2386 (Part-III).
3. In gradients required for ordinary / concrete containing one 50 kg. bag of cement for different proportions of mix shall be as given in Table below.

TABLE

Grade of concrete	Mix by volume	Total quantity of dry aggregates by volume per 50 kg. cement to be taken as sum aggregate of the individual volumes of fine & coarse aggregates, maximum	Proportion of fine aggregate to coarse aggregate	Quantity of water per 50 kg. of cement max.
(1 cubic metre: 1000 Liters)				
1	2	3	4	5
Ordinary	Litres			Litres
M-100	1:3:6	300	General 1:2 for fine aggregate to Coarse aggregate by volume but subject to a upper limit of 1:1.1/2 & a lower limit of 1:3.	34
M-150	1:2:4	220		32
M-200	1:1.1/2:3	160		30
M-250	1:1:2	100		27

Note: - The proportion of the aggregates shall be adjusted from upper limit to lower limit progress grading of the final aggregate becomes finer and the maximum size of coarse aggregate becomes larger.

Example: For an average grading of fine aggregate (that is zone II of IS: 383 - 1963) the proportions 1:1 1/2, 1:2 and 1:3 for maximum size of aggregates 10mm, 20 mm and 40mm respectively (after carrying out sieve analysis).

Note: - A mix leaner than M-100 (1:3:6) may be used for non-structural part, if provided in the contract. In such cases grading of aggregates shall be by volume. Other requirements for mixing, placing and curing shall the same.

4. Following shall be the maximum nominal size of coarse aggregate for the different items of work.

Sr. No.	Item of construction	Maximum nominal size of coarse aggregate
i	steining and R.C.C. Piles	R.C.C. well curb, R.C.C. well 40 mm
ii.		R.C.C. well steining 63 mm
ii	piers, abutments per caps	Well cap or pile cap, solid type 40 mm and wing walls and their
iii	deck slab, wearing blast walls, approach slab etc.	R.C.C. works in cross girders, 20mm coat, kerb, light post,

and hollow type piers, abutments, wing walls and their pier caps

iv

R.C.C. bearings 20 mm

v

For any other item of
As specified on the drawing by
or as desired by the Engineer

construction not covered

items (i) to (v)

in charge in case it is not specified on drawing.

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 5mm. less than the minimum cover to the reinforcement whichever is the smaller.

5. Fine aggregate shall be clean, hard, coarse sand. It shall be free from dust and such other substances. The sand shall be got approved by the Engineer-in-charge.

6. All materials shall be stored as to prevent their deterioration or intrusion of their 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 work

7. Cement shall be store above the ground level in perfectly dry and watertight sheds and shall be stocked not more than eight bags high. 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. Cement more than 3 to 4 months old shall invariably be tested to ascertain that R satisfies the ascertain requirements. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of the fine or coarse aggregate shall be stored in separate stock piles sufficiently removed from each other to prevent intermixing the materials.

8. The water for mixing shall be portable water to the 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.

9. 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 and 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.

10. When hand mixing is permitted by the Engineer-in-charge for small jobs or for certain other reasons, it shall be done on a smooth watertight platform large enough to allow efficient. Turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor does the mixing water flow out. Cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine and coarse aggregate. Which shall also be spread in a layer of uniform thickness on the mixing platform? Dry course and fine aggregate and cement then shall be mixed thoroughly by turning over to get a mixture of uniform colour. Enough water shall then be added gradually through a nose and the mass turned over till a mix of required consistency is obtained. In hand mixing quantity of cement shall be increased by 10 percent above that specified.

11. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer-in-charge the first batch of concrete from the mixer shall contain only two third of normal quantity of course aggregate. Mixing plants shall be thoroughly cleaned before changing from one type of cement to another.

12. The method of transporting and placing concrete shall be approved by the Engineer-in- charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All from 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.

13. If concreting is not started with 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 designed agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to by the Engineer-in-charge, concrete shall be disposed in horizontal layer to a compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.

14. Unless otherwise agreed to by the Engineer-in-charge concrete shall not be dropped into place from a height exceeding 2 metres. When trucking or chutes are used they shall be kept clean and used in such 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 cleaned 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 brushed, care being taken to avoid dislodgement of particulars of coarse aggregate. The surface shall then be thoroughly wetted. All free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this, surface shall not exceed 150 mm. in thickness and shall be well rammed against old work particular attention being given to corner and close spots.

15. All concrete shall be compacted to produce a dense homogenous mass with the assistance of Vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concreting Under water, where vibrators cannot be used Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event, of break downs.

16. Immediately after compaction concrete shall be protected against harmful effects of weather including rain, running water shocks, vibrations due to traffic, rapid temperature changes. Fast drying put 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. It 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 it's laying but the curing of concrete shall be continued for a minimum period of 14 days. 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: -

(1) Shuttering i.e. from work required for forming the concrete

(2) Scaffolding i.e. formwork required for supporting shuttering.

Forms for shuttering shall be constructed only, in metal suitably lined. Forms for scaffolding shall be constructed of metal or timber. Both shuttering and scaffolding shall be or substantial rigid construction and shuttering shall be true to shape and dimensions show on the drawings. All bolts and reverts shall be counter-suck and well ground to provide a smooth, plane surface.

17. Forms shall be mortar tight and shall be made sufficiently rigid by the use of 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 of hardwood wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of structure specialty in long spans to counteract the effects of any deflection. The framework shall be so fixed as to provide for such camber. Forms shall be as constructed as too 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 size 25 mm x 25 mm shall be provided at all angles of framework to avoid sharp comers.

18. The inside surface of forms shall except in the case of permanent from work or where otherwise agreed to by the engineer-in-charge be coated with an approved material to prevent adhesion of concrete to the from work. Release agents shall be applied strictly in accordance with the manufacture's instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons a and anchorage shall be applied strictly in accordance with the manufacturers instruction and shall not be allowed to come into contact with any reinforcement of prestressing tendons and anchorage. Different release agents shall not be used in from work of concrete which will be visible in the finished works.

19. Special measures shall be taken to ensure that the framework does no hinder the shrinkage of concrete because without these cracking could occur before the from work is removed. Wherever applicable arrangement must be made to ensure that the from 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 as to ensure the correct final shape of the structures having regard to the deformation of false work, scaffolding or propping and the instantaneous deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete section, the formwork should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinking of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerances 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 machinery materials and for results obtained.

20. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any for work. While fixing the time for removal of formworks. Due consideration shall be given to local condition, Character of the structure, the weather and other condition that influence the setting of concrete the removal of The load supporting of soffit forms any commence when concrete has attained strength and of the materials used in the mix. Where field operations are controlled by the strength test of concrete, the removal of the load supporting of soffit forms may

commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subject at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength test of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All form work shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to avoid any shock or vibrations. Supports shall be removed 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 mortars. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the framework it shall be cleaned and made good to the satisfaction of the Engineer-in-charge.

23 Immediately after the removal of forms, all exposed bars or bolts passing through the Cement concrete member and used for shuttering or any other purpose shall be cut inside the Cement Concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes 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 corner and other defects shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete with mortar or cement and fine aggregate 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. Surface which has been pointed shall be kept moist for a period of 24 hours. If rock, pockets / honeycombs, in the opinion of the Engineer-in-charge are of such extent and character as to affect materially or to endanger the life of the strength or the steel reinforcement he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

24. 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 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 walls	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

25. Works 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 less 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 suitably 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.

26. 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 percent of the specified strength.

27. 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 is 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.

28. In reinforced concrete the volume occupied by reinforcement shall not be deducted. The slab shall be measured as running continuously through and the beam as the portion below the slab.

29. 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.

30. 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.

31. The payment will be made on [cmt.](#) basis of the finished work.

ITEM NO: 03 Providing and laying plain cement concrete grade M-15 PCC Toe wall for toe protection i.e. to prevent the slope pitching 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.

Specification as per Item No.02 For Toe Protection

The payment will be made on [cmt.](#) basis of the finished work

ITEM NO: 04 "Providing and fixing in position (Thermo mechanically Treated bars) TMT Fe550D FBEC conforming to IS 1786 reinforcing bars of various diameters for Box structure , retaining wall, etc. as per detailed designs and drawings and schedule including cutting, bending, hooking the bars, binding with 18 SWG GI wires with cost of all labour, materials, tools, plants, equipments, supporting as required with all lifts and leads etc. all complete as per specification and as directed by Engineer The rate includes for supply, loading, unloading, transporting to site, cutting, bending, lap length, hooking, placing, tying in position with contractor's own binding wire, welding, forming the cage and lowering it in position in pile bore etc. Welding and supporting in position to ensure lines and levels during concreting, maintaining proper cover/ spacing, all leads & lifts, etc. including contractor's own equipment, labour, supervisor, taxes, machineries, etc. complete as per drawings and specification."

1. Scope of Work

Procurement & Supply: Supply of TMT Fe550D FBEC bars (Fusion Bonded Epoxy Coated or as specified), including all necessary transport, loading, and unloading.

Fabrication: Cutting, bending to the required shapes, and forming hooks for reinforcement as per approved detailed designs and Bar Bending Schedule (BBS).

Placement & Fixing: Placing, tying, and fixing the reinforcement in position, including the provision of chairs, spacer bars, and binding wire (18 SWG GI wire) to ensure rigid cage formation.

Special Operations: Welding of bars where specified, assembling heavy cages, and lowering them into pile bores.

Support: Providing all necessary scaffolding, supports, and machineries to maintain alignment, lines, and levels during concreting.

Protection: Ensuring proper cover to reinforcement using concrete spacer blocks.

2. Materials

TMT Bars: High-strength Deformed Steel Bars, Grade Fe550D, confirming to IS 1786:2008. The 'D' denotes high ductility, suitable for earthquake-resistant structures.

Binding Wire: 18 SWG Galvanized Iron (GI) wire.

Coating (If applicable): Epoxy coating as per IS specifications for corrosion protection.

Spacers: Concrete blocks (1:2 cement-sand mortar) or PVC spacers to maintain proper cover.

3. Workmanship and Installation

Cutting & Bending: All bars shall be cut and bent cold to the dimensions specified in the BBS and drawings.

Cleaning: Reinforcement shall be free from rust, mud, oil, grease, or paint before fixing.

Binding: All bars shall be securely tied at intersections with 18 SWG GI wire, with the ends of the wire turned inwards.

Laps & Welding: Laps shall be provided as per design drawings. Welding (spot or butt) shall only be done if specified, using low-hydrogen electrodes.

Placement Accuracy: The reinforcement cage for box structures and retaining walls must maintain precise spacing and cover (usually 15mm-40mm or as specified).

Pile Cage Installation: Welding and forming rigid cages, ensuring no deformation during lowering into the pile bore.

4. Mode of Measurement

Quantity: The weight of the reinforcement will be calculated using the standard weight per meter (e.g., 8mm = 0.395 kg/m, 16mm = 1.58 kg/m) as per IS 1786, based on the actual lengths in the approved drawings.

Unit: The measurement will be in Metric Tonnes (MT) or Kilograms (kg).

ITEM NO: 05 Providing fusion bonded Epoxy coating not less than 175 micron thickness and up to 300 micron to reinforcement bars as per IS-13620-1993/ASTM-775 M including testing of coating at plant and all taxes

Fusion bonded epoxy coated reinforcement shall conform to IS:13620 or other international standards as approved by Engineer. The location of the source of supply of the coated bars shall be such as to ensure that the bars are not transported for a distance of more than 300 Km.

Additional requirements for the use of such reinforcement bars are given below:

- a) Patch up materials shall be procured in sealed containers with certificates from the agency who has supplied the fusion bonded epoxy bars.
- b) PVC coated G.I. binding wires of 18G shall only be used in conjunction with fusion bonded epoxy bars.
- c) Chairs for supporting the reinforcement shall also be of fusion bonded epoxy coated bars.
- d) The cut ends and damaged portions shall be touched up with repair patch up material.

- e) The bars shall be cut by saw-cutting and not by flame cutting.
- f) While bending the bars, the pins of work benches shall be provided with PVC or plastic sleeves.
- g) The coated steel shall not be directly exposed to sun rays or rains and shall be protected with opaque polyethylene sheets or such other approved materials.
- h) While concreting, the workmen or trolley shall not move directly on coated bars but shall move only on wooden planks placed on the bars.

Mode of Measurement

Unit of Measurement: Measurement is typically by weight (Metric Tonne or Quintal), based on the theoretical weight of the reinforcement bars as per the Bar Bending Schedule (BBS).

ITEM NO: 06 Providing and casting in situ controlled cement concrete M-25 for R.C.C. box structure, as per drawings (pier shall be cast in single lift or as per direction of Engineer in charge), Stem of Retaining wall etc. 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 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, normal 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 including cost of fair finish form work.

Specification as per Item No.02 for R.C.C. Box Structure

The payment will be made on [cmt.](#) basis of the finished work

ITEM NO: 7 Providing & laying weep hole in Abutments, and returns by using A.C. pipe of 100mm including laying in proper grade and jointing the completed as per detailed specification.

The weep holes in the masonry and returns shall be provided of the A.C. pipes of 100 mm dia.

The pipe shall be fixed of suitable length & in full thickness of the masonry / concrete work.

Necessary C.I. grating shall be provided on back side of abutment & returns on the inlet of opening of weep holes.

Materials the A.C. pipes of 100mm dia.

The Asbestos cement pipe of diameters specified in description of the item shall conform to I.S. 1626-1900. 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 C.I. 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 Number basis.

ITEM NO:8 Providing and laying of Filter media 600mm thk with granular materials/stone crushed aggregates satisfying the requirements laid down in clause 2504.2.2. of MoRTH 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 designation	Percentage by weight passing through the
1	63 mm. to 40 mm	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 over size shall be upto 15% and that for lower size should be upto 15% and below 20 mm. it shall be allowable upto 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

ITEM NO: 09 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.

3104. EARTH FILL

The fill material in the reinforced soil zone shall have drained or effective angle of friction not less than 30°, measured in accordance with IS:2720 (Part 13), by conducting a drained direct shear test. In case the fill material has 25 percent or more particles of 4.75 mm or larger, drained shear test using large shear box may be conducted (IS:2720:Part 39:Section 1). The gradation of fill soil shall be as per following limits.

Sieve Size Percentage Passing

75 mm 100%

425 micron 0-60%

75 micron less than 15 $PI \leq 6$

Materials with more than 15 percent passing 75 micron sieve, but less than 10 percent of particles smaller than 15 microns are acceptable provided PI is less than 6 and angle of friction is not less than 300.

Fly ash may be used as fill material in reinforced soil walls provided its angle of internal friction is not less than 300 and PI is less than 6. Gradation requirements need not be completely satisfied. Reference may be made to IRC Guide lines on Use of Flyash in Road Embankments (IRC:SP-58). Fly ash shall also satisfy requirements concerning pH and environmental conditions of the fill vis-à-vis the reinforcement type as specified in Clause 3014.1.

The fill material used in the reinforced soil zone shall be free from organic or other deleterious materials and shall not react adversely (chemically, electrically or biologically) with the reinforcement material and/or facia material.

Properties of fill soil in the reinforced zone, unreinforced zone (or retained/back fill) soil and the foundation soil shall be determined accurately during the construction phase, as per quality assurance plans and directions of Engineer so as to ensure that these are the same as those considered in the design phase.

The fill soil in the unreinforced zone shall conform to the requirements specified in the design.

3104.1 Environmental Conditions of Fill 3104.1.1 Steel Reinforcement

Where galvanized steel reinforcement is used, the fill material shall be free draining granular material and shall meet the following requirements as per Table 3100.1.

Table 3100.1 : Recommended Limits of Electrochemical Properties for Reinforced Fills with Steel Reinforcement

Property	Criteria	Test Method
Resistivity	> 3000 ohm-cm	AASHTO T-288
pH	> 5 and < 10	AASHTO T-289
Chlorides	< 100 PPM	ASTM D 4327
Sulphates	< 200 PPM	ASTM D 4327

3104.1.2 Geosynthetic Reinforcement

Where geosynthetic reinforcement is used for reinforcing elements manufactured from polyester yarn, pH value of the fill material shall be between 3 and 9, and for reinforcing elements manufactured from PVA, PP and HDPE, the pH value shall be greater than 3.

Payment shall be made on the Cum. basis.

ITEM NO: 10 Providing and laying rubble for apron (each stone weighting not less than 40Kg.) including and packing and filing in the interestices with quarry-spalls for Rigid Apron.

Rubble Pitching

1.1 The work shall consist of covering the slopes of high banks, training works and road embankment with rubble, over a layer of sand bedding with C.C. 1:3:6 panelling at 3.0 mt. C/C and 30 cm. x 30 cm panel wall as per the detailed drawing with necessary excavation and providing water chute of C.C. 1:3:6 at 24.00 mt. C/C as directed.

1.2. Rubble subject to marked deterioration by water or weather will not be accepted. The rubble shall be sound hard, durable and fairly regular in shape and its thickness in any one direction shall not be less than the thickness of pitching as specified in the item and thickness of the rubble at any place shall not be less by 15% of the thickness specified. The largest rubbles procurable shall be supplied on site. The sizes of spalls shall be minimum 25 mm and shall be suitable to fill the voids in the pitching. Thickness of the pitching shall be as specified in the pitching item. (G.C. No. SSR/ 2080 IB 547/28/C Dated 6th March 1982)

1.3. Before laying the pitching the sides of banks shall be trimmed to the required slopes and profiles put up by means of line and pegs at intervals of 3 meters of ensure regular straight work and uniform slope throughout. Depressions shall be filled and thoroughly compacted.

1.4. Murrum for bedding shall be laid over the prepared base and suitably compacted to a thickness 150 Quality of murrum will be as per its relevant specifications.

1.5. The rubble pitching shall commence in a trench below the toe of the slope. Rubble shall be placed by derrick or by hand to the required length, thickness and depth conforming to the drawings. Rubbles shall be set normal to the slope and placed so that the largest dimension is perpendicular to the face of the slop, unless such dimensions are greater than the specified thickness of pitching. The largest rubbles shall be placed in the bottom courses and use as headers for subsequent courses. When full depth of pitching can be formed with single rubble, the rubble shall be laid breaking joints and all interstices between adjacent rubbles shall be filled in with spalls of the proper size and wedged in with hammers to ensure tight packing. Pitching shall be done in panels of 3.0 M x 3.0 M with a 45 cm. wide and 22.5 cm. deeper band all around.

2.00 Stone Masonary

2.1. Panel wall of cement concrete 1:3:6 at 3 mt. centre to centre horizontally and vertically size 0.3 mt. x 0.3 mt. or as per guidelines of Engineer in charge in case of irregular dimensions.

2.2 Necessary curing shall be carried out.

3.00 Cement pointing

3.1. For a surface which is to be subsequently jointed, the joints shall be squarely raked out to a depth of 15 mm. while the mortar is still green. The raked joints shall be well brushed to remove dust and loose particles and the surface shall be thoroughly washed with water, cleaned and wetted.

3.2 Cement and sand shall be mixed in proportions as specified in the hem. Cement and sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added and the mortar mixed to produce workable consistency.

3.3. The mixing shall be done intimately by hand mixing. The operation shall be carried out on a clean watertight platform and cement and sand shall be first mixed dry in the required proportion to obtain a uniform colour and then the mortar shall be mixed for at least two minutes after addition of water. In case of cement mortar, that has stiffened because of evaporation of water, the same shall be re-tempered by adding water as frequently as needed to restore the

requisite consistency but this re-tempering shall be permitted only with thirty minutes from the time of addition of water at the time of initial mixing.

3.4. For pointing, the mortar shall be filled and pressed into the raked out joints before giving the required finish. The pointing shall then be finished to proper type given on the drawings. If type of pointing after the mortar has been filled and pressed into the joints and finished off level with the edge of the bricks, it shall while still green ruled along the centre with a half round tool of such width as may be specified by the Engineer-in-charge. The superfluous mortar shall then be cut off from the edges of the lines and the surface of masonry shall also be cleaned of all mortar.

3.5 Curing shall be started as soon as the mortar used for finishing has hardened sufficiently not to be damaged when watered. It shall be kept wet for a period of at least 7 days. During this period shall be suitably protected from all damages.

3.6. Stage scaffolding shall be approved for the work. This shall be independent of the structure.

3.7 Payment shall be made on [Cmt.](#) basis of the finished work. If directed by the Engineer-in charge for measurement the materials may have to be stacked at site before laying and nothing extra will be paid to the Contractor for this stacking. Preparation of base for laying bedding shall be deemed incidental to the work.

3.8 The rate shall include the cost preparing the base, putting to the profiles, providing, laying and compacting the sand bedding and rubble pitching of dry rubble, C.C. 1:3:6 panelling at 3.0 mt. C/C and 30 cm. x 30 cm panel wall as per the detailed drawing with necessary excavation and providing water chute of C.C. 1:3:6 at 24.00 mt. C/C as directed as per embankment slopes to specified thickness, lines curves, slopes and levels and all labour and material as well as tools and plant required of the work.

ITEM NO: 11 Providing and laying plain cement concrete grade M-20 protection wall and curtain wall with minimum depth below floor level of 2m on upstream and 2.5m on downstream side as per clause 20.1.2.3 of IRC:SP:13:2004 and section 2507.1 of MORTH specification.

Specification as per Item No.02 For Protection wall & Curtain wall

The payment will be made on [cmt.](#) basis of the finished work

ITEM NO: 12 Providing and laying rubble for apron (each stone weighting not less than 40Kg.) including and packing and filling in the interestices with quarry-spalls for Flexible Apron.

Specification as per Item No.10

The payment will be made on [cmt.](#) basis of the finished work

ITEM NO: 13 Providing and laying of Filter media 150mm thk with granular materials/stone crushed aggregates below pitching on slopes satisfying the requirements laid down in clause 2504.2.2. of MoRTH specifications.

Specification as per Item No.8

The payment will be made on [cmt.](#) basis of the finished work

ITEM NO: 14 Providing and laying Pitching on slopes laid over prepared filter media including boulder apron laid dry in front of toe of embankment complete as per drawing and Technical specifications

2504.1 description

The work shall consist of covering the river side slopes of guide bunds, training works and road embankments with stone, boulders, cement concrete blocks or stones in wire crates over a layer of granular material which will act as a filter. The rear slopes, not subjected to direct attack of the river, may be protected by 300 mm - 600 mm thick cover of clayey or silty earth and turfing.

2504.2 Pitching and Filter Medium

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 M15 grade concrete conforming to Section 1700 of these Specifications or stones in wire crates, shall be used.

Geosynthetics, if used in pitching, shall conform to Section 700 of these Specifications.

2504.2.2 Filter 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:

$$\frac{D_{15} \text{ (Filter)}}{D_{85} \text{ (Base)}} < 5$$

$$\begin{array}{c}
 \text{D 15 (Filter)} \\
 4 < \text{—————} < 20 \\
 \text{D 15 (Base)}
 \end{array}$$

$$\begin{array}{c}
 \text{D 50 (Filter)} \\
 \text{—————} < 25 \\
 \text{D 50 (Base)}
 \end{array}$$

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.

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.

2504.4 toe Protection

A toe wall shall be provided at the junction of slope pitching and launching apron of a guide bund so as to prevent the slope pitching from sliding down. The toe wall shall be in dry rubble masonry (uncoursed) conforming to Section 1400 of these Specifications or in cement concrete of M15 grade. The pitching/revetment shall be of stones in wire crates or cement concrete blocks in M15 grade. For protection of ties of bank slopes terminating either in short aprons at bed levels or anchored in flooring/rocky bed, the provision of Clause 8.2.2 of IRC:89 may be complied with.

The payment will be made on [cmt.](#) basis of the finished work

ITEM NO: 15 Providing and laying rubble for soling (each stone weighting not less than 40Kg.) including and packing and filing in the interestices with quarry-spalls. For rublle soling work under pcc.

Specification as per Item No.10

The payment will be made on [cmt.](#) basis of the finished work

ITEM NO: 16 Providing and casting in-situ Reinforced Controlled Cement Concrete M40 grade controlled cement concrete in Crash barrier for 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 etc complete as per specification. The rate is inclusive of all materials, necessary mixing, transport, curing, vibrating, placing in position, scaffolding, staging, normal shuttering, formworks, deshuttering carefully, cut-out etc in formwork, 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 including cost of fair finish form work.

Specification as per Item No.2 For Crash Barrier

The payment will be made on [cmt.](#) basis of the finished work

ITEM NO: 17 Providing and casting in situ controlled cement concrete M-40 for average 100 mm thick wearing coat laid as directed including tamping, vibrating, finishing, curing and filling joints with bitumen complete

Specification as per Item No.2 for average 100 mm thick wearing coat.

The payment will be made on [cmt.](#) basis of the finished work

ITEM NO: 18 Providing Pre-moulded asphalt filler joints as per drawings.(A) 12mm

1. Open joints shall be constructed at the location as directed by the Engineer-in-charge using a wood strip metal (plate or other suitable material which is subsequently removed. When removing the material, care shall be exercised to avoid chipping or breaking the corners of the concrete. The edge of the concrete, at the joints, shall be well finished. Reinforcement shall not extend across an open joint.
2. When preformed filler is to be provided, the filler shall be placed in correct position before concrete is placed against the filler. The filler material shall form part of the joint and while concreting the slab, care shall be taken to prevent the former being displaced. After the work is completed, the exposed face of the joint shall be cleaned of all loose material sticking to it.
3. The material used for filling expansion joint shall be bitumen impregnated felt. Impregnate felt shall conform to the requirement of IS: 1838, and shall be got approved from the Engineer-in-charge. The joint shall consist of large pieces and assembly of small pieces to make up the required size shall be avoided.
4. The expansion joint shall be measured in Square metres. Thickness of the expansion joint will be 20 mm. width of expansion joint shall be equal to full depth of the slab.
5. The rate shall include the cost of all materials, labour, equipments & incidental charges for fixing the joints complete in all respects as per these specifications and as shown on the drawing.

ITEM NO: 19 Providing and laying geogrid below approach slab and in approach road portion as specified in GR No. PRC/102020/1293/C and as mentioned in the drawings.

3103 REINFORCING ELEMENT

3103.1 The reinforcing element shall be metallic in the form of strips (aluminum alloy strip, copper strip, carbon steel strip, galvanised steel strip, stainless steel strip, ladder) or mats of metal (steel grids, woven and welded steel wire meshes) or synthetic (PET, HDPE, PVA, PP) reinforcement in the form of grid or strip or strap or combination of metallic or synthetic or any other proprietary material which may be approved by the Engineer and shown on the drawings

3103.2 Aluminum alloy strip shall comply with BS:1470 quality 5454 in the H 24 condition.

3103.3 Copper strip shall comply with BS:2870 quality C 101 or C 102 in the ½ H condition and shall have 0.2 percent proof stress of not less than 180 N/mm².

3103.4 Carbon steel strip shall comply with BS EN 10025 or IS:2062 and have a silicon content of not more than 0.55 percent. The fabricated element shall be galvanized in accordance with IS:4759 and IS:2629 and the minimum zinc coating weight shall not be less than 1000gm/sq.m

The steel strips with minimum bearing and shear strength of 490N/mm^2 shall comply with the requirements of BS EN 10025, Grade S 355 JR, or IS:2062 grade Fe 490, except the elongation (on base metal) for which minimum 22 percent is acceptable.

The panel lugs shall be manufactured from hot-rolled steel strips with the same steel quality and grades as specified above, except that the minimum zinc coating weight not less than 600 gm/sq.m.

All permanent metallic connectors (exposed to soil), tie strips and lugs shall be hot dip galvanized. Nuts/ bolts (fasteners) shall be galvanized as per requirements of IS: 1367-Part 3. Nuts/ bolts (fasteners) shall be of grade 10.9.

For all metallic components, where holes or penetrations are made through the reinforcing elements to accommodate connection such as bolts, pins, or other, the cross section thickness and/or width of metallic component shall be increased to account for section loss caused by the hole or penetration.

3103.5 Stainless steel strip shall comply with BS: 1449 (Part 2) quality 315 S 31 or 316 S 33 except that the material shall be cold rolled to provide a 0.2 percent proof stress of not less than 400 N/mm^2 and the tensile strength shall not be less than 540 N/mm^2 .

3103.6 All metallic components buried in soil shall be of electrolytically compatible materials.

3103.7 Geotextile, Geogrids and other Geosynthetic Materials used as Reinforcing Elements

3103.7.1 Geotextile

High strength high tenacity geotextile fabrics used as reinforcement in the construction of reinforced slopes or in the base of reinforced soil structure as reinforcement, shall be considered as reinforcing element and shall satisfy all the requirements stipulated for geosynthetic reinforcing elements, in Clause 3103.7.2.

Geotextile fabric used for separation, filtration and/ or drainage shall satisfy the requirements given in relevant Clauses of Section 700 Geosynthetics.

3103.7.2 Geogrids

The manufacturer of geogrids, geotextiles, geostrips, polymeric strips or straps, polymeric ties or any other geosynthetic material, including any proprietary geosynthetic material, for use as reinforcing element shall fulfill the following requirements:

- a) Shall have ISO (ISO-9001) or CE Certification for manufacturing process and quality control, and
- b) The product shall have certification for use as soil reinforcing material from an agency accredited for certifying geosynthetic reinforcement products.
- c) The manufacturer shall provide test reports from an independent laboratory with valid accreditation, for all the tests needed to establish the reduction factors listed below
 - RF_{CR} - Reduction factor for creep.
 - RF_{ID} - Reduction factor for installation damage RF_W - Reduction factor for weathering
 - RF_{CH} - Reduction factor for chemical/ environmental effects.
 - f_s - Factor for the extrapolation of data

All the above factors shall be determined in accordance with the provisions of ISO/TR 20432-“Guide to the determination of long-term strength of geosynthetics for soil reinforcement.”

Project Specific Tests/Data

Test for the ultimate tensile strength shall be carried out on a random sample for each grade of reinforcement as per ISO-10319. The test results shall be accompanied by stress-strain curves showing strength at 2% and 5% strain and strain/elongation at failure.

The manufacturer shall also provide the results of ultimate tensile strength for each lot and all grades of reinforcement proposed for use in the project.

Annual Average Daily Temperatures (AADT)/design temperature of the project site shall be worked out and values of reduction factor for creep RF_{CR} and for RF_{CH} shall be provided as per procedures given in ISO/TR-20432.

Tests shall be carried out to provide values of

- i) Pull-out coefficient as per ASTM D 6706 “Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil” and
- ii) Coefficient of interaction between reinforced fill soil and geogrids as per ASTM D 5321-“Standard Test method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear method” or as per IS: 13326: Part 1-1992 “Method of test for the evaluation of interface friction between geosynthetics and soil: Part 1 Modified direct shear technique” for all types of geogrids.

One set of project specific tests shall be conducted at third party accredited laboratory or at a reputed institute.

Each roll shall have at least one identification label with roll number and product type.

The payment will be made on [Smt.](#) basis of the finished work

ITEM NO: 20 MMGSY "LOGO" Board : Providing and fixing of MMGSY LOGO informatory sign ward with Logo as per section 1700 of MORD specifications and drawing. The board will be a composite unit consisting of Two Plates of Aluminum Material specifications as per clause 17001.3. The top most plate will be of 3mm Aluminium sheet in diamond shape of 600x600mm size, riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. The Lower plate will be of 4mm Aluminium sheet of 1100x300mm size riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. Riveting of all the sheets over angle and flat iron frame will be done neatly to have plain surface on one side. The angle iron frame of Both the plates will be welded to a 75mm x75mmx6mm Mild steel post at Centre and this post will be embeded in cement concrete M15 grade block of 450x450x600mm below ground level. The height of the bottom of the lower plate will be 1200mm from normal ground level. The spacing between the diamond shaped plate and Lower Plate is kept 150mm. MMGSY logo, etters and numerals on the ACM should be made up of Retro Reflective sheeting of Type-1 AEGP Class-A grade as per the latest MORD section 1700 and IRC 67-2012 specifications. Al the section of the frame and posts shall be painted with primer and two coats of epoxy paint. The design, painting and lettering shall be done as per the MMGSY Logo sign Design and as directed by Engineer in-charge. A warranty for 5 years for the Retro reflective sheeting for Type-1 Class-A from original manufacturer shall be submitted by contractor.

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.

801.1.1 The colour, configuration, size and location of all traffic signs for highways other than Expressways shall be in accordance with the code of Practice for Road Signs, IRC: 67 or as shown on the drawings. For Expressways, the size of the signs, letters and their placement shall be as specified in the Contract drawings and relevant Specifications. In the absence of any details or for any missing details, the signs shall be provided as directed by the Engineer.

801.1.2 The signs shall be either reflectorized or non-reflectorized as shown on the drawings or as directed by the Engineer. When they are of reflectorized type, they shall be of retro-reflectorized type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed Over aluminium sheeting as per these Specifications.

801.1.3. In general, cautionary and mandatory signs shall be fabricated through process of screen-printing. In regard to informatory signs with inscriptions, either the message could be printed over the reflective sheeting, or cut letters of non-reflective black sheeting used for the purpose which must be bonded well on the base sheeting as directed by the Engineer.

801.2. Materials

The various materials and fabrication of the traffic signs shall conform to the following requirements otherwise shown on the drawing.

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 confirm 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 signposts shall conform to IS: 226and IS: 2062or any other relevant IS Specifications.

801.2.5 Substrate:

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

The mechanical proportion of ACM and that of aluminum 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: Specification for Aluminum Composite Material (ACM)

Sr.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 N/mm ²
7	Shear strength with punch shear test	ASTM 732	
B	Properties of Aluminium Skin		
1	Tensile strength	ASTM E8	Min. 65 N/mm ²
2	Modulus of elasticity	ASTM E8	Min. 70000 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

Signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5mm thick. All others shall be at least 2 mm thick. 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 the 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.

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 outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

801.3.2. High intensity grade sheeting: This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent water-proof plastic having a smooth surface. 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 Standard E : 810) as indicated in Table 800-1.

TABLE 800-2. Acceptable Minimum Co-efficient of Retro-Reflection for High Intensity Grade Sheeting (Type III) (Encapsulated Lens Type) (Candles Per Lux Per Square Metre)

Observation Angle in Degrees	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)	150	170	100	45	45	20	12
0.2 ⁰	(+30 ⁰)	95	100	60	25	25	11	8.5
0.5 ⁰	(-4 ⁰)	65	62	30	15	15	7.5	5
0.5 ⁰	(+30 ⁰)	65	45	25	10	10	5	3.5

A. Minimum of coefficient of Retro-reflection (RA)

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%, of the values of retro reflectance indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 % of its original retro-reflectance.

801.3.3. Engineering grade sheeting: This sheeting shall be of enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-exposed lens optical reflecting system. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM Standard : E-810) as indicated in Table 800-2.

TABLE 800-3. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR ENGINEERING GRADE SHEETING (CANDELAS PER LUX PER SQUARE METRE)

Observation Angle in Degrees	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 of coefficient of Retro-reflection (RA)

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%, of the values of retro reflectance indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 % of its original retro-reflectance.

801.3.4. Prismatic Grade Sheetting

801.3.4 Prismatic Grade Sheetting (Type VIII)

801.3.4.1 Prismatic Grade Sheetting

The reflective sheeting shall be retro reflective sheeting made of micro prismatic retro reflective material. The retro reflective surface, after clearing with soap and water and in dry condition shall have the minimum co-efficient of retro reflection (determined in accordance with ASTM E810) as indicated in Table 800-4.

801.3.4.2 Prismatic Grade Sheetting (Type IX)

The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro-reflective surface, after clearing with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM E810) as indicated in Table 800-5.

TABLE 800-4. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR PRISMATIC GRADE SHEETING (Type VI) (CANDELAS PER LUX PER SQUARE METRE)

Observation Angle in Degrees	Entrance Angle in Degrees	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow/Green	Fluorescent Yellow	Fluorescent Orange
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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 of coefficient of Retro-reflection (R^A) cd/fc/ft² (cd-lx-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%, of the values of retro reflectance indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 % of its original retro-reflectance.

TABLE 800-5. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO-REFLECTION FOR PRISMATIC GRADE SHEETING (Type IX) (CANDELAS PER LUX PER SQUARE METRE)

Observation Angle in Degrees	Entrance Angle in Degrees	White	Yellow	Orange	Green	Red	Blue	Fluorescent Yellow/Green	Fluorescent Yellow	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	110	81	41
1.0 ⁰	(-4 ⁰)	80	60	30	8	16	3.6	64	48	24
1.0 ⁰	(+30 ⁰)	45	34	17	4.5	9	2	36	27	14

- A. Minimum of coefficient of Retro-reflection (R^A) cd/fc/ft² (cd-lx-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%, of the values of retro reflectance indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 % of its original retro-reflectance.

801.3.4.3 Prismatic Grade Sheeting (Type XI)

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 clearing 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 COEFFICIENT OF RETRO-REFLECTION FOR PRISMATIC GRADE SHEETING TYPE A (Type XI) (CANDELAS PER LUX PER SQUARE METRE)

Observation Angle in Degrees	Entrance Angle in Degree	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow/Green	Fluorescent Yellow	Fluorescent Orange
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	s										
0.1 ^{0B}	(-4 ⁰)	830	620	290	83	12 5	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	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	5	120	90	45
1.0 ⁰	(-4 ⁰)	120	90	42	12	18	5	4	96	72	36
1.0 ⁰	(+30 ⁰)	45	34	16	5	7	2	1	36	27	14

A. Minimum of coefficient of Retro-reflection (R^A) $\text{cd}/\text{fc}/\text{ft}^2$ ($\text{cd}/\text{lx}/\text{lm}^2$)

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%, of the values of retro reflectance indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 % of its original retro-reflectance.

801.3.5. Adhesives: The sheeting shall either have pressure-sensitive adhesive of the aggressive-tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, or a tack free adhesive activated by heat, applied in a heat-vacuum applicator, 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. In case of pressure-sensitive adhesive sheeting, the sheeting shall be applied in accordance with the manufacturer's Specifications. Sheetting with adhesives requiring use of solvents or other preparation for adhesive shall be applied strictly in accordance with the manufacturer's instructions.

801.3.6. Fabrication:

Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminum backing 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.

Surface to be reflectorized shall be effectively prepared to receive the retro-reflective sheeting. The aluminum 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. Sheetting with heat-activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. Where screen printing with transparent colors is proposed, only butt jointing 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 informatory 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 colored areas on white sheeting, the coefficient 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 of 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 be 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	0.30 3	0.3	0.36 8	0.36 6	0.34	0.39 3	0.27 4	0.32 9	15	-
Yellow	0.49 8	0.41 2	0.55 7	0.44 2	0.47 9	0.52	0.43 8	0.47 2	24	45
Green	0.02 6	0.39 9	0.16 6	0.36 4	0.28 6	0.44 6	0.20 7	0.77 1	2.5	11
Red	0.64 8	0.35 1	0.73 5	0.26 5	0.62 9	0.28 1	0.56 5	0.34 6	2.5	11
Blue	0.14 0	0.03 5	0.24 4	0.21	0.19	0.25 5	0.06 5	0.21 6	1	10
Orange	0.55 8	0.35 2	0.63 6	0.36 4	0.57	0.42 9	0.50 6	0.40 4	12	30
Brown	0.43	0.34	0.61	0.39 0	0.55	0.45	0.43	0.39	1	6
Fluorescent Yellow-Green	0.38 7	0.61	0.36 9	0.54 6	0.42 8	0.49 6	0.46	0.54	60	-
Fluorescent Yellow	0.47 9	0.52	0.44 6	0.48 3	0.51 2	0.42 1	0.55 7	0.44 2	45	-
Fluorescent Orange	0.58 3	0.41 6	0.53 5	0.40 0	0.59 5	0.35 1	0.64 5	0.35 5	25	-

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 informative 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 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 seven-year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of high intensity grade and a five-year warranty for the adhesive sheeting of engineering grade, and submit the same to the Engineer. In addition, a seven year and a five-year warranty for satisfactory in-field performance of the finished sign with retro-reflective sheeting of high intensity grade and engineering grade respectively, inclusive of the screen printed or cut out letters/legends and their bonding to the retro-reflective sheeting shall be obtained from the Contractor/supplier and passed on to the Engineer. The Contractor/supplier shall also furnish a certification that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty.

Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning, shall show no appreciable discoloration, cracking, blistering or dimensional change and shall not have less than 80 per cent of the specified minimum reflective intensity values (Tables 800-1 and 800-2) when subjected to accelerated weathering for 1000 hours, using type E or EH Weather meter (AASHTO Designation M 268).

801.4. Installation

801.4.1. 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. Sign supports may be of mild steel, reinforced concrete or galvanized iron (G.I). 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 and supports, other than the reflective portion and G.I. posts shall be thoroughly descaled, cleaned primed and painted with two coats of epoxy paint. Any part of mild steel (M.S.) post below ground shall be painted with three coats of red lead 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 in the case of reinforced concrete or G.I. posts. After the nuts have been tightened, the tails of the bolts shall be furred over with a hammer to prevent removal.

. 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 Re

801.5. Measurements 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 meters.

The mode of Measurement shall be made in Number basis.

The description of Item shall be self-specification of work shall be carried as per IRC and drawing supplied by engineer in charge.

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 and incidentals to complete the work in accordance with the Specifications.

The Measurement & Payment shall be made of No. Basis

ITEM NO: 21 Citizen's information Board- Providing and fixing of typical MMGSY information board as per instruction. Two Aluminium sheets of 3 mm thick, of 900 mm x 750mm size fixed at top & bottom duly rivetted with MS angles of 25 x 25 x 5 mm thick M.S angle shall be welded by two vertical M.S angle of 5 mm thick to 75 mm x 75 mm of 12 SWG square tubes posts duly embedded in cement concrete M-15 grade blocks of 600mm x 600mm x 75mm, below ground level. The letters & figure of any shade reflectorised with High Intensity Prismatic Grade Retro Reflective Sheeting of Type-4 as per ASTM D-4956 and latest MORD specifications; All sections of framed posts and steel tube will be painted with primer and two coats of epoxy paints as per drawing Clause 1701 and Annexure 1700.1 (10.16). (A) Class-B High intensity Grade Retro Reflective sheeting.

The specification of **Item No. 20** shall be followed for the execution of this item except the size of **Citizen's information board** As Per Item Description.

Use Class-B High intensity grade Retro Reflective sheet as per instruction of EIC.

The Measurement & Payment shall be made of No. Basis.

ITEM NO: 22 MMGSY Project Information Board: Providing and fixing of typical PMGSY Project informatory sign board with Logo as per 1700 of MORD specifications and drawing. The board will be a composite unit consisting of Three Plates Aluminum material specifications as per clause 1700.1.3. The top most plate will be of 3mm ACM in diamond shape of 600x600mm size, riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. The middle 4mm ACM plate will be 1200x150mm size riveted with MS angle iron frame of 25mmx25mmx5mm size on back on edges. The main 4mm ACM lower most plate will be 1500mmx600mm size, riveted with MS angle iron frame of 25mmx25mmx5mm size. Riveting of all the sheets over angle and flat iron frame will be done neatly to have plain surface on one side. The angle iron frame of lower most plate and flat iron frame of the middle plate will be welded to two nos. 75mm x 75mm (12 SWG) sheet tubes posts placed at 1125mm apart centre to centre, the top of the middle plate will be flushed with the top of 75mm dia medium steel tube posts and these posts will be embedded in cement concrete M15 grade block of 450x450x600mm below ground level. The height of the bottom of the lower plate will be 1200mm from normal ground level and the bottom of the middle plate will be 100mm above the top level of the lower most plate, the diamond shaped plate mounted over flat angle iron frame will be connected to middle plate by square steel section of 47mmx 47mm , thickness 12SWG having a spacing of 100mm between the diamond shaped plate and middle plate and this square section will be riveted to the bottom point of the diamond shaped plate. MMGSY logo, letters and numerals on the ACM should be made up of Retro Reflective sheeting of Type-1 AEGP Class-A grade as per the latest MORD section 1700 and IRC 67- 2012 specifications. All the section of the frame and posts shall be painted with primer and two coats of epoxy paint. The design, painting and lettering shall be done as per the MMGSY Signage Guide and as directed by Engineer-In-charge. . A warranty for 5 years for the Retro reflective sheeting for Class-A respectively, from original manufacturer shall be submitted by contractor.

The specification of **Item No. 20** shall be followed for the execution of this item except the size of **MMGSY PRTOJECT Information sign board** As Per Item Description.

Use Type 1 Class A grade Retro Reflective sheet as per instruction of EIC.

The Measurement & Payment shall be made of No. Basis.

ITEM NO 23: 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.

CLEARING AND GRUBBING

201.1. Scope

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 Equipment's

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 tire 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 soil within 500 mm of the sub grade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/sub grade 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 meters, 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 lifts and up to a lead of 1000 m.

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, sub grade 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 up to 300 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.

Cutting, including removal of stumps and roots of trees of girth above 300 mm and backfilling to required compaction shall be measured in terms of number according to the sizes given below:-

- i) Above 300 mm to 600 mm
- ii) Above 600 mm to 900 mm
- iii) Above 900 mm to 1800 mm
- iv) Above 1800 mm

For this purpose, the girth shall be measured at a height of 1 meter above ground or at the top of the stump if the height of the stump is less than one meter from the ground.

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 labor, materials, tools, equipment and incidentals necessary to complete the work. These will also include removal of stumps of trees less than 300 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 lifts and up to a **lead of 1000 m**.

ITEM NO: 24 Dismantling of flexible pavements and disposal of dismantled materials up to a lead of 1000 metres, stacking serviceable and unserviceable materials separately

(A) Dismantaling of Bituminous Layer

(B) Dismantaling of Granular Layer

"1. This work shall consist of removing , as here in after set forth, existing culverts, bridges, pavements, kerbs and other structures like guard-rails, fences, utility poles, manholes, catch basins, inlets, etc. Which are in place but interfere with the new construction or are not suitable to remain in place, and of salvaging and disposing of the resulting materials and backfilling the resulting trenches and pits.

2 Existing culverts, bridges, pavements and other structures which are within the highway and which are designed to be removed shall be removed upto the limits and extent specified in the drawings or as indicated by the Engineer-in-charge.

3. Dismantaling and removal operations shall be carried out with equipment and in such a manner as to leave undisturbed, adjacent pavement, structure and any other work to be left in place.

4. 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.

5. The structures shall be dismantled carefully and the resulting materials so removed as not to cause any damage to the serviceable materials to be salvaged, the part of the structure to be retained and any other properties or structures nearby.
6. Unless otherwise specified, the superstructure portion of culverts/ bridges shall be entirely removed and other parts removed to below the ground level or as necessary depending upon the interference they cause to the new construction. Removal of overlying or adjacent materials if required in connection with the dismantling of the structures, shall be incidental to this item.
7. Where existing culverts/ bridges are to be extended or otherwise incorporated in the new work, only such part of the existing structure shall be removed as are necessary to provide a proper connection to 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. Reinforcing bars which are to be left in place so as to project into new work as dowels or ties shall not be injured during removal of concrete.
8. Pipe culverts shall be carefully removed in such a manner to avoid damage to the pipes.
9. Steel structures shall unless otherwise provided be carefully dismantled in such a manner as to avoid damage to members thereof. If specified in the drawing or directed by the Engineer-in-charge that 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 surface 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.
10. Timber structures shall be removed in such a manner as to avoid damage to such timber or lumber as is designated to be salvaged by the Engineer-in-charge.
11. 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 out and chipped to a true line with a face perpendicular to the surface of the existing strata. Sufficient removal shall be made to provide for proper grades and connections with the new work as directed by the Engineer-in-charge. All concrete pavements, base course in carriage way and shoulders etc. designed for removal shall be broken to pieces whose volume shall not exceed 0.02 cubic meter and stockpiled at designated locations if the materials is to be used later or otherwise arranged for disposal as directed.
12. Where directed by the Engineer-in-charge holes and depressions caused by dismantling operations shall be backfilled with excavated or other approved materials thoroughly compacted in line with surrounding area.
13. All materials obtained by dismantling shall be the property of Government. Unless otherwise specified, materials having any salvage value shall be placed in neat stacks of like material with the right of way as directed by the Engineer-in-charge, for which Contractor will remain responsible for its safe custody and preservation for 60 days after recording measurements of the salvaged materials. Pipe culverts that are removed shall be cleared and neatly piled on the right-of-way at point designed by the Engineer-in-charge.

14. Pipe culverts that are removed shall be cleared and neatly piled on the right of way at points designated by the Engineer-in-charge.

15. Structural steel removal from old structure shall, unless otherwise specified or directed, be stored in a neat and presentable manner. Structures or portions thereof which are specified in the contract for re-erections shall be stored in separate piles.

16. Timber or lumber from old structure which is designated by the Engineer-in-charge as materials to be shall have all nails and bolts removed there from and shall be stored in neat piles locations suitable for loading.

17. All products of dismantling operations which in the opinion of the Engineer-in-charge cannot be used or auctioned shall, be disposed as directed, within 100 metres.,

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

- | | |
|---|--------------|
| (i) Dismantling Stone/brick/concrete (Plain and Reinforced) masonry | Cubic Metre |
| (ii) Dismantling flexible and cement concrete pavement./RCC pipes | Cubic Metre |
| (iii) Dismantling steel structure. | Tonne |
| (iv) Dismantling timber structure | Cubic Metre |
| (v) Dismantling pipes, guard rails, kerbs, gutters and fencing. | Linear Metre |
| (vi) Utility poles. | Nos. |

26. The contract unit rates for the various items of dismantling shall by payment 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. These will also include excavation and backfilling where necessary and for handling, salvaging, piling and disposing of the dismantled materials within all lifts and upto all lead.

27. The rate shall be for a unit of one cubic meter

ITEM NO 25: Earthwork for embankment including breaking clods, dressing with all lead and lift and including watering rolling and consolidation of subgrade in layers at O.M.C. to required dry density including filling the depression which occur during the process using power roller 8T to 10T.(E) From Borrow area within 3.0KM lead.

EMBANKMENT CONSTRUCTION

301.1 **General**

301.1.1 Description:

These specifications shall apply to the construction of embankments, sub-grades, earthen shoulders and miscellaneous back fills with approved material obtained either from excavation for road construction, borrow pits or other sources. All embankments and sub-grades shall be constructed to accordance with the requirements of these specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the Engineer.

301.2 Materials

301.2.1 Physical Requirements :

The materials used in embankments, sub-grades, earthen shoulders and miscellaneous backfills shall be moorum, gravel, a mixture of these or any other material approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment/sub-grade.

The following types of material may be considered unsuitable for embankment:

- Material from swamps, marshes or bogs
- Peat, log, stump or perishable material; any soil classifies as OL, OI, OLL or Pt in accordance with IS:1498.
- Material susceptible to spontaneous combustions
- Material in a frozen condition and
- Clay of liquid limit exceeding 70 and plasticity index exceeding 45 ; and
- Materials with salts resulting in leaching in the embankment.

Expansive clay exhibiting marked swell and shrinkage properties ("free swelling index" exceeding 50 per cent when tested as per IS: 2720 – Part 40) shall not be used as a fill material. Where expansive clay with acceptable "free swelling index" value is used as a fill material, subgrade and top 500 mm. Portion of the embankment just below sub-grade shall be non-expansive in nature.

Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO₃) per litre when tested in accordance with BS: 1377 Test 10, but using a 2:1 water-soil ratio shall not be deposited within 500mm. or other distance described in the Contractor, of concrete, cement bound materials or other cementitious materials forming part of the Paramount Works.

Material with a total sulphate content (expressed as SO₃) exceeding 0.5 percent by mass, when tested in accordance with BS:1377 Test 9 shall not be deposited within 500mm, or other distances described in the Contract, or metallic items forming part of the Permanent Works.

The size of the coarse material in the mixture of earth shall ordinarily not exceed 75mm. when being placed in the embankment and 60mm. when placed in the sub-grade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the placement of fill material and its compaction to the requirements of these specifications. The maximum particle size shall not be more than two-third of the compacted layer thickness.

Ordinarily, only the materials satisfying the density requirements given in Table 300.1 shall be employed for the construction of the embankment and the sub-grade.

TABLE 300.1

DENSITY REQUIREMENTS OF EMBANKMENT AND SUB-GRADE MATERIALS

Sl. No.	Type of Work	Maximum laboratory dry density when tested as per IS: 2720 (Part-VIII).
1.	Embankments up to 3m. Height, not subjected to extensive flooding.	Not less than 15.2 kN/cu.m.
2.	Embankments exceeding 3 metre height or embankments of any height subject to long periods of inundation.	Not less than 16 kN/cu.m.
3.	Sub-grade and earthen shoulders /verge/backfill	Not less than 17.5 kN/cu.m.

Note:

- 1) This table is not applicable for lightweight fill material e.g. cinder, fly ash etc..
- 2) The material to be used in subgrade shall be non-expansive and shall satisfy design CBR at the specified dry density and moisture content. In case the available material fails to meet the requirement of CBR, use of stabilization

method in accordance with Clause 403 and 404 or by any stabilization method approved by the engineer shall be followed.

General Requirements:

The materials for embankment shall be obtained from approved sources with preference given to materials becoming available from nearby roadway excavation or any other excavation under the same Contract.

The work shall be so planned and executed that the best available materials are saved for the sub grade and the embankment portion just below the sub grade.

Borrow materials: Where the materials are to be obtained from designated borrow areas, the location, size and shape of these areas shall be as indicated by the Engineer and the same shall not be opened without his written permission. Where specific borrow areas are not designated by the Employer/the Engineer, arrangement for locating the source of supply of materials for embankment and sub grade as well as compliance to environmental requirements in respect of excavation and borrow areas as stipulated, from time to time by the Ministry of Environment and Forests, Government of India and the local bodies, as applicable, shall be the sole responsibility of the Contractor.

Borrow pits along the road shall be discouraged. If permitted by the Engineer, these shall not be dug continuously. Ridges of not less than 8 m width should be left at intervals not exceeding 300m. Small drains shall be cut through the ridges to facilitate drainage. The depth of the pits shall be so regulated that their bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of the final section of the bank, the maximum depth in any case being limited to 1.5 m. Also no pit shall be dug within the offset width from the toe of the embankment required as per the consideration of stability with a minimum width of 10 m.

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition.

Where the excavation reveals a combination of acceptable and unacceptable materials, the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately.

The Contractor shall ensure that he does not adversely affect the stability of excavation or fills by the methods of stockpiling materials, use of plants or sitting of temporary buildings or structures.

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing programme approved by the Engineer. It shall be ensured that the sub grade material when compacted to the density requirements as in Table 300-2 shall yield the design CBR value of the sub grade.

Table 300-2 : Compaction Requirements for Embankment and Sub-grade

S. No.	Type of work/material	Relative compaction as percentage of max. laboratory dry density as per IS:2720 (Part 8)
1)	Subgrade and earthen shoulders	Not less than 97%
2)	Embankment,	Not less than 95%
3)	Expansive Clays	
	a) Subgrade and 500 mm portion just below the subgrade	Not allowed
	b) Remaining portion of embankment	90–95%

Construction Operations:

Setting Out: After the site has been cleared to Clause 201, the work shall be set out to Clause 301.3.1. The limits of embankment/sub grade shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. The embankment/sub grade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed; ensuring that the remaining material is to be desired density and the position specified and conforms to the specified side slopes.

Dewatering: If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is feasible to remove it, the same shall be removed by bailing out or pumping, as directed by the Engineer and the area of the embankment foundation shall be kept dry. Care shall be taken to discharge the drained water so as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair. /restore it to original condition or compensate the damage at his own cost.

If the embankment is to be constructed under water, Clause 305.4.6 shall apply.

Stripping and Storing topsoil: In localities where most of the available embankment materials are not conducive to plant growth, or when so directed by the Engineer, the topsoil from all areas of cutting and from all areas to be covered by embankment foundation shall be stripped to specified depths not exceeding 150 mm and stored in stockpiles of height not exceeding 2 m for covering embankment slopes, cut slopes and other disturbed areas where re-vegetation is

desired. Topsoil shall not be unnecessarily trafficked either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

Compacting ground supporting embankment/Sub grade:

Where necessary, the original ground shall be leveled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced by approved materials laid in layers to the required degree of compaction.

Embankment or sub grade work shall not proceed until the foundations for embankment/sub grade have been inspected by the Engineer for satisfactory condition and approved.

Spreading material in layers:

The embankment and sub grade material shall be spread in layers of uniform thickness not exceeding 200mm compacted thickness over the entire width of embankment by mechanical means, finished by a motor grader and compacted.

Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made good. Where water is required to be added in such constructions, water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by balding, dicing or barrowing until a uniform moisture content is obtained throughout the depth of the layer.

If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, compaction work shall be suspended.

After adding the required amount of water, the soil shall be processed by means of graders, harrows, rotary mixers or as otherwise approved by the Engineer until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have a maximum size of 75 mm when being placed in the embankment and a maximum size of 50 mm when being placed in the sub grade.

Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and other vehicular traffic uniformly over them. Damage by construction plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength as the material had before it was damaged.

Embankments and other areas of unsupported fills shall not be constructed with steeper side slopes, or to greater widths than those shown in the Contract, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material.

Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cutting, another fills and excavations steeper than 1 vertical on 4 horizontal, such faces shall be benched as per Clause 305.4.1 immediately before placing the subsequent fill.

All permanent faces of side slopes of embankments and other areas of fill formed shall, subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer, on the slope or any other method approved by the Engineer.

Compaction: Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Vibratory rollers of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

The compaction shall be done with the help of power roller of 80 to 100 KN static weight with plain or pad foot drum or heavy pneumatic tyred roller of adequate capacity capable of achieving required compaction.

The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials.

When density measurements reveal any soft areas in the embankments / subgrade / earthen shoulders, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted to the density requirements and satisfaction of the Engineer.

Drainage: The surface of the embankment/subgrade at all times during construction shall be maintained at such a cross fall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding.

Repairing of damages caused by rain/spillage of water:

The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density in accordance with Clause 305.3.6 If the cut is not sufficiently wide for use of required mechanical means for compaction, the same shall be widened suitably to permit their use for proper

compaction. Tests shall be carried out as directed by the Engineer to ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery/equipment for the purpose.

Finishing operations:

Finishing operations shall include the work of shaping and dressing the shoulders/verge/ roadbed and side slopes to conform to the alignment, levels, cross sections and dimensions shown on the drawings or as directed by the Engineer subject to the surface tolerance described in Clause 902. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.

The topsoil, removed and conserved earlier (Clause 301.3.2 and 305.3.3) shall be spread over the fill slopes as per directions of the Engineer to facilitate the growth of vegetation. Slopes shall be roughened and moisture slightly prior to the application of the topsoil in order to provide satisfactory bond. The depth of the top soil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 150 mm.

Where directed, the slopes shall be turfed with sods in accordance with Clause 307. If seeding and mulching of slopes is prescribed, this shall be done to the requirement of Clause 308.

Construction of Embankment and subgrade under special conditions.

Earthwork for widening existing road embankment:

When an existing embankment and/or subgrade is to be widened and its slopes are steeper than 1 vertical on 4 horizontal, continuous horizontal benches, each at least 300 mm wide, shall be cut into the old slope for ensuring adequate bond with the fresh embankment / subgrade material to be added. The material obtained from cutting of benches could be utilized in the widening of the embankment/subgrade. However when the existing slope against which the fresh material is to be placed is flatter than 1 vertical on 4 horizontal, the slope surface may only be ploughed or scarified instead of resorting to benching.

Where the width of the widened portions is insufficient to permit the use of conventional rollers, compaction shall be carried out with the help of small vibratory rollers/plate compactors/power rammers or any other appropriate equipment approved by the Engineer. End dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other types of hauling equipment.

Earthwork for embankment and subgrade to be placed against sloping ground:-

Where an embankment /subgrade is to be placed against sloping ground, the latter shall be appropriately benched or ploughed/scarified as required in Clause 305.4.1 before placing the embankment/subgrade material. Extra earthwork involved in benching or due to ploughing / scarifying etc. shall be considered incidental to the work.

For wet conditions, benches with slightly inward fall and subsoil drains at the lowest point shall be provided as per the drawings, before the fill is placed against sloping ground.

Where the contract requires construction of transverse subsurface drain at the cut-fill interface, work on the same shall be carried out to Clause 309 in proper sequence with the embankment and subgrade work as approved by the Engineer.

Earthwork over existing road surface:-

Where the embankment is to be placed over an existing road surface, the work shall be carried out as indicated below:-

If the existing road surface is of granular or bituminous type and lies within 1 m of the new subgrade level, the same shall be scarified to a depth of 50mm or more if specified, so as to provide ample bond between the old and new material ensuring that at least 500 mm portion below the top of new subgrade level is compacted to the desired density.

If the existing road surface is of cement concrete type and lies within 1 m of the new subgrade level the same shall be removed completely.

If the level difference between the existing road surface and the new formation level is more than 1 m. the existing surface shall be permitted to stay in place without any modification.

Embankment and subgrade around structures:-

To avoid interference with the construction of abutments, wing walls or return walls of culvert/bridge structures, the Contractor shall, at points to be determined by the Engineer 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 damage to the structure.

Unless directed otherwise, the filling around culverts, bridges and other structures up to a distance of twice the height of the road from the back of the abutment 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 but in any case not until the concrete or masonry has been in position for 14 days. The embankment and subgrade shall be brought up simultaneously in equal layers 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.

Where it may be impracticable to use conventional rollers, the compaction shall be carried out by appropriate mechanical means such as small vibratory roller, plate compactor or power rammer. Care shall be taken to see that the compaction equipment does not hit or come too close to any structural member so as to cause any damage to them or

excessive pressure against the structure.

Construction of embankment over ground incapable of supporting construction equipment.

Where embankment is to be constructed across ground which will not support the weight of repeated heavy loads of construction equipment, the first layer of the fill may be constructed by placing successive loads of material in a uniformly distributed layer of a minimum thickness required to support the construction equipment as permitted by the Engineer. The Contractor, if so desired by him, may also use suitable geosynthetic material to increase the bearing capacity of the foundation. This exception to normal procedure will not be permitted where, in the opinion of the Engineer, the embankments could be constructed in the approved manner over such ground by the use of lighter or modified equipment after proper ditching and drainage have been provided. Where this exception is permitted, the selection of the material and the construction procedure to obtain an acceptable layer shall be the responsibility of the Contractor. The cost of providing suitable traffic conditions for construction equipment over any area of the Contract, will be the responsibility of the Contractor and no extra payment will be made to him. The remainder of the embankment shall be constructed as specified in Clause 305.3.

Embankment construction under water :

Where filling or backfilling is to be placed under water, only acceptable granular material or rock shall be used unless otherwise approved by the Engineer. Acceptable granular material shall consist of graded, hard durable particles with maximum particle size not exceeding 75mm. The material should be non-plastic having uniformity coefficient of not less than 10. The material placed in open water shall be deposited by end tipping without compaction.

Earthwork for high embankment:-

In the case of high embankments, the Contractor shall normally use the material from the specified borrow area. In case he desires to use different material for his own convenience, he shall have to carry out necessary soil investigations and redesign the high embankment at his own cost. The contractor shall then furnish the soil test data and design of high embankment for approval of the Engineer, who reserves the right to accept or reject it.

If necessary, stage construction of fills and any controlled rates of filling shall be carried out in accordance with the Contract including installation of instruments and its monitoring.

Where required, the contractor shall surcharge embankments or other areas of fill with approved material for the periods specified in the Contract. If settlement of surcharged fill results in any surcharging

Material, which is unacceptable for use in the fill being surcharged, laying below formation level, the Contractor shall remove the unacceptable material and dispose it as per direction of the Engineer. He shall then bring the resultant level upto formation level with acceptable materials.

Settlement period :- Where settlement period is specified in the Contract, the embankment shall remain in place for the required settlement period before excavating for abutment, wing wall, retaining wall, footings, etc. or driving foundation piles. The duration of the required settlement period at each location shall be as provided for in the contract or as directed by the Engineer.

Plying of Traffic :

Construction and other vehicular traffic shall not use the prepared surface of the embankment and/or subgrade without the prior permission of the Engineer. Any damage arising out of such use shall, however be made good by the Contractor at his own expense as directed by the Engineer.

Surface Finish and Quality Control of Work :-

The surface finish of construction of subgrade shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised in accordance with Clause 903.

Subgrade Strength :-

It shall be ensured prior to actual execution that the borrow area material to be used in the subgrade satisfies the requirements of design CBR.

Subgrade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed subgrade shall be determined on undisturbed samples cut out from the compacted subgrade in CBR mould fitted with cutting shoe or on remoulded samples, compacted to the field density at the field moisture content.

Measurements for Payment:-

Earth embankment/subgrade construction shall be measured separately by taking cross sections at intervals in the original position before the work starts and after its completion and computing the volumes of earthwork in cubic metres by the method of average end areas.

The measurement of fill material from borrow areas shall be the difference between the net quantities of compacted fill and the net quantities of suitable material brought from roadway and drainage excavation. For this purpose, it shall be assumed that one cu.m. of suitable material brought to site from road and drainage excavation forms one cu.m. of

compacted fill and all bulking or shrinkage shall be ignored.
Construction of embankment under water shall be measured in cu.m.
Construction of high embankment with specified material and in specified manner shall be measured in cum.
Stripping including storing and reapplication of topsoil shall be measured in cu.m.
Work involving loosening and re-compacting of ground supporting embankment/subgrade shall be measured in cu.m.
Removal of unsuitable material at embankment/subgrade foundation and replacement with suitable material shall be measured in Cu.m.
Scarifying existing granular/bituminous road surface shall be measured in Square metres.
Dismantling and removal of existing cement concrete pavement shall be measured vide Clause 202.6.
Filter medium and backfill material behind abutments, wing walls and other retaining structures shall be measured as finished work in position in cu.m.

RATES:

The Contract unit rates for the items of embankment and subgrade construction shall be payment in full for carrying out the required operations including full compensation for:

Cost of arrangement of land as a source of supply of material of required quantity for construction unless provided otherwise in the contract.

Setting out;

Compacting ground supporting embankment/subgrade except where removal and replacement of unsuitable material or loosening and re-compacting is involved;

Scarifying or cutting continuous horizontal benches 300mm wide on side slopes of existing embankment and subgrade as applicable;

Cost of watering or drying of material in borrow areas and/or embankment and subgrade during construction as required;

Spreading in layers, bringing to appropriate moisture content and compacting to specification requirements;

Shaping and dressing top and slopes of the embankment and subgrade including rounding of corners;

Restricted working at sites of structures;

Working on narrow width of embankment and subgrade;

Excavation in all soils from borrow pits/designated borrow areas including clearing and grubbing and transporting the material to embankment and subgrade site with all lifts and leads unless otherwise provided for in the contract.

All labour, material, tools, equipment and incidentals necessary to complete the work to the Specifications;

Dewatering and

Keeping the embankment/completed formation free of water as per Clause 311.

In case the Contract unit rate specified is not inclusive of all leads, the unit rate for transporting material beyond the initial lead, as specified in the contract for construction of embankment and subgrade shall be inclusive of full compensation for all labour, equipment, tools and incidentals necessary on account of the additional haul or transportation involved beyond the specified initial lead.

Measurement shall be taken and paid in Cmt.

ITEM NO: 26 Construction of sub-grade and earthen shoulders 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.

408.1 scope

The work shall consist of constructing shoulder (hard/paved/earthen with brick or stone block edging) on either side of the pavement, median in the road dividing the carriageway into separate lanes and islands for channelising the traffic at junctions in accordance with the requirements of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

408.2 Materials

Shoulder on either side of the road may be of selected earth/granular material/paved conforming to the requirements of Clause 305/401 and the median may be of selected earth conforming to the requirements of Clause 305.

Median/Traffic islands shall be raised and kerbed at the perimeter and the enclosed area filled with earth and suitably covered with grass turf/shrubs as per Clause 307 and/or paved as per Clauses 410.3.4 or 410.3.5.

Paved shoulders shall consist of sub-base, base and surfacing courses, as shown in the drawings and materials for the same shall conform to relevant Specifications of the corresponding items. Where paved or hard shoulders are not provided, the pavement shall be provided with brick/stone block edgings as shown in the drawings. The brick shall conform to Clause 1003 of these Specifications. Stone blocks shall conform to Clause 1004 of these Specifications and shall be of size 225 mm x 110 mm x 75 mm.

408.3 size of shoulders/Medians/islands

Shoulder (earthen/hard/paved)/median/traffic island dimensions shall be as shown on the drawings or as directed by the Engineer.

408.4 construction operations

408.4.1 shoulders

The sequence of operations shall be such that the construction of paved shoulder is done in layers each matching the thickness of adjoining pavement layer. Only after a layer of pavement and corresponding layers in paved and earth shoulder portion have been laid and compacted, the construction of next layer of pavement and shoulder shall be taken up.

Where the materials in adjacent layers are different, these shall be laid together and the pavement layer shall be compacted first. The corresponding layer in paved shoulder portion shall be compacted thereafter, which shall be followed by compaction of each shoulder layer. The adjacent layers having same material shall be laid and compacted together.

In all cases where paved shoulders have to be provided along side of existing carriageway, the existing shoulders shall be excavated in full width and to the required depth as per Clause 301.3.7. Under no circumstances, box cutting shall be done for construction of shoulders.

Compaction requirement of earthen shoulder shall be as per Table 300-3. In the case of bituminous courses and concrete pavement, work on shoulder shall start only after the pavement course has been laid and compacted.

During all stages of shoulder construction, the required crossfall shall be maintained to drain off surface water.

Regardless of the method of laying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed, without damage to the pavement, and the area so affected thoroughly cleaned.

408.4.2 Median and islands

Median and islands shall be constructed in a manner similar to shoulder up to the road level. Thereafter, the median and islands, if raised, shall be raised at least 300 mm by using kerb stones of approved material and dimensions and suitably finished and painted as directed by the Engineer. If not raised, the median and islands shall be differentiated from the shoulder/pavement as the case may be, as directed by the Engineer. The confined area of the median and islands shall be filled with local earth or granular material or any other approved material and compacted by plate compactor/power rammer. The confined area after filling with earth shall be turfed with grass or planted with shrubs, or finished with tiles/slabs as provided in the drawings.

408.4.3 Brick/stone Block edging

The brick/stone blocks shall be laid on edge, with the length parallel to the transverse direction of the road. They shall be laid on a bed of 25 mm sand, set carefully rolled into position by a light roller and made flush with the finished level of the pavement.

408.5 surface finish and Quality control of works

The surface finish of construction shall conform to the requirements of Clause 902. Control on the quality of materials and works shall be exercised by the Engineer in accordance with section 900.

408.6 Measurements for payment

Shoulder (earthen/hard/paved), island and median construction shall be measured as finished work in position as below:

- i) For excavation in cu.m.
- ii) For earthwork/granular fill in cu.m.
- iii) For sub-base, base, surfacing courses in units as for respective items
- iv) For kerb in running metre; length of kerb for median shall be measured for each side separately.
- v) For turfing, shrubs and tile/slab finish in sq.m.

- vi) For brick/stone block edging in running metre, the length for brick/ stone block edging for median edging shall be measured for each side separately.

408.7rate

The Contract unit rate for shoulder (hard/paved/earthen with brick or stone block edging), island and median construction 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 applicable. The rate for brick/stone block edging shall include the cost of sand cushion

The payment will be made on [cmt](#) basis of the finished work

ITEM NO: 27 Granular sub base Grade 1 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 rotavator at OMC and compacting with vibratory roller to achieve the desired density complete. (As per technical specification clause-401) for Gr-1 Material

Scope: -

This work shall consist of laying and compacting natural sand, murrum, gravel, crushed stone 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 hereinafter) as necessary according to lines, grades and cross sections shown on the drawings or as directed by the Engineer.

Materials: -

The material to be used for the work shall be natural sand, murrum, gravel, crushed stone depending upon the grading required. Materials like crushed slag, crushed concrete brick metal & kanker may be allowed only with the specific approval of the Engineer.

Maximum particle size of the corresponding gradings for the natural sand, murrum, gravel, crushed stone materials are given at Table 400-2. The grading to be adopted for a project shall be as specified in the Contract.

Physical requirements: -

The materials shall have a 10 percent lines value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS:812(Part 111). The water absorption value of the coarse aggregate shall be determined as per IS: 2386 (Part 3), if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 383. For Grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 percent.

TABLE 400-2, GRADING FOR COARSE GRADED GRANULAR SUB-BASE MATERIALS

IS Sieve	Percent by weight passing the IS Sieve		
Designation	-----		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm		100	
26.5 mm	55-75	50-80	400
9.50 mm			
4.75 mm	10-30	15-35	25-45
2.36 mm			

0.425 mm			
0.075 mm	<10	<10	<10
CBR Value	30	25	20
(Minimum)			

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

Strength of sub-base: -

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished.

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

Construction Operations:

Preparation of subgrade: -

Immediately prior to laying of sub-base, the subgrade already finished to Clause 301 or 305 as applicable 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.

Spreading and compacting:

The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and 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.

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 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 8). 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 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 up to 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum or pad foot-drum or heavy pneumatic tired roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7 MN/m² or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional cross fall and super elevation and shall commence at the edges and progress towards the center for portions having cross fall 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 cross fall (Camber) shall be checked 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 at least 98 per cent of the maximum dry density for the material determined as per IS:2720 (Part 8). 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.

Surface Finish and Quality Control of Work: -

The surface finish of construction shall conform to the requirements of Clause 902.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

Arrangements for Traffic: -

During the period of construction, arrangement of traffic shall be maintained in accordance with clause 112.

Measurements for payment: -

During sub-base shall be measured as finished work in position in [cubic meters](#).

The protection of edges of natural sand, murrum, gravel, crushed stone 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.

RATE: -

The contract unit rate for natural sand, murrum, gravel, crushed stone shall be payment in full for carrying out the required operations including full compensation for

- (i) making arrangements for traffic to Clause 112 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, machineries, 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, 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.

404.1 SCOPE

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

404-2. Materials

404.2.1 Coarse aggregates

Coarse aggregates shall be either crushed or broken stone, crushed slag, overburnt (Jhama) brick aggregates or any other naturally occurring aggregates such as kankar and laterite of suitable quality. Materials other than crushed gravel / shingle is used, not less than 90 percent by weight of the gravel / shingle pieces retained on 4.75mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-8. The type and size range of the aggregate shall be 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 percent, the soundness test shall be carried out on the material delivered to site as per IS:2386 (Part-5).

**TABLE 400-8. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR
WATER BOUND MACADAM FOR SUB-BASE / BASE COURSES**

<u>S.No. Test</u>	<u>Test Method</u>	<u>Requirement</u>
1. *** Los Angeles	IS:2386	40 percent (Max)
Abrasion value	(Part-4)	
or		
Aggregate	IS: 2386	30 percent (Max)
Impact value	(Part-4) or <i>IS:5640*</i>	
2. Combined		
Flakiness and	IS:2386	30 percent (Max)
Elongation -	(Part- 1)	
Indices (Total)**		

* Aggregate which get softened in presence of water shall be tested for impact value under wet conditions in accordance with IS:5640.

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

*** In case water bound macadam is used for sub-base, the requirements in respect of Los Angeles Value and Aggregate impact value shall be relaxed to 50 percent and 40 percent maximum respectively.

404.2.2 Crushed or broken stone

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

404.2.3. Crushed slag :

Crushed slag shall be made from air-cooled blast furnace slag. It shall be of angular shape, reasonably uniform in quality and density and generally free from thin, elongated and soft pieces, dirt or other deleterious materials. The weight of crushed slag shall not be less than 11.2 kN per m³ and the percentage of glossy material shall not be more than 20. It should also comply with the following requirements:

- (i) Chemical stability : To comply with requirement of appendix of

- (ii) Sulphur content : Maximum 2 per cent
- (iii) Water absorption : Maximum 10 per cent

404.2.4. Overburnt (Jhama) Brick aggregates :

Jhama brick aggregates shall be made from overburnt bricks or brick bats and be free from dust and other objectionable and deleterious materials. This shall be used only for road stretch when traffic is low.

404.2.5. Grading requirement of Coarse aggregates :

The coarse aggregates shall conform to one of the Gradings given in Table 400-9 as specified.

404.2.6. Screenings:

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 murrum 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.

TABLE 400-9 : GRADING REQUIREMENTS OF COARSE AGGREGATES

Grading No.	Size Range	IS Sieve Designation	Per cent by weight passing
1.	63 mm to 45 mm	75 mm	100
		63 mm	90-100
		53 mm	25-75
		45 mm	0-15
		22.4 mm	0-5
2.	53 mm to 22.4 mm	63 mm	100
		53 mm	95-100
		45 mm	65-90
		22.4 mm	0-10
		11.2 mm	0-5

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

Screenings shall conform to the grading set forth in Table 400–10. The quantity of screenings required for various grades of stone aggregates are given in Table 400–11. The table also gives the quantities of materials (loose) required for 10 m² for sub-base / base compacted thickness of 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.

404.2.7 Binding Material :

Binding material to be used for water bound macadam as a filler material meant for preventing ravelling, 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 screening. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be $0.06 - 0.09 \text{ m}^3 / 10 \text{ m}^2$.

TABLE 400 – 10. 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
		9.5 mm	80-100
		5.6 mm	50-70
		180 micron	5-25

TABLE 400 – 11. APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS REQUIRED FOR 75 MM COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SUB-BASE / BASE COURSE FOR 10 M² AREA

Classification	Size Range	Compact thickness	Loose Qty.	Screenings			
				Stone screening		Crushable type such as murrum or gravel	
				Grading classification and size	For WBM sub-base / base course (loose Qty)	Grading classification and size	Loose Qty.
Grading 1	63mm to 45 mm	75 mm	0.91 to 1.07m ³	Type A 13.2 mm	0.12 to 0.15 m ³	No uniform	0.22 to 0.24 m ³
- do -	- do -	- do -	- do -	Type B 11.2 mm	0.20 to 0.22 m ³	- do -	- do -

Grading 2	53mm to 22.4 mm	75 mm	- do -	- do -	0.18 to 0.21 m3	- do -	- do -
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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 murrum 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 grade and camber and cleaned of dust, dirt and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained.

Where the WBM is to be laid on an existing metalled road, damaged area including depressions and potholes shall be repaired and made good with the suitable material. The existing surface shall be scarified and re-shaped to the required grade and camber before spreading the coarse aggregate for WBM.

As far as possible, laying water bound macadam course over an existing bituminous layer may be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous wearing course where water bound macadam is proposed to be laid over it.

404.3.2 Inverted Choke / Sub surface Drainage layer

If water bound macadam is to be laid directly over the subgrade, without any other intervening pavement course, a 25 mm course of screenings (Grading B) or coarse sand shall be spread on the prepared subgrade before application of the aggregates is taken up. In case of a fine sand or silty or clayey subgrade, it is advisable to lay 100 mm insulating layer of screening or coarse sand on top of Fine grained soil, the gradation of which will depend upon whether it is intended to act as a drainage layer as well. As a preferred alternative to inverted choke, appropriate geosynthetics performing functions of separation and drainage may be used over the prepared subgrade as directed by the Engineer. Section 700 shall be applicable for use of geosynthetics.

404.3.3 Lateral Confinement of Aggregates

For construction of WBM, arrangement shall be made for the lateral confinement of aggregates. This shall be done by building adjoining shoulders along with WBM layers. The practice of constructing WBM in a trench section excavated in the finished formation must be completely avoided.

Where the WBM course is to be constructed in narrow widths for widening of an existing pavement, the existing shoulders should be excavated to their full depth and width upto the sub grade level except where widening specifications envisages laying of a stabilised sub base using in situ operations in which case the same should be removed only upto the sub base level.

404.3.4 Spreading coarse aggregates:

The coarse aggregates shall be spread uniformly and evenly upon the prepared sub grade/sub-base/ in the required quantities from the stock piles to proper profile by using templates placed across the road about. 6 m apart, in such quantities that the thickness of each compacted layer is not more than 75 mm. In no case shall these be dumped in heaps directly on the area where there are to be laid nor shall their hauling over a partly completed base be permitted. 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.

No segregation of coarse aggregate shall be allowed and the coarse aggregates, as spread shall be of uniform gradation with no pockets of fine material.

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

Rolling:

Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 80 to 100 kN capacity or tandem or vibratory rollers of 80 to 100 kN static weight. The type of roller to be used shall be approved by the Engineer based on trial run.

Except on super elevated portions and carriageway with unidirectional cross-fall, where the rolling shall proceed from inner edge to the 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 inward parallel to the centre line of the road, in successive passes uniformly overlapping preceding tracks by at least one half width.

Rolling shall be carried out on courses where coarse aggregates of crushed / broken stone are used, till the road metal is partially compacted. This will be followed by application of screening and binding material where required in Clauses 404.3.6 and 404.3.7.

However, where screenings are not to be applied as in the case of aggregates like brick metal laterite and kankar for the sub base construction, the compaction shall be continued until the aggregates are thoroughly keyed. Rolling shall be continued and light sprinkling of water shall be done till the surface is well compacted. 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 with templates and longitudinally with 3 m. straight edge. Any irregularities exceeding 12mm shall be 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 depressions.

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

404.3.6 Application of screenings:

After the coarse aggregate have been rolled to Clause 404.3.5, 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 motion & of hand shovels or by mechanical spreaders or directly from tipper with suitable grit spreading arrangement Tipper operating for spreading the screenings shall be equipped with pneumatic tyres and operated so as not to disturb to coarse aggregates.

The screenings shall be applied at a slow and uniform rate (in three or more applications) 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 booming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation.

404.3.7 Sprinkling of water and grouting :

After application of screenings, 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 have 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 sub base or sub grade does not get damaged due to the addition of excessive quantities of water during construction.

In case of lime treated soil sub-base, construction of water bound macadam on top of it shall be taken up after curing as per Clause 402.3.9 and as directed by the Engineer.

Application of binding material : After the application of screenings in accordance with Clauses 404.3.6 and 404.3.7, 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 material 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 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 of Work

404.4.1 The surface finish of construction shall conform to the requirements of Clause 902.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

The water bound macadam work shall not be carried out when the atmospheric temperature is less than 10° 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. 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 re-compacted. The area treated shall not be less than 10 sq.m. 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 for traffic shall be done as per Clause 112.

404.6 Mode of Measurement & payment

Water bound macadam shall be measured as finished work in position in [cubic meters](#).

404.7 RATE

The Contract unit rate for water bound macadam sub-base/base course shall be payable in full for carrying out the required operations including full compensation for all components listed below including arrangement of water used in the work as approved by the Engineer.

- (i) Making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions;
- (ii) Supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts,
- (iii) All labour, tools, equipment and incidental to complete the work to the Specifications
- (iv) Carrying out the work in part widths of the road where required and
- (i) Carrying out the required tests for quality control.

ITEM NO: 29 Providing and laying plain cement concrete below Cement concrete pavement complete as per drawings and technical specifications as per sections 1500, 1700 and 2100 of MORTH. (M-15)

Specification as per Item No.02

The payment will be made on [cmt](#). basis of the finished work

ITEM NO: 30 Cement Concrete Pavement (Construction of un-reinforced, dowel jointed, plain cement concrete pavement over a prepared sub base with 53 grade cement @ 380 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)

Specification as per Item No.02

The payment will be made on [CMT](#). basis of the finished work

ITEM NO: 31 Providing and fixing "W" type metal beam crash safety barrier comprising of single row 3 mm thick galvanized sheet to be fixed on ISMC 150 (150 mm x 75 mm x 5.4 mm) series channel vertical post to be spaced 2.0 mtr c/c to be kept 1.65 mtr height including necessary foundation, fittings with bolts, painting and required all process as per specification and as per drawing.

GENERAL :

This work shall consist of furnishing and creation of metal beam crash barrier of dimensions and at locations as shown on the drawing (8) or as directed by the Engineer.

Metal beam crash barrier shall generally be located on approaches to bridge structures at locations where the embankment height is more than 3 meters and at horizontal curves.

1.2 MATERIALS:

1.2.1 Metal beam rail shall be corrugated sheet steel beams of the class, type, section and thickness indicated on the plans, Railing posts shall be made of steel of the sections, weight and length as shown on the plans. All complete steel rail element, terminal section, posts, bolts, nuts, hardware and other steel 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.

1.2.3 Concrete for bedding anchor assembly shall conform to section 1700 of Most specification for road and Bridgework (third revision) 1995.

1.3 CONSTRUCTION OPERATIONS:

1.3.1 The line and grade of railing shall be true to that shown on the plans. The railing shall be carefully adjusted prior to fixing in place to ensure proper matching at abutting joints and correct alignment and camber throughout their length. Holes for field connections shall be drilled with the railing in place in the structure at proper grade and alignment.

1.3.2 Unless otherwise specified on the drawing, railing steel posts and their beam shall be given one shop coat of paint (Primer) and three coats of paint on structural steel after erection. Any part of assembly below ground shall be painted with three coats of red lead paint.

1.3.3. Splices and end connections shall be of the type and designs specified or shown on the plans and shall be of such strength as to develop full design strength of the rail elements.

1.4 INSTALLATION POSTS :

1.4.1 Holes shall be dug or drilled to the depth indicated on the plans or posts may be driven by approved methods and equipments, provided these are erected in proper position and free from distortions and burring or any other damage.

1.4.2 All post holes that are dug or drilled shall be of such size as will permit proper setting of the posts and allow sufficient room for back filling and topping.

1.4.3 Holes shall be backfilled with selected earth of stable materials in layers not exceeding 100mm thickness and each layer shall be thoroughly tamped and rammed. When back filling and tamping are completed. The posts or anchors shall be held securely in place.

1.4.4 Post holes that are drilled in rock and holes for anchor posts shall be back filled with concrete M.15.

1.4.5. Posts of metal beam guardrails on bridges shall be bolted to the structure as detailed on the plans. The anchor bolts shall be set to proper location and elevation with templates and carefully checked.

1.5 ERECTIONS :

1.5.1 All guard rail anchors shall be set and attachments made and placed as indicated on the plans or as directed by the engineer.

1.5.2. 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 6mm 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.

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

1.6 TOLERANCE :

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

MEASUREMENT AND PAYMENT :

1.7.1 Steel guard railing (three type earth barriers) shall be measured by Linear meter or completed length as per plans and accepted in place.

No measurement for payment shall be made for proportion or anchor beyond the end posts except soled above furnishing and placing anchor book and or devices for guard rail posts on bridges shall be considered incidental to the construction and the costs there of shall be included in the price for other items of construction.

No measurement for pavement will be made for excavation or back filing performed in connection with this constructing.

1.8 RATE :

The contract unit rate shall include full compensation for furnishing or labour, materials, tools equipments and incidental costs necessary for doing all the work involved in constructing the metal beam – railing barrier complete in place in all respects as per these specifications. The payment shall be made on Rmt.

ITEM NO: 32 Village name/ Bump Ahead sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 60cms. rectangle as as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50 x 50 x 5mm painted with best quality 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 block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade

The specification of **Item No. 20** shall be followed for the execution of this item except the size of **Village Name SIGN board** As Per Item Description.

Use Engineer Grade Retro Reflective sheet as per instruction of EIC.

The Measurement & Payment shall be made of No. Basis

ITEM NO: 33 Supplying Raised Pavement Markers made of polycarbonate and ABS moulded body and reflective panels 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 D 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.

General

The colour, configuration, size and location of Cat eye reflector for highways other than Expressways shall be in accordance with the code of Practice for Road Signs, IRC:67 or as shown on the drawings or as directed by the Engineer.

The Cat eye reflector shall be reflectorised as shown on the drawings or as directed by the Engineer. It shall be of retro-reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 801.3, fixed over aluminium sheeting as per these specifications.

In general, cautionary and mandatory signs shall be fabricated through process of screen printing. In regard to informatory signs with inscriptions, either the message could be printed over the reflective sheeting, or cut letters of non-reflective black sheeting used for the purpose which must be bonded well on the base sheeting as directed by the Engineer.

1.2 Materials:

The various materials and fabrication of the Cat eye reflector shall conform to the following requirements.

The adhesive materials shall be of standard quality and it shall be high resistance quality against heavy moving vehicles.

The materials shall be used for the body of the Cat eye reflector is of high-density PVC materials.

The dimensions and size of the Cat eye reflector shall be as per IS standard. The retro- reflective sheeting used on the cat-eye shall consist of the white or colored 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 these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

High intensity grade sheeting's: This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent water-proof plastic having a smooth surface. 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 Standard E:810).TABLE 800.1

ACCEPTABLE MINIMUM CO-EFFICIENT OF RETRO-REFLECTIONFORHIGHINTENSITYGRADESHEETING

[CANDEL AS PER LUX PER SQUARE METRE]

Observation (in degree)	Entrance angle (in degree)	White	Yellow	Orange	Green/ Red	Blue
0 .2	-4	250	170	100	45	20
2	+ 30	150	100	60	25	1.1
0. 5	- 4	95	62	30	15	7.5
5	+ 30	65	45	25	10	5.0

When totally wet, the sheeting shall not show less than 90 percent of the values of retro reflective indicated in Table 800-1. At the end of 7 years, the sheeting shall retain at least 75 percent of its original retro-reflectance.

Engineer grade sheetings : This sheeting shall be of enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water proof plastic, resulting in a non-exposed lens optical reflecting system. 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 Standard E:810) as indicated in Table 800.2.

TABLE 800.2

**ACCEPTABLE MINIMUM CO-EFFICIENT OF
RETRO-REFLECTION FOR HIGH INTENSITY GRADE SHEETING**

[CANDEL AS PER LUX PER SQUARE METRE]

Observation (in degree)	Entrance angle (in degree)	White	Yellow	Orange	Green	Red	Blue
0.2	-4	70	50	25	9.0	14.5	4.0
0.2	+ 30	30	22	7.0	3.5	6.0	1.7
0.5	-4	30	25	13.5	4.5	7.5	2.0
0.5	+ 30	15	13	4.0	2.2	3.0	0.8

When totally wet, the sheeting shall not show less than 90 percent of the values of retro reflective indicated in Table 800-2. At the end of 5 years, the sheeting shall retain at least 50 percent of its original retro-reflectance.

1.3 Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning, show no appreciable discolouration, cracking, blistering or dimensional change and shall not have less than 50 percent of the specified minimum reflective intensity values (Table 800-1 and 800-2) when subjected to accelerated weathering for 1000 hours, using type E or EH Weatherometer (AASHTO Designation M 268).

1.4 INSTALLATION:

The Cat eye (stimsonite) reflector shall be installed directly on road surface, after cleaning completely by removing all dust and other foreign materials from the surface of the road.

1.5 MEASUREMENT FOR PAYMENT:

The measurement shall be in numbers, these shall be measured in No.

1.6 RATE :

The Contract unit rate shall be payment in full for the cost of making Cat-Eye, including all materials, installing it at the site and incidentals to complete the work in accordance with the specifications.

ITEM NO: 34 Road marking with hot applied thermoplastic paints with reflectorising glass beads on bitumin surface providing and laying a hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250gms per sqm area, thickness of 2.5mm is excluding of surface applied glass beds 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 the Retro reflectivity should be two years.

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.

803.4 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 O36/BS-3262-(Part I), shall be as below:

a) Luminance:

White: Daylight luminance at 45°-65 percent min. as per AASHTO M249

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°C ± 9.5°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.

i) **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.

ii) **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 manufacturer
- 4) Colour (White or Yellow)
- 5) Maximum application temperature and maximum safe heating temperature

iii) 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 reflectorized pavement marking. 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, colorless and free from milky, dark particles and excessive air inclusions. These shall conform to the requirements spelt out in Clause 803.4.2.3.

803.4.2.3 Specification 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

	Percent Retained	
Sieve Size	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 desiccator which is filled within 25 mm of the top of a desiccator plate with sulphuric acid water solution (specific gravity 1.10). Cover the desiccator and let it stand for 4 hours at 20°C to 29°C. Remove sample from desiccator, 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 screened / 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, the material upon heating to application temperatures shall not exude fumes.

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 Reflectorised Paint

Reflectorised 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 IS: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 up to 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).

803.6.9 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: 35 Supplying and fixing reinforced concrete heavy duty nonpressure 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.(v) 900mm dia.

SCOPE

This work shall consist of furnishing and installing reinforced cement concrete pipes, of the type, diameter and length as per design and details and at locations shown on the drawings or as ordered by the Engineer and in accordance with the requirements of these Specifications.

MATERIALS

Each consignment of cement concrete pipes shall be inspected, tested, if necessary and approved by the Engineer either at the place of manufacture or at the site before their incorporation in the works.

EXCAVATION FOR PIPE

The foundation bed for pipe culverts shall be excavated true to the lines and grades shown on the drawings or as directed by the Engineer. The pipes shall be placed in shallow excavation of the natural ground or in open trenches cut in existing

embankments, taken down to levels as shown on the drawings. In case of high embankments where the height of fill is more than three times the external diameter of the pipe, the embankment shall first be built to an elevation above the top of the pipe equal to the external diameter of the pipe, and to width on each side of the pipe of not less than five times the diameter of pipe, after which a trench shall be excavated and the pipe shall be laid.

Where trenching is involved, its width on either side of the pipe shall be a minimum of 150 mm or one-fourth of the diameter of the pipe whichever is more and shall not be more than one-third the diameter of the pipe. The sides of the trench shall be as nearly vertical as possible.

The pipe shall be placed where the ground for the foundation is reasonably firm. Installation of pipes under existing bridges or culverts shall be avoided as far as possible. When during excavation the material encountered is soft, spongy or other unstable soil, and unless other special construction methods are called for on the drawings or in special provisions, such unsuitable material shall be removed to such depth, width and length as directed by the Engineer. The excavation shall then be backfilled with approved granular material which shall be properly shaped and thoroughly compacted upto the specified level.

Where bed-rock or boulder strata are encountered, excavation shall be taken down to atleast 200 mm below the bottom level of the pipe with prior permission of the Engineer and all rock/boulders in this area be removed and the space filled with approved earth, free from stone or fragmented material, shaped to the requirements and thoroughly compacted to provide adequate support for the pipe.

Trenches shall be kept free from water until the pipes are installed and the joints have hardened.

BEDDING FOR PIPE

The bedding surface shall provide a firm foundation of uniform density throughout the length of the culvert, shall conform to the specified levels and grade, and shall be of one of the following two types as specified on the drawings :

- i) **First Class Bedding:** Under first class bedding, the pipe shall be evenly bedded on a continuous layer of well compacted approved granular material, shaped concentrically to fit the lower part of the pipe exterior for atleast ten percent of its overall height or as otherwise shown on the drawings. The bedding material shall be well graded sand or another granular material passing 5.6 mm sieve suitably compacted/rammed. The compacted thickness of the bedding layer shall be as shown on the drawings and in no case shall it be less than 75 mm.
- ii) **Concrete Cradle Bedding :** When indicated on the drawings or directed by the Engineer, the pipe shall be bedded in a cradle constructed of concrete having a mix not leaner than M 15 conforming to Section 1700. The shape and dimensions of the cradle shall be as indicated on the drawings. The pipes shall be laid on the concrete bedding before the concrete has set.

LAYING OF PIPE

No pipe shall be laid in position until the foundation has been approved by the Engineer. 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 a minimum of 450 mm. The arrangement for lifting, loading and unloading concrete pipes from factory/yard and at site shall be such that the pipes do not suffer any undue structural strain, any damage due to fall or impact. The arrangement may be got approved by the Engineer.

Similarly, the arrangement for lowering the pipe in the bed shall be got approved by the Engineer. it may be with tripod-pulley arrangement or simply by manual labour in a manner that the pipe is placed in the proper position without damage.

The laying of pipes on the prepared foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. In case of use of pipes with bell-mouth, the belled end shall face upstream. The pipes shall be fitted and matched so that when laid in work, they form a culvert with a smooth uniform invert.

Any pipe found defective or damaged during laying shall be removed at the cost of the Contractor.

JOINTING

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 between 13 and 20 mm according to the diameter of the pipe. Caulking material 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 center coincides with the joint and an even annular space is left between the collar and the pipe.

Flush joint may be internal flush joint or external flush joint. In either case, the ends of the pipes shall be specially shaped to form a self centering joint with a jointing space 13 mm wide. The jointing space shall be filled with cement mortar, 1 cement to 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.

For jointing pipe lines under light hydraulic pressure, the recess at the end of the pipe shall be filled with jute braiding dipped in hot bitumen or other suitable approved compound. Pipes shall be so jointed that the bitumen ring of one pipe shall set into the recess of the next pipe. The ring shall be thoroughly compressed by jacking or by any other suitable method.

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.

BACK FILLING

Trenches shall be backfilled immediately after the pipes have been laid and the jointing material has hardened. The backfill soil shall be clean, free from boulders, large roots, excessive amounts of sods or other vegetable matter, and lumps and shall be approved by the Engineer. Backfilling upto 300 mm above the top of the pipe shall be carefully done and the soil thoroughly rammed, tamped or vibrated in layers not exceeding 150 mm, particular care being taken to thoroughly consolidate the materials under the haunches of the pipe. Approved pneumatic or light mechanical tamping equipment can be used.

Filling of the trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur.

In case of high embankment, after filling the trench upto the top of the pipe in the above said manner, a loose fill of a depth equal to external diameter of the pipe shall be placed over the pipe before further layers are added and compacted.

OPENING TO TRAFFIC

No traffic shall be permitted to cross the pipes unless height of filling above the top of the pipes is atleast 600 mm.

MEASUREMENTS FOR PAYMENT

RCC pipe shall be measured as complete work in Running metres along its length between the inlet and outlet ends.

RATE

The Contract unit rate for the RCC pipe shall include the cost of pipes including loading, unloading, hauling, handling, storing, laying in position and jointing and all ancillary works such as excavation, bedding for pipes, backfilling, and incidental costs to complete the work as per these specifications

ITEM NO: 36 Providing & laying tack coat with VG 30 grade bitumen with spray set fitted on mechanical bouzer at the rate of 4 Kg./10 Sqm. On WBM surface incl. cleaning the surface 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.

502.2. Materials

502.2.1. Primer: The choice of a bituminous primer shall depend upon the porosity characteristics of the surface to be primed as classified in IRC: 16. These are:

- (i) Surfaces of low porosity, such as wet mix macadam and water bound macadam,
- (ii) Surfaces of medium porosity; such as cement stabilised soil base,
- (iii) Surfaces of high porosity; such as a gravel base.

502.2.2. Primer viscosity: The type and viscosity of the primer shall comply with the requirements of IS 8887, as sampled and tested for bituminous primer in accordance with these standards. Guidance on viscosity and rate of spray is given in Table 500-1.

**TABLE 500-1 VISCOSITY REQUIREMENT AND QUANTITY OF LIQUID
BITUMINOUS PRIMER**

Type of surface	Kinematics Viscosity of	Quantity of Liquid
	Primer at 60°C	Bituminous Material
	(Centistokes)	Per 10 Sq.m./Kg
Low porosity	30-60	6 To 9
Medium porosity	70-140	9 To 12
High porosity	250-500	12 To 15

502.2.3. Choice of primer: The primer shall be bitumen emulsion, complying with IS 8887 (slow setting) of a type and grade as specified in the Contract or as directed by the Engineer. The use of medium curing cutback as per IS 217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer.

502.3. Weather and Seasonal Limitations

Bituminous primer shall not be applied to a wet surface (see 502.4.2) or 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. Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present.

502.4. Construction

502.4.1. Equipment: The primer distributor shall be a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at specified rates and temperatures. Hand spraying of small areas, inaccessible to the distributor or in narrow strips shall be sprayed with a pressure hand sprayer or as directed by the Engineer.

502.4.2. Preparation of road surface: The surface to be primed shall be prepared in accordance with Clauses 501.8 and 902 as appropriate. Immediately prior to applying the primer the surface shall be carefully swept clean of dust and loose particles, care being taken not to disturb the interlocked aggregate. This is best achieved when the

surface layer is slightly moist (lightly sprayed with water and the surface allowed to dry) and the surface should be kept moist until the primer is applied.

502.4.3. Application of bituminous primer : The viscosity and rate of application of the primer shall be as specified in the Contract, or as determined by site trials carried out as directed by the Engineer. Where a geosynthetic is proposed for use, the requirements of Clauses 703.3.2 and 703.4 shall apply. The bituminous primer shall be sprayed uniformly in accordance with Clause 501. 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.

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 period as is found to be necessary to allow all the volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with an 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. A very thin layer of clean sand may be applied to the surface of the primer, to prevent the primer picking up under the wheels of the paver and the trucks delivering bituminous material to the paver.

502.4.5. Tack coat: Over the primed surface, a tack coat should be applied in accordance with Clause 503.

502.5. Quality Control of Work

For control of the quality of materials supplied 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.

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 with adjustments as described in Clause 502.7 shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8 (i) to (v) 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 **4 kg per 10 square meter**, with adjustment, plus or minus, for the variation between this amount and the actual amount approved by the Engineer after the preliminary trials referred to in Clause 502.4.3.

ITEM NO: 37 Providing & laying 20mm thick premix seal surfacing using specified graded machine crushed aggregates with VG-30 grade bitumen at the rate of 5.1 Yo i.e. 51.0 Kg/ M.T. by weight mix including heating & mixing in drum mix plant transporting the mix spreading the same by paver finisher and consolidation by vibratory roller as per MORT&H specification including cost of all materials fuel, labours, tools and plant etc. comp. and flushind sand @ rate of 0.30 cmt / 100 smt.(typeB)

512.1. Scope

512.1.1. This work shall consist of the preparation, laying and compaction of a close graded premix surfacing material of **20 mm thickness** composed of graded aggregates premixed with a bituminous binder on a previously prepared surface in accordance with the requirements of these Specifications, to serve as a wearing course.

512.1.2. Close graded premix surfacing shall be of Type A or Type B as specified in the Contract documents.

512.2. Materials

512.2.1. Binder: The binder shall be bitumen of a suitable viscosity grade **VG-30 (80/100)** as specified in the Contract, or as directed by the Engineer, and satisfying the requirements of IS: 73.

Viscosity Grade (VG) Bitumen Specification as per IS 73 : 2006

Characteristics	VG-10	VG-20	VG-30	VG-40
Absolute Viscosity 60°C, poises, min	800	160 0	240 0	320 0
Kinematics Viscosity 135°C CSI, min	250	300	350	400
Flash point, C, min	220	220	220	220
Solubility in trichloroethylene, % min	99.0	99.0	99.0	99.0
Penetration at 25°C	80-100	60-80	50-70	40-60
Softening point, C min	40	45	47	50
Test on residue from thin film oven test / RTFOT:				
(A) Viscosity ration at 60°C, max	4.0	4.0	4.0	4.0
(B) Ductility at 25°C, cm, min after thin film over test	75	50	40	25

Coarse aggregates: 504.2.2.1. The aggregates shall consist of crushed stone, crushed gravel/shingle or other stones. They shall be clean, strong, durable, of fairly cubical shape and free from disintegrated pieces, organic or other deleterious matter and adherent coating. If crushed shingle/gravel is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall preferably be hydrophobic and of low porosity. If hydrophilic aggregates are to be used, the bitumen shall preferably be treated with anti-stripping agents of approved quality in suitable dose as per *Appendix-5*. The aggregates shall satisfy the physical requirements set forth in Table 500-3.

**TABLE 500-3. PHYSICAL REQUIREMENTS OF AGGREGATES FOR
BITUMINOUS MACADAM**

S. No.	Test	Test Method	Requirement
1	Los Angeles Abrasion Value	IS:2386 (Part - 4)	40 percent Maximum
2	Aggregate Impact Value*	-do-	30 percent Maximum
3	Flakiness and Elongation	IS: 2386 (Part - 1)	30 percent (combined)
Indices (Total)			

4	Coating and Stripping of Bitumen Aggregate	AASHTO T 182 Minimum retained Mixtures coating	95 per cent
5	Soundness:	IS: 2386 (Part - 5)	
	(i) Loss with Sodium Sulphate 5 cycles		12 percent Maximum
	(ii) Loss with Magnesium Sulphate 5 cycles		18 per cent Maximum
6	Water absorption	IS: 2386(Part - 3)	1 per cent Maximum

***Aggregates may satisfy requirements for either of the two tests.**

Note: If crushed slag is used, Clause 404.2.3 shall apply.

512.2.3. Fine aggregates: The fine aggregates shall consist of crushed rock quarry sands, natural gravel / sand or a mixture of both. These shall be clean, hard, durable, un-coated, mineral particles, dry and free from injurious, soft or flaky particles and organic or deleterious substances.

512.2.4. Aggregate gradation.: The coarse and fine aggregates shall be so graded or combined as to conform to one or the other grading shown in Table 500-26, as specified in the contract.

TABLE 500-26. AGGREGATE GRADATION

IS Sieve	Cumulative per cent by weight of	
Designation	Total aggregate passing	
(mm)	Type A	Type B
13.2 mm	-	100
11.2 mm	100	88- 100
5.6 mm	52 - 88	31 - 52
2.8 mm	14 - 38	5 - 27
0.090 mm	0 - 5	0- 5

512.2.5. Proportioning of materials: The total quantity of aggregates used for Type A or B close-graded premix surfacing shall be 0.27 cubic metre per 10 square metre area. The quantity of binder used for premixing in. terms of straight-run bitumen shall be 22.0 kg and 19.40 kg per 10 Square metre area for Type A and Type B surfacing respectively.

512.3. Construction Operations

501.5.1. Weather and seasonal limitations: Laying shall be suspended while free standing water is present on the surface to be covered or during rain, fog and dust storms. After rain, the bituminous surface, prime or tack coat, be blown off

with a high pressure air jet to remove excess moisture or the surface left to dry before laying shall start Laying of bituminous mixtures shall not be carried out when the air temperature at the surface on which it is to be laid is below 10⁰C or when the wind speed at any temperature exceeds 40 km/h at 2m height unless specifically approved by the Engineer.

501.5.2. Cleaning of surface: The surface on which the bituminous work is to be laid shall be cleaned of all loose and extraneous matter by means of a mechanical broom or any other approved equipment / method as specified in the contract. The use of a high-pressure air jet from a compressor to remove dust or loose matter shall be available full time on the site, unless otherwise specified in the Contract.

501.53. Spreading: 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 the paver and its of operations, 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 levelled 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 145⁰C 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:

- (i) For laying regulating courses of irregular shape and varying thickness.
- (ii) In confined spaces where it is impracticable for a paver to operate.
- (iii) For footways.
- (iv) At the approaches to expansion joints at bridges, viaducts or other structures.
- (v) For laying mastic asphalt in accordance with Clause 515.
- (vi) For filling of potholes.
- (vii) 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.

501.5.4. Cleanliness and overlaying: Bituminous material shall be kept clean and uncontaminated. The only traffic permitted to run on bituminous material to be overlaid shall be that engaged in laying and compacting the next course or, where a binder course is to be sealed or surface dressed, that engaged on such surface treatment. Should any bituminous material become contaminated the Contractor shall make it good to the satisfaction of the Engineer, in compliance with Clause 501.8.

Binder course material shall not remain uncovered by either the wearing course or surface treatment, whichever is specified in the Contract, for more than three consecutive days after being laid. The Engineer may extend this period, by the minimum amount of time necessary, because of weather conditions or for any other reason. If the surface of the base course is subjected to traffic, or not covered within three days, a tack coat shall be applied, as directed by the Engineer.

Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature. Excessive traffic speeds should not be permitted.

512.7. Measurements for Payment

Close graded premix surfacing, Type A shall be measured as finished work, for the area specified to be covered, in square meters at a specified thickness. The area will be the net area covered, and all allowances for wastage and cutting of joints shall be deemed to be included in the rate.

The measurement shall be all measures for finished work on weight base in Metric Tonne.

512.8. Rate

The contract unit rate for close graded premix surfacing, Type A shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2. (i) to (xi).

501.8.8.2. Rate for premixed bituminous material: The contract unit rate for premixed bituminous material shall be payment in full for carrying out the required operations including full compensation for, but not necessarily limited to:

- (i) Making arrangements for traffic to Clause 112 except for initial ant to verge. shoulders and construction of diversions;
- (ii) Preparation of the surface to receive the material.
- (iii) Providing all materials to be incorporated in the work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lift.
- (iv) Mixing, transporting, laying and compacting the mix, as specified.
- (v) All labor, tools, equipment, plant including installation of drum mix plant power supply units and all machinery, incidental to complete the work to these Specifications;
- (vi) Carrying out the work in part widths of the road where directed;
- (vii) Carrying out all tests for control of quality; and
- (viii) 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 payment will be adjusted accordingly.
- (ix) The rates for premixed material are to include for all wastage in cutting of joints etc.

(x) 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.

(xi) 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 material.

ITEM NO: 38 Diversion sign board :-Providing & Fixing sign boards made out of 2mm aluminium sheet, size 180 x 60 cms. rectangle as per the attached drawing pre treated with phospheting process & acid etching. coated with one coat of epoxy priemr and two coats of best quality epoxy paint reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968,3.1m long (2nos) stand post and frame fabricated from iron angle of 35x35x3mm, 50x50x5mm painted with best quality epoxy coatings in blak and white bends. The fixing at site shall be in 1:2:4 CC block of size 45 x 45x 60cms for each leg, including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR).

The specification of **Item No. 20** shall be followed for the execution of this item except the size of Diversion **Sign board** As Per Item Description.

Use Engineer Grade Retro Reflective sheet as per instruction of EIC.

The Measurement & Payment shall be made of No. Basis.

ITEM NO: 39 Informatory Signs :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 80 x 60cms. rectangle as per the design of IRC-67-1977 pre treated with phospheting process & acid teching; coated with one coat of epoxyprimer and two coats of best qualityepoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand postand frame fabricated from suitable size iron angle of 35 x 35 x 3mm75x75x6mm as required; painted with best qualityepoxy coatings in black and whitebends. the details of symbol for eachboard shall details of symbol for eachboard 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 x45 x 60cms. for each leg. including excavation curing tec. complete under the supervision of engineer in charge.(A) Engineer Grade(VR).

The specification of **Item No. 20** shall be followed for the execution of this item except the size of **informatory Sign board** As Per Item Description.

Use Engineer Grade Retro Reflective sheet as per instruction of EIC.

The Measurement & Payment shall be made of No. Basis.

**Executive Engineer
R.& B. (P) Division
Ahmedabad**