

Name of Work: - Pamol Khadol Road Km 0/00 to 4/200 (FDR, Asphaltic Work, CC Road, Structure Work, Road Furniture & Miscellaneous work) - CRIF Work-2025-26

DETAIL ITEM SPECIFICATION

Item No.: - 02.

Providing and laying 50 mm thick Bituminous Macadam (BM) with B.T. aggregate as per MORT&H specification & using bitumen VG-30 for tack coat @ 2.50 KG / 10 Sqm with mechanical sprayer & bitumen VG-30 for mixing @ 34.00 KG / M.T. i.e., 3.40 % of total weight of mix, including heating and mixing the aggregate & asphalt in drum mix plant and hot laid process spreading the same by paver finisher & consolidation with vibratory roller as per MORT&H specification to achieve desire density, including providing all materials equipments, tools & plants, fire wood, oil, kerosene, labour charges etc. complete using contractor's own machinery drum mix plant & paver finisher etc. complete.

504 BITUMINOUS MACADAM

504.1 Scope

This work shall consist of construction in a single course having 50 mm to 100 mm thickness or in multiple courses of compacted crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these Specifications. Since the bituminous macadam is an open-graded mix, there is a potential that it may trap water or moisture vapour within the pavement system. Therefore, adjacent layer (shoulders) should have proper drainage quality to prevent moisture-induced damage to the BM.

504.2 Materials:

504.2.1 Bitumen

The bitumen shall be viscosity graded paving bitumen complying with Indian Standard Specification for paving bitumen, IS: 73 or as specified in the Contract. The type and grade of bitumen to be used would depend upon the climatic conditions and the traffic. Guidelines for selection of bitumen are given in Table 500-1.

504.2.2 Coarse aggregates

The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. It shall be clean, hard, durable and cubical shape, free from dust and soft organic and other deleterious substances. The aggregate shall satisfy the physical requirements specified in Table 500-6. Where crushed gravel is proposed for use as aggregate, not less than 90 percent by weight of the crushed material retained on 4.75 mm sieve shall have at least two fractured faces resulting from crushing operation. Before approval of the source, the aggregates shall be tested for stripping. Where the Contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with approved anti-stripping agents, as per the manufacturer's recommendations, without additional payment.

504.2.3 Fine aggregates

Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of two, passing 2.36 mm sieve and retained on 75-micron sieve. It shall be clean, hard, durable, free from dust and soft organic and other deleterious substances. Natural sand shall not be used in the binder course.

Table 500-6: Physical Properties of Coarse Aggregate

Property	Test	Requirement	Test method
Cleanliness	Grain size analysis	Max. 5% passing 0.075 micron	IS: 2386 Part I
Particle shape	Combined Flakiness and Elongation Indices	Max. 35%	IS: 2386 Part I
Strength	Los Angeles Abrasion Value or	Max. 40%	IS: 2386 Part IV
	Aggregate Impact Value	Max. 30%	IS: 2386 Part IV
Durability	Soundness (Sodium or Magnesium)	5 cycles	IS: 2386 Part V IS: 2386 Part V
	Sodium Sulphate	Max. 12%	
	Magnesium Sulphate	Max. 18%	
Water absorption	Water absorption	Max. 2%	IS: 2386 Part III
Stripping	Coating and Stripping of Bitumen Aggregate	Min. Retained Coating 95%	IS: 6241
Water sensitivity	Retained Tensile strength*	Min. 80%	AASHTO 283

* If the minimum retained tensile strength falls below 80 percent, use of anti-stripping agent is recommended to meet the minimum requirements

504.2.4 Aggregate grading and binder content

The combined grading of the coarse aggregates and fine aggregates, when tested in accordance with IS: 2386 Part 1, wet sieving method, shall conform to limits given in Table 500-8. The type and quantity of bitumen and appropriate thickness is also given in Table 500-7.

504.2.5 Proportioning of material

The combined aggregate grading shall not vary from the lower limit on one sieve to the higher limit on the adjacent sieve to avoid gap grading. The aggregate may be proportioned and blended to produce a uniform mix complying with the requirements in Table 500-7. The binder content shall be within a tolerance of + 0.3 percent by weight of total mix when individual specimens are taken for quality control tests in accordance with the provisions of Section 900.

504.3 Construction Operations

504.3.1 Weather and seasonal limitations

The provisions of Clause 501.5.1 shall apply.

Table 500-7: Aggregate Grading and Bitumen Content

Grading	1	2
Nominal maximum aggregate size*	40 mm	19 mm
Layer thickness	80-100 mm	50-75 mm
IS Sieve size (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	90-100	
26.5	75-10	100
19	-	90-100
13.2	35-61	56-88
4.75	13-22	16-36
2.36	4-19	4-19
0.3	2-10	2-10
0.075	0-8	0-8
Bitumen content** percent by mass of total mix	3.3**	3.4**

* Nominal maximum aggregate size is the largest specified sieve size upon which any of the aggregate material is retained.

** Corresponds to specific gravity of the Aggregate being 2.7. In case aggregates have specific gravity more than 2.7, bitumen content can be reduced proportionately. Further, for regions where highest daily mean air temperature is 30° C or lower and lowest daily mean air temperature is -10° C or lower, the bitumen content may be increased by 0.5 percent.

504.3.2 Preparation of the base

The base on which bituminous macadam is to be laid shall be prepared, shaped and compacted to the required profile in accordance with Clauses 501.8 and 902.3 as appropriate, and a prime coat, shall be applied in accordance with Clause 502 where specified, or as directed by the Engineer. The surface shall be thoroughly swept clean by a mechanical broom, and the dust removed by compressed air. In locations where mechanical broom cannot get access, other approved methods shall be used as directed by the Engineer.

504.3.3 Tack coat

A tack coat in accordance with Clause 503 shall be applied as required by the Contract documents, or as directed by the Engineer.

504.3.4 Preparation and transportation of the mixture

The provisions of Clauses 501.3 and 501.4 shall apply.

504.3.5 Spreading

The provisions of Clauses 501.5.3 shall apply.

504.3.6 Rolling

Compaction shall be carried out in accordance with the provisions of Clauses 501.6 and 501.7.

Rolling shall be continued until the specified density is achieved, or where no density is specified, until there is no further movement under the roller. The required frequency of testing is defined in Clause 903.

504.4 Surface Finish and Quality Control of Work

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

504.5 Protection of the Layer

The bituminous macadam shall be covered with either the next pavement course or wearing course, as the case may be, within a maximum of forty-eight hours. If there is to be any delay, by the Contractor the course shall be covered by a seal coat to the requirement of Clause 512 before opening to any traffic. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

504.6 Arrangements for Traffic

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

504.7 Measurement for Payment

Bituminous macadam shall be measured as finished work in cubic meters, or by weight in metric tonnes, where used as regulating course, or square meters at the specified thickness as indicated in the Contract or shown on the drawings, or as otherwise directed by the Engineer.

504.8 Rate

The contract unit rate for bituminous macadam shall be payment in full for carrying out the required operations as specified. The rate shall include cost for all components listed in Clause 501.8.8.2.

The payment will be made on M.T. basis of the finished work.

Item No.: - 03,

Providing and laying 25 mm thick Semi Dense Bituminous Concrete (SDBC) with B.T. aggregate as per MORT&H gradation using bulk bitumen Grade VG-30 for mixing @ 50.00 KG / M.T. i.e., 5.0 % by weight of total mix, including heating and mixing the aggregates and bitumen in drum mix plant and hot laid process laying with paver finisher and consolidation with roller as per MORT&H specification to achieve desire density, including cost of all materials, equipments, tools, and plants, fire wood, oil, kerosene, labour charges etc. complete using contractor's own machineries drum mix plant and paver finisher etc. complete.

508 SEMI-DENSE BITUMINOUS CONCRETE

508.1. Scope

This clause specifies the construction of Semi Dense Bituminous Concrete, for use in wearing / binder and profile corrective courses. This work shall consist of construction in a single or multiple layers of semi dense bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 25 mm to 100 mm in thickness.

508.2. Materials

508.2.1. Bitumen:

The bitumen shall be paving bitumen of Penetration grade complying with Indian Standard Specification for Paving Bitumen, IS: 73 and of the penetration indicated in Table 500-15, for semi

dense bituminous concrete, or this bitumen as modified by one of the methods specified in Clause 52 1, or as otherwise specified in the Contract. Guidance on the selection of an appropriate grade of bitumen is given in The Manual for Construction and Supervision of Bituminous Works.

508.2.2. Coarse aggregates:

The coarse aggregates shall be generally as specified in Clause 507.2.2, except that the aggregates shall satisfy the physical requirements of Table 500-14.

508.2.3. Fine aggregates:

The fine aggregates shall be all as specified in Clause 507.2.3.

508.2.4. Filler:

Filler shall be generally as specified in Clause 507.2.4. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-14 then 2 per cent by total weight of aggregate, of hydrated lime shall be added without additional cost.

508.2.5. Aggregate grading and binder content:

When tested in accordance with IS 2386 Part I (Wet sieving method), the combined grading of the coarse and fine aggregates and added filler shall fall within the limits shown in Table 500-15 for gradings 1 or 2 as specified in the Contract.

508.3. Mixture Design

508.3.1. Requirements for the mixture:

Apart from conformity with the grading and quality requirements for individual ingredients the mixture shall meet the requirements set out in Table 500-16.

TABLE 500-14: PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR SEMI DENSE BITUMINOUS CONCRETE PAVEMENT LAYERS

Property	Test	Specification
Cleanliness (Dust)	Grain size analysis ¹	Max. 5 % passing 0.075 mm sieve
Particle shape	Flakiness and Elongation Index (Combined) ²	Max. 30 %
Strength*	Los Angeles Abrasion Value ³	Max. 35 %
	Aggregate Impact Value ⁴	Max. 27 %
Polishing	Polishing Stone Value ⁵	Min. 55
Durability	Soundness ⁶	
	Sodium Sulfate Magnesium Sulfate	Max. 12 % Max. 18 %
Water Absorption	Water Absorption ⁷	Max. 2%
Stripping	Coating and Stripping of Bitumen aggregate Mixtures ⁸	Min. retained coating 95 %
Water Sensitivity **	Retained Tensile Strength ⁹	Min. 80 %

Notes: 1. IS: 2386 Part 1 6. IS: 2386 Part 5
 2. IS: 2386 Part 1 7. IS: 2386 Part 3
 (The elongation test to be done only on non-flaky aggregates in the sample)
 3. IS: 2386 Part 4* 8. AASHTO: 283**
 4. IS: 2386 Part 4* 9. IS: 6241
 5. BS: 812 Part 114

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

** The water sensitivity test is only required if the minimum retained coating in the stripping test is less than 95%.

The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table 500-12.

508.3.2. Binder content: The binder content shall be optimized to achieve the requirements of the mixture set out in Table 500-16 and the traffic volume as specified in the Contract. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5 mm sieve and retained on the 22.4 mm sieve, where approved by the Engineer-in-charge.

**TABLE 500-15: COMPOSITION OF SEMI DENSE BITUMINOUS CONCRETE
PAVEMENT LAYERS**

Mix designation nominal aggregate size layer thickness	Grading 1 13 mm 35 – 40 mm	Grading 2 10 mm 25 – 30 mm
IS Sieve (mm)	Cumulative % weight of total aggregate passing	
45	-	-
37.5	-	-
26.5	-	-
19	100	-
13.20	90 – 100	100
9.50	70 – 90	90 – 100
4.75	35 – 51	35 – 51
2.36	24 – 39	24 – 39
1.18	15 – 30	15 – 30
0.60	-	-
0.30	9 – 19	9 – 19
0.15	-	-
0.075	3 – 8	3 – 8
Bitumen content % by weight of total mixture ¹	Min. 4.5	Min. 5.0
Bitumen grade	65*	65*

- Notes:**
1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.
 2. Determined by the Marshall method.
 - * Only in exceptional circumstances, 80/100 penetration grade may be used, as approved by the Engineer.

**TABLE 500 – 16. REQUIREMENTS FOR SEMI DENSE
BITUMINOUS PAVEMENT LAYERS**

Minimum stability (KN at 60°C)	8.2
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 below on each of the two faces of the specimen
Per cent air voids	3 – 5
Per cent voids in mineral aggregate (VMA)	See Table 500 – 12
Per cent voids filled with bitumen (VFB)	65 – 78

508.3.3. Job mix formula: The procedure for formulating the job mix formula shall be generally as specified in Clause 507.3.3 and the results of tests enumerated in Table 500-16 as obtained by the Contractors.

508.3.4. Plant trials - permissible variation in job mix formula: The requirements for plant trials shall be all as specified in Clause 507.3.4, and permissible limits for variation as shown in Table 500-13.

508.3.5. Laying trials: The requirements for laying trials shall be all as specified in Clause 507.3.5.

508.4. Construction Operations

508.4.1. Weather and seasonal limitations: The provisions of Clause 501.5.1 shall apply.

508.4.2. Preparation of base: The surface on which the Semi Dense Bituminous material is to be laid shall be prepared in accordance with Clauses 501 and 902 as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom cannot access, other approved methods shall be used as directed by the Engineer.

508.4.3. Geosynthetics: Where Geosynthetics are specified in the Contract this shall be in accordance with the requirements stated in Clause 703.

508.4.4. Stress absorbing layer: Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of Clause 522.

508.4.6. Mixing and transportation of the mixture: The provisions as specified in Clauses 501.3 and 501.4 shall apply.

508.4.5. Tack coat: Where specified in the Contract, or otherwise required by the Engineer, a tack coat shall be applied in accordance with the requirements of Clause 503.

508.4.7. Spreading: The general provisions of Clauses 501.5.3 and 501.5.4 shall apply.

508.4.8. Rolling: The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials. The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials, which may be varied only with the express approval of the Engineer in writing.

508.5. Opening to Traffic

The newly laid surface shall not be open to traffic for at least 24 hours after laying and the completion of compaction, without the express approval of the Engineer in writing.

508.6. Surface Finish and Quality Control

The surface finish of the completed construction shall conform to the requirements of Clause 902. All materials and workmanship shall comply with the provisions set out in Section 900 of this Specification.

508.7. Arrangements for Traffic

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

508.8. Measurement for Payment

The measurement shall be all as specified in Clause 507.8. The contract rate shall be for a unit of one M.T.

508.9. Rate: The contract unit rate shall be all as specified in Clause 507.9, except that the rate shall include the provision of bitumen at 5.00 percent, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted up or down, accordingly.

The payment will be made on one M.T. basis of the finished work.

Item No.: - 04.

Providing and laying compacted quarry spall in side shoulder, including carriage of material and spreading on prepared base, including compacting as per MOST specification etc. complete.

- 1.0 The quarry spalls shall be approved quarry as approved by the Executive Engineer prior to collection. Filling of boxes, shall not be allowed till the metal is broken to the specified site.

- 2.0 The quarry spall shall be as uniform in size as possible. The quarry spall shall be hard, tough, solid durable of black trap quarry of close texture, free from decay and weathering. The stone shall be angular and roughly cubical in shape and round elongated or flaky materials shall be rejected. No sound or long rubble or angular chips smaller than specified size shall be allowed.

Grading for Quarry Spalls

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

Material passing through 425 micro sieves for all the three gradings when tested according to I.S. 2720 (Part-5) shall have liquid limit and plastic index not more than 25 and 6 respectively.

- 3.0 All unsound, weathered, or disintegrated stone obtained from the under-surface layer of the quarry or other layers of boulders shall be rejected.
- 4.0 Wherever any doubt as to whether above requirement is satisfied in whole or part of the collection it shall be got screened by the Contractor if so, ordered by the Executive Engineer, and for which no extra payment shall be claimed by the contractor
- 5.0 Any collection which does not fully satisfy the above requirements is liable to be rejected all together.
- 6.0 Regular stacks shall be made by the contractor on a fairly level ground. All the stack shall be marked by white wash immediately on being measured and recorded by the Engineer-in-charge.
- 7.0 The rate includes blasting the rock, if any, breaking the quarry spalls, stacking measuring in pharas etc. complete.
- 8.0 Stacks shall as per actual requirements and any materials in excess shall have to be transported by the contractor at the places directed by the Executive Engineer at the risk and cost of the contractor.
- 9.0 While stacking materials the depositing should commence at one end of the KM and carried continuously towards the other end unless the Executive Engineer shall direct otherwise and as a rule measurement shall be taken after metal for half kilometer or Km. has been fully collected. Any fraction of these distance shall not be measured up.
- 10.0 The measurements shall be recorded in on Cum. basis on level computing method after rolling and consolidation and shall be paid accordingly.

Spreading Quarry Spalls in Grade & Camber Complete.

- The quarry spalls shall be only allowed to be spread after the written permission of the Executive Engineer is obtained.
- The permission for spreading the metal shall be given by the Executive Engineer if
 - The full quantity of a particular mile (kilometer) is completely collected.
 - The collection of metal-is also completed in the adjoining two miles (Kilometers)

(iii) The measurements are recorded in the Measurement book.

3. Quarry Spall shall if required, be screened, if containing rubbish dust, grass etc. it shall then be filled in basket & conveyed where required and spread evenly on the prepared surface be given twisting motion to the basket at the time of spreading. The surface shall then (15 m) by means of templates and strings as well as with camber boards and spirit level.
4. Between the straight length and curves and at the meeting points of the convex and concave portions of the reverse curves, the change in camber of the road, due to super elevations shall be made as well as with camber boards and spirit level.
5. At the time of spreading Quarry Spall a small quantity (about 4 to 5 percent) of metal as directed, shall be retained at the first instance. It shall be spread later 0:1 after partial consolidated as required to rectify the camber and to fill up the hollows if any. No extra amount shall be paid for this.
6. Measurements shall be paid as per the measurements of collection less the quantity remained to be spread and on cubic meter basis.
7. The rate includes the cost of screening the Quarry Spall if any spreading, sectioning, with template and adding reserved quota of metal, while/oiling is in progress for making good hollows and camber.
8. The surface shall be brought to the required camber which shall be checked at every 50 ft. (15 M) by means off templates of while the necessary of the in between shall tested by strings and corrected as required.
9. The centre line shall first be marked in the subgrade which is properly consolidated and has uniform camber and grade as required
10. The Quarry Spall shall be laid for a small length on 25 ft. (8 M.) and then the edge stones shall be laid.
11. Pegs shall be driven on either side of the road and joined with strings true and parallel with a distance between they equal to the width be laid with over metal Similarly.
12. The Q. S. shall be laid as close as possible to leave minimum possible interstices and voids.
13. Before roiling is allowed on soling the side berms shall be filled upto the top of the soling and at least 3'-0" (1 m.) on either side to prevent metal layer getting disturbed at times during rolling. The rate is inclusive of all the operations as stated above.
14. Immediately following the spreading of the coarse aggregates rolling shall be started with three wheeled power roller of 8 to 10 tone capacity or tandem roller or equivalent vibratory roller. The weight of the roller shall depend upon the type of the aggregate and be indicated by Engineer-in-charge.
15. Except on super elevated portions where the roiling shall proceed from inner edge to outer, rolling shall 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 centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half the width.
16. Rolling shall continue until the aggregate is thoroughly keyed and the creeping of the aggregate a head of the roller is no longer visible. During rolling, slight sprinkling of water may be done, if necessary. Rolling shall not be done when the sub grade is soft or yielding or when it causes a wave like motion in the sub grade or sub base course.

17. The rolled surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding, or removing necessary amounts of aggregate and re-rolling until the entire surface conform to desired camber and grade. In no case shall the base of screening be permitted to make up depression.
18. The blindage material where it is required to be used 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 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 forms a wave ahead of the wheels of the moving roller.
19. After the final compaction of water bound macadam course, the road shall be allowed to any overnight Next morning hungry spots shall be filled with screenings of binding materials as directed lightly sprinkled with water, if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer-in-charge shall have the discretion to stop hauling traffic from using the completed water bound macadam course, if in his opinion, it would cause excessive damage to the surface.

Mode of Measurements for Payment:

Measurements shall be paid as per the measurements of collection less the quantity remained to be spread and on cubic meter basis.

The rate includes the cost of screening the quarry spall if any spreading, sectioning, with template and adding reserved quota of metal, while/oiling is in progress for making good hollows and camber.

The payment will be made on cubic meter basis of the finished work.

Item No.: - 07.

Construction of 150 mm thick Granular sub base in required layer by providing coarse graded material Grading-I using B.T. M.C. metal 53 mm to 26.5 mm at 35%, aggregate 26.5 to 4.75 mm at 45% and stone dust at 20% (CBR more than 30%) as per Table 400-2 of MORT&H gradation including conveying the material at site of work, mixing and spreading in to grade and camber, watering and consolidating at OMC with vibratory roller including the cost of materials, labours etc. complete.

401 GRANULAR SUB-BASE

401.1. Scope

This work shall consist of laying and compacting well-graded material on prepared sub grade 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.

401.2. Materials

401.2.1. The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag, or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base. The material shall be free from organic or other deleterious constituents and shall conform to the gradings given in Table

400-1 and physical requirements given in Table 400-2. Gradings III and IV shall preferably be used in lower sub-base. Gradings V and VI shall be used as a sub-base-cum-drainage layer. The grading to be adopted for a project shall be as specified in the Contract. Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

401.2.2 If the water absorption of the aggregates determined as per IS: 2386 (Part 3) is greater than 2 percent, the aggregates shall be tested for Wet Aggregate Impact Value (AIV) (IS: 5640). Soft aggregates like Kankar, brick ballast and laterite shall also be tested for Wet AIV (IS: 5640).

Table 400-1: Grading for Granular Sub-base Materials

IS Sieve Designation	Percent by Weight Passing the IS Sieve					
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0 mm	100	-	-	-	100	-
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55-90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	-	-	35-65	55-75
4.75 mm	25-55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20-40	30-50	-	-	10-20	10-25
0.85 mm	-	-	-	-	2-10	-
0.425 mm	10-15	10-15	-	-	0-5,	0-8
0.075 mm	<5	<5	<5	<5	-	0-3

Table 400-2: Physical Requirements for Materials for Granular Sub-base

Aggregate Impact Value (AIV)	IS: 2386 (Part 4) or IS: 5640	40 maximum
Liquid Limit	IS: 2720 (Part 5)	Maximum 25
Plasticity Index	IS: 2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS: 2720-Part 8)	IS: 2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

401.3 Construction Operations

401.3.1. Preparation of sub-grade

Immediately prior to the laying of sub-base, the sub grade 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.

401.3.2 Spreading and compacting

The sub-base material of the grading specified in the Contract and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing. So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS: 2720 (Part 8). The mix 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.

Moisture content of the mix shall be checked in accordance with IS: 2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 percent below the optimum moisture content.

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight 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 or on super elevation. For carriageway having cross fall on both sides, rolling shall commence at the edges and progress towards the crown.

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 percent 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.

401.4 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.

401.5 Arrangements for Traffic

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

401.6. Measurements for Payment

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

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

401.7 Rate

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

- (i) Making arrangements for traffic to Clause 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, equipment, and incidentals to complete the work to the Specifications;
- (iv) Carrying out the work in pan widths of road where directed; and
- (v) Carrying out the required tests for quality control.

The payment will be made on cubic meter basis of the finished work.

Item No.: - 09.

Providing and laying controlled cement concrete M-25, including adding surface hardener @ of 5.0 KG / square meter and curing complete excluding the cost of reinforcement of reinforced concrete work in Road by Trimix method by providing and fixing 'C' channels of 75 mm x 75 mm as per required level slope and thickness of concrete road levelling of placed concrete with surface vibrator finishing the surface with power floater and trowel light brooming on the surface including providing and filling expansion joint having size 20 mm x 20 mm as per manufacturers specifications and making construction joint of 3 mm x 20 mm by using concrete cutter machine, with curing compound etc. complete as directed.

1.0. General:

This work shall consist of controlled cement concrete M-25, including **adding surface hardener @ of 5.0 KG / square meter** and curing complete excluding the cost of reinforcement of reinforced concrete work in Road by Trimix method by mini batch mix plant / RMC plant, with compaction and finishing of cement concrete road by trimix process providing extra labour charges for the trimix vacuums dewatering service process on cement concrete road surface by using vacuum dewatering pump floater surface vibrator, including curing compound, making grooves, filling expansion joint and rough finish to surface, including levelling etc. complete.

1. Workmanship:

The relevant specification of Item No. 71 / P-80 of General Technical Specifications for Road Works Booklet. The work shall be carried out for RCC trimix road work.

The Contractor shall carry out laboratory trials of design mix with the materials from the approved sources to be used as per IRC:44. Trial mixes shall be made in presence of the Engineer or his representative and the design mix shall be subject to the approval of the Engineer. They shall be repeated, if necessary, until the proportions, that will produce a concrete which complies in all respects with these Specifications and conform to the requirements of the design / drawings.

The proportions determined as a result of the laboratory trial mixes may be adjusted, if necessary, during the construction of the trial length. Thereafter, neither the materials nor the mix proportions shall be varied in any way except with the written approval of the Engineer.

The contractor will have submitted the mix design for desired grades of cement concrete at his own cost before execution, and same must be got approval from the Engineer-in-charge. The rate of RCC items tendered by the contractor shall be reduced according to the cement consumption of the approved mix design, if the cement consumption of the mix design is less than as prescribed limit, recovery shall be made for the different of less consumption of cement at the input rate of cement. The condition is also applicable to the (I) excess quantity for RCC items and (II) extra item rate lists. The condition is not applicable to Ready mix concrete items. If there will be any change in grade of concrete items, only the cost difference of cement will be paid / deducted / deducted from concern item as per mix design.

Concrete shall be vibrated with surface vibrator. Levelling shall be carried out with Tremix surface vibrator. This vibrator shall run over "C" channels [pre-levelled with wet concrete prior to concreting] to level the wet concrete @ specified level and grade. While concreting adding surface hardener @ of 5.0 KG / square meter as per manufacturers guidelines. For Dewatering with vacuumed Tremix system screed shall be laid over wet [workable] concrete and fully covered. Thinner screed connected with flange, pipe connection to suction pump shall be laid over it. Dewatering shall be carried out till concrete is fully dense and no excess water or air comes through to discharge nozzle.

Immediately after dewatering surface is floated with a skim power floater. The floating disc shall leave a rather rough texture for non-slippery surface.

For paneling groove cutting shall be carried out as per item description within 48 hours from casting of the floor. Grooves shall be filled with sand & asphalt as per item description as directed.

2. Tremix Process:

The specification of Trimix vacuumed dewatering system shall be carried out as follows.

Reinforcement shall be placed as directed and got checked from Engineer-in-charge before laying cement concrete, if specified. The position of the pipes for water and drainage, heating, electric supply and telephones shall be fixed before concrete work is started, so that they do not disturb the concrete work.

- A** Providing and fixing required side channels fixing in required line & level by true level to get required paneling and shuttering formwork.
- B** Screed vibrators: Providing and operating screed vibrator to get compacted concrete with perfect level as per guldens both side of channels.
- C** Vacuum dewatering in compacted level floor: After laying of concrete in line and level with full compaction excess water should be removed by vacuum dewatering system as per trimix method. Water is drawn out through auction pipe resulting in a dense concrete with a lower water/cement ratio.

Power traveling: After perfect dewatering the surface shall be treated by power traveling to get perfect surface by filling all the voids in flooring, applying two to three times power floater to get hard and smooth surface. After getting smooth and perfect leveling top surface shall be treated by power traveling to get fine smoothing of the surface. Traveling shall be done in some required intervals to get sooth and hard surfacing.

3. Making Grooves:

Cement concrete pavement, the defective areas having surface irregularity exceeding 3 mm but not greater than 6 mm may be rectified by bump cutting or scrubbling or grinding using approved equipment. When required by the Engineer, areas which have been reduced in level by the above operation(s) shall be retextured in an approved mama either by cutting grooves (5 mm deep) or roughening the surface by hacking the surface. If high areas in excess 6 mm or low awn in excess of 3 mm occur, exceeding the permitted numbers and if the Contractor cannot rectify, the slab shall be demolished and reconstructed at the Contractor's expense and in no case the area removed shall be less than the full width of the lane in which the irregularity occurs and full length of the slab.

If deemed necessary by the Engineer, any section of the slab which deviates from the specified levels and tolerances shall be demolished and reconstructed at the Contractor's expense.

4. Pre-moulded asphalt filler Joint:

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.

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 form being displaced, after the work is completed, the exposed face of the joint shall be cleaned of all loose materials sticking to it.

The material used for filling expansion joint shall be bitumen impregnated felt. Impregnated 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 places to make up the required size shall be avoided.

The expansion joint shall be measured in running meters. Thickness of the expansion joint will be 20 to 30 mm. Width of expansion joint shall be equal to full depth of the slab.

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 drawings.

Mode of Measurement & Payment:

The rate includes cost of all materials, labours, tools & plants required formwork, using vacuum dewatering machine, mechanical vibrator, mechanical floaters, curing compound and mechanical trowel as directed. The rate shall include the cost of conveyance loading unloading and placing etc. complete as directed by engineer in-charge.

The payment will be made on cubic meter basis of the finished work.

Item No.: - 10.

Providing and placing T.M.T. FE-500D bars reinforcement (I.S.I. mark) conforming to I.S. 1786 for R.C.C. work including cutting, bending, binding and placing in position etc. complete.

1601. Description:

This work shall consist of furnishing and placing coated or uncoated mild steel or high strength deformed reinforcement bars of the shape and dimensions shown on the drawings and conforming to these Specifications or as approved by the Engineer.

1602. General:

Steel for reinforcement shall meet the requirements of Section 1000 of these specifications.

Reinforcements may be either mild steel or high strength deformed bars. They may be uncoated or coated with epoxy.

1603. Protection of Reinforcement:

Uncoated reinforcing steel shall be protected from rusting or chloride contamination. Reinforcements shall be free from rust, mortar, loose mill scale, grease, oil or paints. This may be ensured either by using reinforcement fresh from the factory or thoroughly cleaning all reinforcement to remove rust using any suitable method such as sand blasting, mechanical wire brushing, etc., as directed by the Engineer. Reinforcements shall be stored on blocks, racks or platforms and above the ground in a clean and dry condition and shall be suitably marked to facilitate inspection and identification.

Portions of uncoated reinforcing steel and dowels projecting from concrete, shall be protected within one week after initial placing of concrete with a brush coat of neat cement mixed with water to a consistency of thick paint. This coating shall be removed by lightly tapping with a hammer or other tool not more than one week before placing of the adjacent pour of concrete. Coated reinforcing steel shall be protected against damage to the coating. If the coating on the bars is damaged during transportation or handling and cannot be repaired, the same shall be rejected.

In case of fusion bonded epoxy coated reinforcement or hot dipped galvanized bars used, reference shall be made Clause 1010.3.2 of Section 1000 of these specifications.

1604. Bending of Reinforcement:

Bar bending schedule shall be furnished by the Contractor and got approved by the Engineer before start of work.

Reinforcing steel shall conform to the dimensions and shapes given in the approved Bar Bending Schedules.

Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer using a proper bar bender, operated by hand or power to obtain the correct shape and radii of bends.

Bars shall not be bent or straightened in a manner that will damage the parent material or the coating.

Bars bent during transport or handling shall be straightened before being used on work. They shall not be heated to facilitate straightening.

1605. Placing of Reinforcement:

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

- i) In case of beam and slab construction, industrially produced polymer cover blocks of thickness equal to the specified cover shall be placed between the bars and formwork subject to satisfactory evidence that the polymer composition is not harmful to concrete and reinforcement. Cover blocks made of concrete may be permitted by the Engineer, provided they have the same strength and specification as those of the member.
- ii) In case of dowels for columns and walls, the vertical reinforcement shall be kept in position by means of timber templates with slots cut in them accurately, or with cover blocks tied to the reinforcement. Timber templates shall be removed after the concreting has progressed up to a level just below their location.
- iii) Layers of reinforcements shall be separated by spacer bars at approximately one-meter intervals. The minimum diameter of spacer bars shall be 12 mm or equal to maximum size of main reinforcement or maximum size of coarse aggregate, whichever is greater. Horizontal reinforcement shall not be allowed to sag between supports.
- iv) Necessary stays, blocks, metal chain, spacers, metal hangers, supporting wires etc. or other subsidiary reinforcement shall be provided to fix the reinforcements firmly in its correct position.
- v) Use of pebbles broken stone, metal pipe, brick, mortar or wooden blocks etc., as devices for positioning reinforcement shall not be permitted.
- d) Bars coated with epoxy shall be placed on supports that do not damage the coating. Supports shall be installed in a manner such that point of weakness is not created in hardened concrete. The coated reinforcing steel shall be held in place by use of plastic or plastic coated binding wires especially manufactured for the purpose. Refer Section 1000 of these specifications for other requirements.
- e) Placing and fixing of reinforcement shall be inspected and approved by the Engineer before concreting is commenced.

1606. Bar Splices:

1606.1. Lapping

All reinforcement shall be furnished in full lengths as indicated on the drawing. No splicing of bars, except where shown on the drawing, shall be permitted without approval of the Engineer. The lengths of the splice shall be as indicated on drawing or as approved by the Engineer. Where practicable, overlapping bars shall not touch each other, and shall be kept apart by 25 mm or 1.25 times the maximum size of coarse aggregate, whichever is greater. If this is not feasible, overlapping bars shall be bound with annealed steel binding wire not less than 1 mm diameter and twisted tight in such a manner as to maintain minimum clear cover to the reinforcement from the concrete surface. Lapped splices shall be staggered or located at points along the span where stresses are low.

1606.2. Welding

1606.2.1. Splicing by welding of reinforcement will be permitted only if detailed on the drawing or approved by the Engineer. Weld shall develop an ultimate strength equal to or greater than that of the bars connected.

1606.2.2. While welding may be permitted for mild steel reinforcing bars conforming to IS: 432, welding of deformed bars conforming to IS: 1786 shall in general be prohibited. Welding may be permitted in case of bars of other than Fe 240 grade including special welding grade of Fe 415 grade bars conforming to IS: 1786, for which necessary chemical analysis has been secured and the carbon equivalent (CE) calculated from the chemical composition using the formula:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mg + V}{5} + \frac{Ni + Cu}{15}$$

is 0.4 or less

1606.2.3. The method of welding shall conform to IS: 2751 and IS: 9417, any supplemental specifications and clause 1904.8 of these Specifications to the satisfaction of the Engineer.

Welding may be carried out by metal arc welding process. Oxy-acetylene welding shall not be permissible. Any other process may be used subject to the approval of the Engineer and necessary additional requirements to ensure satisfactory joint performance. Precautions on overheating, choice of electrode, selection of correct current in arc welding etc., should be strictly observed.

All bars shall be butt welded except for smaller diameter bars (diameter of less than 20 mm) which may be lap welded. Single-V or Double-V butt joints may generally be used. For vertical bars single bevel or double bevel joints may be used.

Welded joints shall be located well away from bends and shall be not less than twice the bar diameter away from a bend.

Generally, shop welding in controlled conditions is to be preferred, where feasible. Site welding where necessary shall, however, be permitted when the facilities, equipment, process, consumables, operators and welding procedure, are adequate to produce and maintain uniform quality at par with that attainable in shop welding to the satisfaction of the Engineer.

Joint welding procedures which are to be employed shall invariably be established by a procedure specification. All welders and welding operators to be employed shall be qualified by tests prescribed in IS: 2751. Inspection of welds shall conform to IS: 822 and destructive or non-destructive testing may be undertaken when deemed necessary. Joints with weld defects detected by visual inspection or dimensional check inspection shall not be accepted.

Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding. When welding is done in two or three stages, the surface shall be cleaned properly after each stage. Bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before carrying out welding. Only competent and experienced welders shall be employed on the work with the approval of the Engineer. No welding shall be done on coated bars.

M.S. electrodes used for welding shall conform to IS: 814.

1606.2.4. Welded joints shall preferably be located at points where steel will not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section, not more than 20 percent of the bars are welded.

1606.2.5. Specimens of Welded pieces of reinforcement taken from the site shall be tested. The number and frequency of tests shall be as directed by the Engineer.

1606.3. Mechanical Couplers and Anchorages:**1606.3.1 Mechanical Couplers:**

Bars may be joined with approved patented mechanical devices as indicated on the drawing or as approved by the Engineer e.g., by special grade steel sleeves swaged on to bars in end-to-end contact or by screwed couplers. In case such devices are permitted by the Engineer, they shall develop at least 125 percent of the characteristic strength of the reinforcement bar.

1606.3.2 Anchorages:

Bars may be anchored with approved patented mechanical anchorages as indicated on the drawing or as approved by the Engineer. The anchorages shall be connected to the reinforcing bar by the use of taper thread system. The anchorage shall be capable of developing the characteristic strength of reinforcement without damage to concrete and shall have sufficient diameter and width to develop adequate shear cone strength. The connection shall develop 125% of the characteristic strength of reinforcement bar.

1607. Testing and Acceptance:

The material shall be tested in accordance with relevant IS specifications and necessary test certificates shall be furnished. Additional tests, if required, will be got carried out by the Contractor at his own cost.

The supply, fabrication and placing of reinforcement shall be in accordance with these specifications and shall be as checked and accepted, by the Engineer.

Manufacturer's test certificate regarding compliance with Indian Standards for each lot of steel, shall be obtained and submitted to the Engineer. If required by the Engineer, the Contractor shall carry out confirmatory tests in the presence of a person authorized by the Engineer. Cost of these tests shall be borne by the Contractor. The sampling and testing procedure shall be as laid down in IS: 1786. If any test piece selected from a lot fails, no re-testing shall be done and the lot shall be rejected.

1608. Measurements for Payment:

For payment, the bar shall be measured correct up to 10 mm length and weight payable works out at the rate specified below:

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

1609. Rate:

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

The unit rate for coated reinforcement shall be deemed to also include cost of all material, labour, tools and plant, royalty, transportation, and expertise required to carry out the coating work as well as sampling, testing and supervision required for the work. **No Payment shall be made for Laps.**

The payment will be made on kilogram basis of the finished work.

Item No.: - 13.

Providing, supply and fixing of manhole chemical fabricated with High-strength precast reinforced cement concrete M-25 grade chamber with top cover as per specification and drawing attached with tender for size as mention herewith, including lowering, laying and joining the RCC Precast Pipe in premixed cement mortar in proper position, grade and alignment at all level including conveyance to site of work, labour, giving hydraulic testing as per ISI code etc. complete as directed by Engineer in charge. (Size 1400 x1600 x 2000 mm deep and suitable for 900 mm dia Np-4 pipe)

Material:

All materials shall be as per item description and specified item's Manufacturer's specifications or as approved by Engineer in charge and associated with General Technical Specifications for Building Works shall be applicable.

Workmanship:

The work shall consist of Providing, supply and fixing of manhole chemical fabricated with High-strength precast reinforced cement concrete M-25 grade chamber with top cover as per specification and drawing attached with tender for size as mention herewith, including lowering, laying and joining the RCC Precast Pipe in premixed cement mortar in proper position, grade and alignment at all level including conveyance to site of work, labour, giving hydraulic testing as per ISI code etc. complete as directed by Engineer in charge. (Size 1400 x1600 x 2000 mm deep and suitable for 900 mm dia Np-4 pipe)

The work shall be carried out with the best practice followed in the industry. The contractor shall make sure that the item to be carried out in its perfect state as per the standards practice. Additionally, executed work shall not be damaged. It is the duty of the contractor to make proper arrangements for protection of the items during execution till handover. The contractor shall get the items inspected and approved or as directed by Engineer in charge before execution / installation. Any claim, upon rejection of item by the Engineer in charge will not be entertained.

The precast readymade product is to be completed as per design, sample, shade, drawing and it shall be of premium quality as approved by Engineer in charge.

Mode of Measurements & Payment:

All the work shall be measured based on finished dimensions as executed at site and shall be paid. The rate includes the cost of all materials, labour, machineries, tools and plants, transporting to site of work, loading and unloading, protective measures required for proper completion of the item of work as directed. No extra charge will be paid for any other reasons.

The payment will be made on Number basis of the finished work.

Item No.: - 14.

Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20 cm in depth consolidating each deposited layer by ramming and watering.

1.0. Workmanship:

1.1. The earth to be used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken.

1.2. As soon as the work in foundation has been completed and measured the site of foundation shall be cleared of all debris, brick bats, mortar dropping etc., and filled with earth in layers not exceeding 20 cm. Each layer shall be adequately watered, rammed, and consolidated before the succeeding layer is laid. The earth shall be rammed with iron rammers where feasible and with the but ends of crow-bars, where rammer cannot be used.

1.3. The plinth shall be similarly filled with earth in layers not exceeding 20 cm adequately watered and consolidated by ramming with iron or wooden rammers. When filling reaches finished level, the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated.

1.4. The finished level of filling shall be kept to shape intended to be given to floor.

1.5. In case of large heavy-duty flooring like factory flooring, the consolidation may be done by power rollers, where so specified. The extent of consolidation required, shall also be as specified.

1.6. The excavated stuff of the selected type shall be allowed to be used in filling the trenches and plinth. Under no circumstances black cotton soil be used for filling the plinth.

2.0. Mode of Measurements & Payment:

2.1. The payment shall be made for filling in plinth and trenches. No deduction shall be made for shrinkage or voids, if consolidated as instructed above.

The payment will be made on cubic meter basis of the finished work.

Item No.: - 21.

Cat Eye / Road Stud / RPM: Supplying of Molded Twin Shanks 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 – 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 strength of detachment of the integrated cylindrical shanks, (of diameter not less than 19 +/- 2 mm and height not less than 30 +/- 2 mm) from the body is to be a minimum value of 500 Kgf. Fixing will be by drilling holes on the road for the shanks to go inside, without nails and using epoxy resin-based adhesive as per manufacturer's recommendation and the colour of the marker should be as per the IRC 35-2015 and as directed by Engineer-in-charge.

1.0 General:

The colour, configuration, size and location of Molded Twin Shanks Raised Pavement Markers for highways other than Expressways shall be in accordance with the Code of Practice for Road Signs, IRC: 35-2015 or as shown on the drawings or as directed by the Engineer.

The Molded Twin Shanks Raised Pavement Markers shall be reflectorized as shown on the drawings or as directed by the Engineer. It shall be of retro-reflectorized type and made of polycarbonate and ABS moulded body and reflective panels with micro prismatic 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 MORT&H Circular No: RW / NH / 33023 / 10-97 - DO III Dt. 11.06.1997.

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 Molded Twin Shanks Raised Pavement Markers 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 Molded Twin Shanks Raised Pavement Markers is of high-density PVC materials.

The dimensions and size of the Molded Twin Shanks Raised Pavement Markers shall be as per IS standard. The retro-reflective sheeting used on the Molded Twin Shanks Raised Pavement Markers shall consist of the white or coloured sheeting having a smooth outer surface which has the property of retro reflection over its entire surface. It shall be weather resistant and show colour fastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for 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 sheetings: 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 D 4280 Type H).

TABLE 800.1 : 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	250	170	100	45	20
0.2	+ 30	150	100	60	25	11
0.5	- 4	95	62	30	15	7.5
0.5	+ 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 micro prismatic 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 D 4280 Type H) 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 discoloration, 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 Molded Twin Shanks Raised Pavement Markers 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 of Molded Twin Shanks Raised Pavement Markers 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 Molded Twin Shanks Raised Pavement Markers including all materials, installing it at the site and incidentals to complete the work in accordance with the specifications.

The payment will be made on number basis of the finished work.

Item No.: - 22.

Providing and fixing Cautionary Warning sign boards made out of 2 mm aluminium sheet / 4 mm ACP (Aluminium composite Panel); size 90 x 90 x 90 cm equilateral triangle as per design of IRC-67-2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer & two coats of best quality epoxy paint; reflectorized with High Intensity Prismatic Grade retro reflective sheeting of Type-4 as per ASTM D-4956 & latest MOST Specifications; 3.6 mtr long stand post of iron angle 75 x 75 x 6 mm / 65NB circular MS pipe as required & frame fabricated from suitable size iron angle of 35 x 35 x 3 mm; painted with best quality epoxy coatings in black & white bends. The details of symbol for each board shall be as per the instruction of Engineer-in-charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 cm for each leg, including excavation, curing etc. complete under the supervision of Engineer-in-charge. A warranty for 7-year for the retro reflective sheeting from original manufacturer & a certified copy of 3-year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting.

Detailed Technical Specifications for Sign Board**1. Material & Manufacturing:****1.1 Scope**

The work shall consist of 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 67-2012.

1.2 Materials

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

1.2.1 Concrete:

Concrete for the 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.

1.2.2 Reinforcing Steel: Reinforcing steel shall conform to the requirements of IS: 1786 unless otherwise shown on the drawings

1.2.3 Bolts, Nuts and Washers: High strength Bolts shall conform to IS: 1367 whereas precision bolts, nuts, etc. shall conform to IS: 1364

1.2.4 Plates and Supports

Plates and support sections for the sign posts shall conform to IS: 226 and IS: 2052 or any other relevant IS specifications.

1.2.5 Substrate

Sign panel shall be fabricated on Aluminum sheet, aluminum composite panel, fibre glass sheeting, or sheet moulding compound. Aluminum sheets used for sign boards shall be of smooth, hard and corrosion resistance aluminum alloy conforming to IS: 735 Material Designation 24345 or 1900. Aluminum composite Material (ACM) sheets shall be sandwiched construction with a thermoplastic core of Low-Density Polyethylene (LDPE) between two thick skins/sheets of aluminum with overall thickness of 3 mm or 4 mm (as specified in the contract), and aluminum skin thickness 0.5 mm and 0.3 mm respectively on both the sides.

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

Sl. No.	Description	Specification for 4 mm		Specification for 3mm
		Standard test	Acceptable value	Acceptable value
A	Mechanical Properties of ACM			
1	Peel off strength with retro reflective sheeting. (Drum Peel Test)	ASTM D903	Min. 4 N/mm	Min. 4 N/mm
2	Tensile strength	ASTM E8	Min. 40 N/mm ²	Min. 30 N/mm ²
3	0.20% Proof Stress	ASTM E8	Min. 34 N/mm ²	Min. 34 N/mm ²
4	Elongation	ASTM E8	Min. 6 %	Min. 5 %
5	Flexural strength	ASTM C393	Min. 130 N/mm ²	Min. 120 N/mm ²
6	Shear strength with Punch shear test	ASTM D732	Min. 18 N/mm ²	Min. 18 N/mm ²
B	Properties of Aluminium Skin			
1	Tensile strength (Rm)	ASTM E8	Min. 150 N/mm ²	Min. 130 N/mm ²
2	Modulus of elasticity	ASTM E8	Min. 70,000 N/mm ²	Min. 70,000 N/mm ²
3	Elongation	ASTM E8	A ₅₀ Min. 2 %	A ₅₀ Min. 2 %
4	0.2 % Proof Stress	ASTM E8	Min. 110 N/mm ²	Min. 110 N/mm ²

1.2.6 Plate Thickness

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

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

1.3.1. General Requirements: The retro reflective sheeting used on the signs shall consist of 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 exhibit colour fastness. It shall be new and unused and show no evidence of cracking, scaling, and pitting, blistering, edge lifting or curling and shall have

negligible shrinkage or expansion. A certificate of having the sheeting tested for coefficient of retro reflection, daytime colour and luminance, shrinkage, flexibility, liner removal, adhesion, impact resistance, specular gloss and fungus resistance, 3 years outdoor weathering and its having passed these tests shall be obtained from International / Government laboratory / Institute by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens, High Intensity Grade with encapsulated lens or Micro-Prismatic Grade retro reflective element material as given in Clauses 801.3.2 to 801.3.7. Guidance on the recommended application of each class of sheeting may be taken from IRC-67,

1.3.2 High Intensity Grade sheeting

1.3.2.1 High Intensity Grade (Type III): 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 or as an unmetallized micro prismatic reflective material elements. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined with ASTM D: 4956-09) as indicated in Table 800-2.

Table 800-2 Acceptable Minimum Coefficient of Retro-reflection for Type III High Intensity Grade Sheetin^A (Encapsulated Lens Type)
(Candelas Per Lux Per Square Metre)

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

^A Minimum Coefficient of Retro reflection (R_d) ($\text{cd.lx}^{-1}.\text{m}^{-2}$).

^B Values for 0.1⁰ observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent, of the values of retro reflectance indicated in above Table. At the end of 7 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

1.3.2.2 High intensity Micro Prismatic Grade Sheetin^A (HIP) (Type IV):

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

Table 800-3 Acceptable Minimum Coefficient of Retro-Reflection for Type IV High Intensity Micro-Prismatic Grade Sheetin^A
(Candelas Per Lux Per Square Metre)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1° ^a	-4°	500	380	200	70	90	42	25	400	300	150
0.1° ^a	+30°	240	175	94	32	42	20	12	185	140	70
0.2°	-4°	360	270	145	50	65	30	18	290	220	105
0.2°	+30°	170	135	68	25	30	14	8.5	135	100	50
0.5°	-4°	150	110	60	21	27	13	7.5	120	90	45
0.5°	+30°	72	54	28	10	13	6	3.5	55	40	22

^a Minimum Coefficient of Retro reflection (R_A) ($\text{cd.lx}^{-1}.\text{m}^{-2}$).

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

1.3.4 Prismatic Grade Sheeting

1.3.4.1 Prismatic Grade Sheeting (Type VIII)

The reflective sheeting shall be retro reflective sheeting made of micro prismatic retro reflective material. The retro reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro reflection (determined in accordance with ASTM D: 4956-09) as indicated in Table 800-4

Table 800-4 Acceptable Minimum Coefficient of Retro-Reflection for Type VIII Prismatic Grade Sheeting^a
(Candelas Per Lux Per Square Metre)

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

^a Minimum Coefficient of Retro reflection (R_A) ($\text{cd.lx}^{-1}.\text{m}^{-2}$).

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

1.3.4.2 Prismatic Grade Sheeting (Type IX)

The reflective sheeting shall be retro reflective sheeting made of micro prismatic retro reflective material. The retro reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro reflection (determined in accordance with ASTM D: 4956-09) as indicated in Table 800-5

Table 800-5 Acceptable Minimum Coefficient of Retro-Reflection for Type IX Prismatic Grade Sheeting ^A (Candelas Per Lux Per Square Metre)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1 ^{0B}	-4 ⁰	660	500	250	66	130	30	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	9.0	2	36	27	17

^A Minimum Coefficient of Retro reflection (R_A) ($cd.lx^{-1}.m^{-2}$).

^B Values for 0.1⁰ observation angles are supplementary requirements that shall apply only when specified by the purchaser in the contract or order. When totally wet, the sheeting shall show not less than 90 percent, of the values of retro reflectance indicated in above Table. At the end of 10 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

1.3.4.3 Prismatic Grade Sheeting (Type XI)

The reflective sheeting shall be retro reflective sheeting made of micro prismatic retro reflective material. The retro reflective surface, after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro reflection (determined in accordance with ASTM D: 4956-09) as indicated in Table 800-6

Table 800-6 Acceptable Minimum Coefficient of Retro-Reflection for Type XI Prismatic Grade Sheeting ^A (Candelas Per Lux Per Square Metre)

Observation Angle	Entrance Angle	White	Yellow	Orange	Green	Red	Blue	Brown	Fluorescent Yellow-Green	Fluorescent Yellow	Fluorescent Orange
0.1 ^{0B}	-4 ⁰	830	620	290	83	125	37	25	660	500	250
0.1 ^{0B}	+30 ⁰	325	245	115	33	50	15	10	260	200	100
0.2 ⁰	-4 ⁰	580	435	200	58	87	26	17	460	350	175
0.2 ⁰	+30 ⁰	220	165	77	22	33	10	7	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 Coefficient of Retro reflection (R_R) ($\text{cd.lx}^{-1}.\text{m}^{-2}$).

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

1.3.5 Adhesive

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

1.3.5 Fabrication

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

1.3.7 Message / Border

The messages (legends, letters, numerals, etc.) and borders shall either be screen-printed or of cut out from durable transparent overlay or cut out from the same type of reflective sheeting for the cautionary / mandatory sign boards. Screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. For the informative and other sign boards, the messages (legends, letters, numerals etc.) and borders shall be cut out from durable transparent overlay film or cut-out from the same reflective sheeting only. Cut-outs shall be from durable transparent overlay materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer. For screen-printed transparent coloured areas on white sheeting, the co-efficient of retro-reflection shall not be less than 50 per cent of the corresponding values in Tables 800-2 to 800-6 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.

1.3.8 Color for Signs

1.3.8.1 Signs shall be provided with retro-reflective sheeting and / or overlay film / screening ink as shown on the detailed drawings. The reverse side of all signs shall be painted grey.

1.3.8.2 Except in the case of railway level crossing signs (for which the colour scheme is given later) the sign posts shall be painted in 250 mm wide bands, alternately black and white. The lowest band next to the ground shall be in black.

1.3.8.3 The colour of the material shall be located within the area defined by the chromaticity coordinates in Table 8.1 and comply with the luminance factor given in Table 800-7 when measured as per ASTM D: 4956-09

<i>Table 8.1 Specification Limits (Daytime)^a</i>								
Colour	1		2		3		4	
	X	Y	X	Y	X	Y	X	Y
White	0.303	0.300	0.368	0.366	0.340	0.393	0.274	0.329
Yellow	0.498	0.412	0.557	0.442	0.479	0.520	0.438	0.472
Green ^a	0.026	0.399	0.116	0.364	0.286	0.446	0.207	0.771
Red	0.648	0.351	0.735	0.265	0.629	0.281	0.565	0.346
Blue ^a	0.140	0.035	0.244	0.210	0.190	0.255	0.065	0.216
Orange	0.558	0.352	0.636	0.364	0.570	0.429	0.506	0.404
Brown	0.430	0.340	0.610	0.390	0.550	0.450	0.430	0.390
Fluorescent Yellow-Green	0.387	0.610	0.369	0.546	0.428	0.496	0.460	0.540
Fluorescent Yellow	0.479	0.520	0.446	0.483	0.512	0.421	0.557	0.442
Fluorescent Orange	0.583	0.416	0.535	0.400	0.595	0.351	0.645	0.355

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

1.3.8.4 The mandatory and warning signs shall be provided with white background and red border. The legend / symbol for these signs shall be in black.

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

1.3.9 Refurbishments

Where existing signs are specified for refurbishments, the sheeting shall have semi-rigid aluminum backing or materials as per clause 1.2.5; pre-coated with aggressive tack type pressure sensitive adhesive. The adhesive shall be suitable for the type of material used for the signs and should thoroughly bond with that material.

1.3.10 Sizes of Letters

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

Table 800-8 Acceptable Limits for Size of Letters and Visibility Distance

Design Speed (kmph)	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 and the heights are indicated in Table IV (a) of the Annexure-IV to facilitate the design of the informative signs and definition plates"

1.3.10.2 For advance direction signs on non-urban roads, the letter size ('x' height) should be minimum of 150 mm for 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 initial upper-case letter followed by lower case letters.

1.3.10.3 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 with two lines and the 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.

1.3.11 Warranty and Durability

The Contractor shall obtain from the original manufacturer of the Retro Reflective sheeting for period of ten (10) years warranty for satisfactory field performance including stipulated retro reflectance of Micro-Prismatic sheeting and a Seven years warranty for High Intensity Grade and submit the same to the Engineer. The warranty shall be inclusive of the screen printed or cut out letters / legends and their bonding to the retro reflective sheeting. The contractor shall also furnish LOT numbers and certificate that the signs and material supplied against the assigned work meet all the stipulated requirements and carry the stipulated warranty and the contractor / supplier is the authorized converter of the particular sheeting.

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

A certificate in original shall be given by the manufacturer of the sheeting that its offered retroreflective sheeting has been tested for various parameters such as co-efficient of retro reflection, day / night time color and luminance, shrinkage, flexibility, liner removal, adhesion, impact resistance, specular gloss and fungus resistance; the tests shall be carried out by a Government laboratory in accordance with the various ASTM procedures and the results must show that the sheeting has passed the requirements for all the above mentioned parameters. A copy of the test reports shall be attached with the certificate.

1.4 installation

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

1.4.2 All components of signs and supports, other than the reflective portion of GI posts shall be thoroughly de-sealed, cleaned, primed and painted with two coats of epoxy paint. Any part of post below ground shall be painted with protective paint.

1.4.3 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 GI posts. After the nuts have been tightened, the tails of the bolts shall be furred over with a hammer to prevent removal.

1.5 Measurement for Payment

The measurements of standard cautionary, mandatory and information signs shall be in number of different types of signs supplied and fixed, while for direction and place identification signs, these shall be measured by per Number.

1.6 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 payment will be made on number basis of the finished work.

Item No.: - 23.

Providing and fixing Facility Informatory sign boards made out of 2 mm aluminium sheet / 4 mm ACP (Aluminium composite Panel); size 80 x 60 cm rectangular as per design of IRC-67-2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorized with High Intensity Prismatic Grade retro reflective sheeting of Type-4 as per ASTM D-4956 and latest MOST Specifications; 3.6 mtr long stand post of iron angle 75 x 75 x 6 mm / 65NB circular MS pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3 mm; painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of Engineer-in-charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 cm for each leg, including excavation, curing etc. complete under the supervision of Engineer-in-charge. A warranty for 7-years for the Retro reflective sheeting from original manufacturer & a certified copy of 3-year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting.

The relevant specifications of this Tender **Item No. 22** shall be followed as directed.

The item shall be providing and fixing Facility Informatory sign boards made out of 2 mm aluminium sheet / 4 mm ACP (Aluminium composite Panel); size 80 x 60 cm rectangular as per design of IRC-67-2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorized with High Intensity Prismatic Grade etc. complete as directed by the Engineer-in-charge.

The payment will be made on number basis of the finished work.

Item No.: - 24.

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

The relevant specifications of this Tender Item No. 22 shall be followed as directed.

The item shall be providing and fixing Regulatory / Mandatory sign boards made out of 2 mm aluminium sheet / 4 mm ACP (Aluminium composite Panel); size 60 cm dia circle as per design of IRC-67-2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorized with High Intensity Prismatic Grade etc. complete as directed by the Engineer-in-charge.

The payment will be made on number basis of the finished work.

Item No.: - 25.

Providing and fixing Stop sign boards made out of 2 mm aluminium sheet / 4 mm ACP (Aluminium composite Panel); size 90 cm octagonal as per design of IRC-67-2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorized with High Intensity Prismatic Grade retro reflective sheeting of Type-4 as per ASTM D-4956 and latest MOST Specifications; 3.6 mtr long stand post of iron angle 75 x 75 x 6 mm / 65NB circular MS pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3 mm; painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of Engineer-in-charge. The fixing at site shall be in 1:2:4 C.C. block of size 45 x 45 x 60 cm for each leg, including excavation, curing etc. complete under the supervision of Engineer-in-charge. A warranty for 7-years for the Retro reflective sheeting from original manufacturer & a certified copy of 3-year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting.

The relevant specifications of this Tender **Item No. 22** shall be followed as directed.

The item shall be providing and fixing Stop sign boards made out of 2 mm aluminium sheet / 4 mm ACP (Aluminium composite Panel); size 90 cm octagon as per design of IRC-67-2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorized with High Intensity Prismatic Grade etc. complete as directed by the Engineer-in-charge.

The payment will be made on number basis of the finished work.

Item No.: - 26.

Providing and fixing Direction (Junction) sign boards made out of 2 mm aluminium sheet / 4 mm ACP (Aluminium composite Panel); size 244 x 122 cms rectangular as per design of IRC-67-2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorized with High Intensity Prismatic Grade retro reflective sheeting of Type-4 as per ASTM D-4956 and latest MOST Specifications; 4.0 mtr long (2 Nos) stand post of 75 x 75 x 6 mm / 65NB circular MS pipe as required and frame fabricated from suitable size iron angle of 50 x 50 x 5 mm; painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of Engineer-in-charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 cms for each leg, including excavation, curing etc. complete under the supervision of Engineer-in-charge. A warranty for 7-years for the Retro reflective sheeting from original manufacturer & a certified copy of 3-year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting.

The relevant specifications of this Tender **Item No. 22** shall be followed as directed.

The item shall be providing and fixing Direction (Junction) sign boards made out of 2 mm aluminium sheet / 4 mm ACP (Aluminium composite Panel); size 244 x 122 cms rectangular as per design of IRC-

67-2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorized with High Intensity Prismatic Grade etc. complete as directed by the Engineer-in-charge.

The payment will be made on number basis of the finished work.

Item No.: - 27.

Providing and fixing Village name / Bump Ahead Sign boards made out of 2 mm aluminium sheet / 4 mm ACP (Aluminium composite Panel); size 90 x 60 cms rectangular as per design of IRC-67-2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorized with High Intensity Prismatic Grade retro reflective sheeting of Type-4 as per ASTM D-4956 and latest MOST Specifications; 3.3 mtr long stand post of 75 x 75 x 6 mm / 65NB circular MS pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3 mm; painted with best quality epoxy coatings in black and white bends. The details of symbol or inscription / letters / 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 60 cms for each leg, including excavation, curing etc. complete under the supervision of Engineer-in-charge. A warranty for 7 years for the Retro reflective sheeting from original manufacturer & a certified copy of 3-year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor.

(B) Class-B Type-4 Retro Reflective sheeting.

The relevant specifications of this Tender Item No. 22 shall be followed as directed.

The item shall be providing and fixing Village name / Bump Ahead Sign boards made out of 2 mm aluminium sheet / 4 mm ACP (Aluminium composite Panel); size 90 x 60 cms rectangular as per design of IRC-67-2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorized with High Intensity Prismatic Grade etc. complete as directed by the Engineer-in-charge.

The payment will be made on number basis of the finished work.

Item No.: - 28.

Providing and fixing Hazard Marker sign boards made out of 1.5mm aluminium sheet / 3mm ACP (Aluminium composite Panel); size 90 x 30 cms rectangular as per design of IRC-67-2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorized with High Intensity Prismatic Grade retro reflective sheeting of Type-4 as per ASTM D-4956 and latest MOST Specifications; 1.8mtr long stand post of Iron Angle 75 x 75 x 6mm / 65NB circular MS pipe as required and frame fabricated from suitable size iron angle of 35 x 35 x 3mm; painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per the instruction of Engineer-in-charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 Cms for each leg including excavation, curing etc. complete under the supervision of Engineer-in-charge. A warranty for 7-years for the Retro reflective sheeting from original manufacturer & a certified copy of 3-year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting.

The relevant specifications of this Tender **Item No. 22** shall be followed as directed.

The item shall be providing and fixing Hazard Marker Sign boards made out of 1.5 mm aluminium sheet / 3 mm ACP (Aluminium composite Panel); size 90 x 30 cms rectangular as per design of IRC-67-2012. Pre-treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorized with High Intensity Prismatic Grade etc. complete as directed by the Engineer-in-charge.

The payment will be made on number basis of the finished work.

Item No.: - 29.

Providing and fixing Tree Guard sign board made out of 2 mm aluminium sheet / 3 mm ACP (Aluminium composite Panel), size 30 cms diameter circle, pre-treated with phosphating process and acid etching, painted with one coat of epoxy primer and two coats of best quality epoxy paint reflectorized with retro reflective sheeting as per latest MOST specifications. A warranty for 7-years for the Retro reflective sheeting from original manufacturer & a certified copy of 3-year outdoor exposure test report from third party test lab for the product offered shall be submitted by contractor. (B) Class-B Type-4 Retro Reflective sheeting.

The relevant specifications of this Tender **Item No. 22** shall be followed as directed.

The item shall be providing and fixing Tree Guard sign board made out of 2 mm aluminium sheet / 3 mm ACP (Aluminium composite Panel), size 30 cms diameter circle, pre-treated with phosphating process and acid etching, painted with one coat of epoxy primer and two coats of best quality epoxy paint reflectorized with retro reflective sheeting and it shall be fixed on site as directed by the Engineer-in-charge.

The payment will be made on number basis of the finished work.

Item No.: - 30.

Providing and erecting a Type-B, "Thrie" Metal Beam Crash Barrier comprising of 3 mm thick corrugated sheet metal beam rail, 85 cm above road / ground level, fixed on ISMC series channel vertical post, 150 x 75 x 5 mm spaced 2 m centre to centre, 2 m high with 1.15 m below ground level, all steel parts and fitments to be galvanized by hot dip process, all fittings to conform to IS:1367 and IS:1364, metal beam rail to be fixed on the vertical post with a space of channel section 150 x 75 x 5 mm, 546 mm long complete as per clause 811) etc. complete as directed by Engineer in charge.

811.3 Metal Beam Crash Barrier**811.3.1 Materials**

811.3.1.1 Metal beam rail shall be corrugated sheet steel beams of the class, type, section and thickness indicated on the drawings. Railing posts shall be made of steel of the section, weight and length as shown on the drawings. All complete steel rail elements, terminal sections, posts, bolts, nuts, hardware and other steel fittings shall be galvanized. All elements of the railing shall be free from abrasions, rough or sharp edges and shall not be kinked, twisted or bent.

811.3.1.2 The "W" beam type safety barrier shall consist of a steel post and a 3 mm thick "W" beam rail element. The steel post and the blocking out spacer shall both be channel section of 75 mm x 150 mm & size 5 mm thick. The rail shall be 70 cm above the ground level and posts shall be spaced 2 m center-to-center. Double "W" beam barrier shall be as indicated in IRC: 5-1998.

The thrie beam safety barrier shall have posts and spacers similar to the ones mentioned above for "W" beam type. The rail shall be placed at 85 cm above the ground level.

The "W" beam, the thrie beam, the posts, spacers and fasteners for steel barriers shall be galvanized by hot dip process (zinc coated, 0.55 kg per square meter; minimum single spot) unless otherwise specified. The galvanizing on all other steel parts shall conform to the relevant IS Specifications. All fittings (bolts, nuts, washers) shall conform to the IS: 1367 and IS: 1364. All galvanizing shall be done after fabrication.

811.3.1.3 Concrete for bedding and anchor assembly shall conform to Section 1700 of these Specifications.

811.3.2 Construction Operations

811.3.2.1 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.

811.3.2.2 Unless otherwise specified on the drawing, railing steel posts shall be given one shop coat of paint (primer) and three coats of paint on structural steel after erection, if the sections are not galvanized. Any part of assembly below ground shall be painted with three coats of red lead paint.

811.3.2.3 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.

811.3.3 Installation of Posts

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

811.3.3.2 All post holes that are dug or drilled shall of such size as will permit proper setting of the posts and allow sufficient room for backfilling and tapping.

811.3.3.3 Holes shall be backfilled with selected earth or stable materials in layers not exceeding 100 mm thickness and each layer shall be thoroughly tamped and rammed. When backfilling and tamping are completed, the posts or anchors shall be held securely in place.

811.3.3.4 Post holes that are drilled in rock and holes for anchor posts shall be backfilled with concrete.

811.3.3.5 Posts for metal beam guardrail 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.

811.3.4 Erection

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

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

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

811.3.5 End Treatment for Steel Barrier

811.3.5.1 End treatments shall form an integral part of safety barriers which should not spear, vault or roll a vehicle for head-on or angled impacts. The two end treatments recommended for steel barriers are "Turned-down-guardrail" and "Anchored in back slope", as shown on the drawings or as directed by the Engineer.

811.3.6 Tolerance

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

The relevant specification as per M.O.R.T. & H. Clause-801, 802 of Section 800 & Section 1900 for fixing and fabrication and other for completed satisfactory work as directed.

811.3.7 Measurements for Payment

811.3.7.1 Metal beam railing barriers will be measured by linear meter of completed length as per plans and accepted in place. Terminals/anchors of various types shall be paid for by numbers.

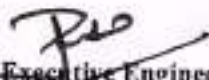
811.3.7.2 Furnishing and placing anchor bolts and/or devices for guard rail posts on bridges shall be considered incidental to the construction and the costs thereof shall be included in the price for other items of construction.

811.3.7.3 No measurement for payment will be made for excavation or backfilling performed in connection with this construction.

811.3.8 Rate

The Contract unit rate shall include full compensation for furnishing of 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 will be made on running meter basis of the finished work.


Deputy Executive Engineer
R & B Sub Division,
ANAND.


Executive Engineer
R & B Division,
ANAND.