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up or down, accordingly.

ITEM-36 : Liquid / Premixed seal coat (IRC type _____) with _____ cmt. of aggregate / stone chippings of _____ Kg. / 10 mg. bitumen per road surface, excluding rolling consolidation (chipping & bitumen shall be paid).

513.1 Scope :

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

513.1.2 Seal coat shall be of either of the two types specified below :

- (a) Liquid seal coat comprising of an application of a layer of bituminous binder followed by a cover of stone chips.
- (b) Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder.

513.2 Materials :

513.2.1. **Binder :** the requirements of Clause 511.2.1 and 511.2.2.1 shall apply.

The quantity of bitumen per 10 square metres, shall be 9.8 Kg for Type A, and 6.8 Kg for Type B seal coat. Where bituminous emulsion is used as a binder the quantities for Type A and Type B seal coats shall be 15 Kg and 10.5 Kg respectively.

513.2.2. **Stone chips for type A seal Coat :** The stone chips shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They should be free of soft or disintegrated stone, organic or other deleterious matter. Stone chips shall be of 6.7 mm. size defined as 100 per cent passing through 11.2 mm sieve and retained on 2.36 mm sieve. The quantity used for spreading shall be 0.09 cubic metre per 10 square metre area.

513.2.3 **Aggregate for Type B seal coat :** The aggregate shall pass 2.36 mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.06 cubic metres per 10 Square metres area.

513.3. Construction Operations :

513.3.1 **Weather and seasonal limitations :** The requirements of clause 501.5.1 shall apply.

513.3.2 **Preparation of surface :** The seal coat shall be applied immediately after laying the bituminous course which is required to be sealed. Before application of seal coat materials, the surface shall be cleaned free of any dust or other extraneous matter.

513.3.3 **Construction of Type A seal coat :** Bitumen shall be heated to 150°C-163°C and sprayed at the rate specified on the dry surface in a uniform manner with a self-propelled mechanical sprayer as described in the Manual for Construction and supervision of Bituminous Works.

Immediately after the application of the cover material, the entire surface shall be rolled with a 8-10 tonne smooth wheeled steel roller, 8-10 tonne static weight vibratory roller, or other equipment approved by the Engineer after laying trials if required. Rolling shall commence at the edges and progress towards the centre except in superelevated and unidirectional cambered portions where it shall proceed from the lower edge to the higher edge. While rolling is in progress, additional chips shall be spread by hand in necessary quantities required to make up irregularities.

513.3.4. **Construction of Type B Seal coat :** A mixer of appropriate capacity and type approved by the Engineer shall be used for preparation of the mixed material. The Plant shall have separate dryer arrangements for heating aggregate.

The binder shall be heated in boilers of suitable design, approved by the Engineer to the temperature appropriate to the grade of bitumen or as directed by the Engineer. The aggregates shall be dry and suitably heated to a temperature between 150°C and 165°C or as directed by the Engineer before these components are placed in the mixer. Mixing of binder with aggregates to the specified proportions shall be continued until the later are thoroughly coated with the former.

The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed.

As soon as a sufficient length has been covered with the premixed material, the surface shall be rolled with an 8-10 tonne smooth-wheeled roller. Rolling shall be continued until the premixed material completely seals the voids in the bituminous course and a smooth uniform surface is obtained.

513.4 **Opening to Traffic :** In the case of Type B seal coat, traffic may be allowed soon after final rolling when the premixed material has cooled down to the surrounding temperature. In the case of Type A seal coat, traffic shall not be permitted to run on any newly sealed area until the following day. In special circumstances, however, the Engineer may open the road to traffic immediately after rolling, but in such case, traffic speed shall be rigorously limited to 16 Km. per hour until the following day.

513.5 **Surface Finish and Quality Control of Work :** The surface finish of construction shall conform to the requirements of Clause 902.

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

513.6 **Arrangements for Traffic :** During the period of construction, arrangements for traffic shall be made in accordance with the provisions of Clause 112.

513.7 **Measurement for Payment :** Seal coat Type A or B shall be measured as finished work, over the area specified to be covered, in square metres at the thickness specified in the Contract.

513.8 **Rate :** The contract unit rate for seal coat Type A or B shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.2 (i) to (xi)

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ITEM - 37 : BITUMINOUS MACADAM**504.1. Scope**

This work shall consist of Construction in a single course having 50 mm. to 100mm or multiple course of thickness of compacted crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these Specifications. Bituminous macadam is more Clauses 507, 508 and 509.

504.2. Materials

5.4.2.1 Bitumen: The bitumen shall be paving bitumen of 60/70 Penetration Grade complying with Indian Standard Specifications for "Paving Bitumen" IS:73, and of the penetration indicated in Table 500.4

5.4.2.2 Coarse Aggregates: The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on the 2.36 mm sieve. They shall be clean, hard, durable, of cubical shape, free from dust and soft or friable matter, organic or other deleterious matter. The bitumen shall be treated with approved anti-stripping agents, as per the manufacturer's recommendations, without additional payment. Before approval of the source, the aggregates shall be tested for stripping.

The aggregates shall satisfy the physical requirements set forth in Table 500.3.

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

504.2.3 Fine Aggregates : Fine aggregates shall consist of crushed material or naturally occurring material or a combination of the two, passing 2.36 mm sieve and retained on 75 micron sieve. They shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter.

TABLE 500.3 : PHYSICAL REQUIREMENTS FOR AGGREGATES FOR BITUMINOUS MACADAM

Property	Test	Specification
Cleanliness	Grain size analysis	Max 5% passing 0.075 mm sieve
Particle shape	Flakiness & Elongation Index (Combined) ¹	Max. 30 per cent
Strength	Los Angeles Abrasion value	Max. 40 per cent
	Aggregate Impact Value ²	Max. 30 per cent
Durability	Soundness ⁴	
	Sodium Sulphate	Max. 12 per cent
	Magnesium Sulphate	Max. 18 per cent
Water Absorption	Water absorption ⁵	Max. 2 per cent
Stripping	Coating and stripping of bitumen aggregate mixtures ³	Min. retained coating 95 per cent
Water Sensitivity ⁷	Retained Tensile strength	Min 80%

Notes: 1. IS:2386 Part 1

4. IS:2386 Part 5

2. IS:2386 Part1

5. IS:2386 Part 3

The elongation test to be done only on non flaky aggregates in the sample

3. IS:2386 Part 4*

6. IS:6241

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

* Aggregates may satisfy requirements or either of these two tests.

504.2.4 Aggregate grading and binder content: When tested in accordance with IS:2386 (Part 1) (wet sieving method), the combined aggregate grading for the particular mixture shall fall within the limits shown in Table 500.4. The type and quantity of bitumen are also indicated in Table 500.4. for the grading specified in the contract. The type and quantity of bitumen and appropriate thickness, are also indicated for each mixture type.

504.2.5 Proportioning of Materials : The aggregates shall be proportioned and blended to produce a uniform mixture complying with the requirements of Table 500.4. The binder content shall be within a tolerance of \pm percent by weight of total mixture when individual specimens are taken for quality control tests in accordance with the provisions of Section 900

TABLE 500.4 : COMPOSITION OF BITUMINOUS MACADAM

Mix designation Nominal aggregate size Layer thickness IS Sieve (mm)	GRADING : 1 40 mm 80-100 mm	GRADING : 2 19 mm 50 - 75 mm
	Cumulative Per cent Passing by Weight of Total Aggregate	
45	100	
37.5	90-100	
26.5	75-100	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

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0.075	0-8	0-5
*Bitumen content, % by weight of total mixture	3.1-3.4	3.3-3.5
Bitumen Penetration Grade	35 to 90	35 to 90

Notes : * Appropriate bitumen contents for conditions in cooler areas of India may be upto 0.5 per cent higher, subject to the approval of the Engineer.

The binder content shall be within a tolerance of ± 0.3 per cent by weight of total mixture when individual specimens are taken for quality control tests in accordance with the provisions of Section 1800. Asphalt 60/70 3.4 % by weight of total mix shall be used for mixing

504.3. Construction Operations

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

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 Clause 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.

504.3.3 Tack Coat : A tack coat in accordance with Clause 503 shall be applied as specified in the Contract documents or as directed by the Engineer. The provisions of Clauses 501.3 and 501.4 shall apply.

(i) At the edges of the layers of material and at gullies and manholes.

(ii) At the approaches to expansion joints at bridges, viaducts or other structures.

(iii) As directed by the Engineer.

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 provision 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 on account of the construction procedure adopted by the Contractor, the course shall be covered by a seal coat to the requirement of Clause 509 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 Measurements for Payment : Bituminous macadam shall be measured as finished work in cubic metres or by weight in metric tonnes. Where used as regulating course or square meter at the specified thickness as indicated in the contract or shown on the drawing 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 for, all components listed in Clause 501.8.8.2 (i) to (xi).

ITEM - 38 : BUILT-UP SPRAY GROUT

506.1 Scope

This work shall consist of a two layer composite construction of compacted crushed coarse aggregates with application of bituminous binder after each layer and key aggregates on top for the second layer, in accordance with the requirements of these Specifications to serve as a base course and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer. Thickness of the course shall be 75mm.

Build-up spray grout shall be used in a single course in a pavement structure.

506.2. Materials

506.2.1. Bitumen : Clause 504.2.1 shall apply.

506.2.2. Aggregates: The coarse aggregate shall conform to Clause 504.2.2.

The aggregate shall satisfy the physical requirements set out in Table 500-3. The coarse and key aggregates for built-up spray grout shall conform to the grading given in Table 500-7.

TABLE 500-7. GRADING REQUIREMENTS OF COARSE AND KEY AGGREGATES FOR BUILT-UP SPRAY GROUT

IS Sieve Designation	Per cent by weight passing the Sieve	
	Coarse Aggregate	Key Aggregate
53.0 mm	100	-
26.5 mm	40-75	-
22.4 mm	-	100

13.2 mm	0.20	40.75
5.6 mm	-	0.20
2.8 mm	0.5	0.5

506.3. Construction Operations

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

506.3.2. Equipment: The provisions of Clause 505.3.2. shall apply.

506.3.3. Preparation of base: The base on which the built-up spray grout course is to be laid shall be prepared, shaped and conditioned to the specified lines, grades and cross-sections in accordance with Clause 501 and 902. A priming coat where needed shall be applied in accordance with Clause 502 with suitable primer as directed by the Engineer.

506.3.4. Tack coat: A tack coat over the base shall be applied as per Clause 503.

506.3.5. Spreading and rolling coarse aggregates for the first layer: Immediately after the application of tack coat, the coarse aggregates in a dry and clean form shall be spread uniformly and evenly preferably by mechanical means at the rate of 0.5 cu.m. per 10 sq.m area. Immediately after spreading of the aggregates, the entire surface shall be rolled with a 80-100 kN smooth-wheeled roller. Rolling shall commence at the edges and progress towards the centre except in superelevated and uni-directional cambered portions where it shall proceed from the lower edge to the higher edge.

After initial rolling, the surface shall be checked transversely and longitudinally with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate, followed by rolling.

Rolling shall be stopped before voids in the aggregate layer are closed to such an extent as to prevent free and uniform penetration of the binder.

506.3.6. Application of binder-first spray: The binder shall be heated to the temperature appropriate to grade of bitumen approved by the Engineer and sprayed on aggregate layer at the rate of 15 kg/10 sq. m. (in terms of straight-run bitumen) in a uniform manner with the help of mechanical sprayers capable of spraying bitumen uniformly at specified rates and temperatures.

506.3.7. Spreading and rolling of coarse aggregate for the second layer: Immediately after the first application of the binder, the second layer of coarse aggregates shall be spread and rolled to Clause 506.3.5.

506.3.8. Application of binder-second spray: The second aggregate layer shall then be given a binder spray at the rate of 15 kg/10 sq.m. (in terms of straight-run bitumen) to Clause 506.3.6.

506.3.9. Application of key aggregate: Immediately after second application of the binder, key aggregates in a clean and dry state shall be spread uniformly and evenly, preferably by mechanical means at the rate of 0.13 cu.m./10 sq.m. so as to cover the surface completely. If necessary, the surface shall be broomed to ensure uniform application of the key aggregates. The entire surface shall then be rolled with a 80-100 kN smooth-wheeled roller to Clause 506.3.4. While rolling is in progress, additional key aggregates, where required, shall be spread by hand. Rolling shall continue until the entire course is thoroughly compacted and key aggregates are firmly in position.

506.4. Surface Finish and Quality Control

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.

506.5. The built-up spray grout shall be provided with final surfacing without any delay. If there is to be any delay, the course shall be covered by a seal coat in accordance with Clause 513 before allowing any traffic over it. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

506.6. Arrangements for Traffic: During the period of construction, arrangement of traffic shall be done to Clause 112.

506.7. Measurements for Payment: Built-up spray grout shall be measured as finished work in square metres.

506.8. Rate: The contract unit rate for built-up spray grout shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8 (i) to (xi).

Item No. 39: Close graded premix surfacing / mixed seal surfacing

512.1. Scope:

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

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

512.2. Materials

512.2.1. Binder: The provisions of Clause 511.1.2.1 shall apply.

512.2.2. Coarse aggregates: The provisions of Clause 511.1.2.2 shall apply.

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

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

TABLE 500-26. AGGREGATES GRADATION FOR MIX SEAL SURFACING

IS Sieve Designation	Cumulative per cent by weight of total aggregate passing	
	Type A	Type B
13.2 mm	-	100
11.2 mm	100	88-100
5.6 mm	52-88	31-52
2.8 mm	14-38	5-25
0.090 mm	0-5	0-5

512.2.5. Proportioning of materials: The total quantity of aggregates used for Type A or B close-graded premix surfacing shall be 0.27 cubic metre per 10 square metres area. The quantity of binder used for premixing in terms of straight-run bitumen shall be 22.0 kg and 19.0 kg per 10 square metres area for Type A and Type B surfacing respectively.

512.3. Construction Operations : The provisions of Clause 511.1.3.1. Through 511.1.3.5. shall apply.

512.4. Opening to Traffic : Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature.

512.5. Surface Finish and Quality Control of Work : The surface finish of construction shall conform to the requirements of Clause 902. For control on the quality of materials supplied and the works carried out, the relevant provisions of Section 900 shall apply.

512.6. Arrangements for Traffic : During the period of construction, arrangement for traffic shall be accordance with the provisions of Clause 112.

512.7. Measurements for Payment : Close-graded premix surfacing, Type A or B shall be measured as finished work for the area specified to be covered, in square metres at a specified thickness.

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

Item No. 40 : Road marking with hot applied thermoplastic compound with reflectorising glass beads on bituminous surface providing and laying hot applied thermoplastic compound 2.5 mm thick including reflectorised glass beads @ 250 gms per sq.mt. area thickness of 2.5 mm exclusive of surface applied glass beads as per IRC:35. The finished surface to be level, uniform & free from streaks & holes.

803.1. General

The colour, width and layout of road markings shall be in accordance with the code of Practice of Road Markings with paints, 1 RC: 35, and specified in the drawings or as directed by the Engineer.

803.2. Materials

Road marking shall be of hot applied thermoplastic compound, and reflectorised paint specified in the item and the material shall meet the requirements as specified below.

803.3 Hot Applied Thermoplastic Road Marking

803.4.1 General :

- The work under this section consists of marking traffic stripes using a thermoplastic compound meeting the requirements specified herein.
- The Thermoplastic compound shall be screeded /extruded on to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall be produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.
- The colour of the compound shall be white or yellow (IS colour no. 356) as specified in the drawings or as directed by the engineer.

803.4.2 Thermoplastic materials.

803.4.2.1 General:

The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorizing beads.

803.4.2.2 Requirement:

In composition the pigment, beads and aggregate shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt and foreign objects and shall comply with requirements indicated in Table 800-3.

Table 800-3 PROPORTIONS OF CONSTITUTENTS OF MARKING MATERIAL (Percentage by weight)

Component	White	Yellow
Binder	18.0 min.	18.0 min.
Glass Beads	30 - 40	30 - 40
Titanium dioxide	10.0 min.	-
Calcium Carbonate and Inert Fillers	42.0max.	See Note
Yellow pigments	-	See Note

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

II Properties :

The properties of thermoplastic material, when tested in accordance with ASTM D36/8S-3262 (Part-I) shall be as below:

A) Luminance:

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

803.4.3 Reflectorizing glass beads:

803.4.3.1 General : The specification covers types of glass beads to be used for to production of reflectorised pavement markings.

Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 800-3 and type-2 beads are those which are to be sprayed on the surface vide clause 803.6.3

803.4.3.2 The glass beads shall be transparent, colourless and free from miliness, dark particles and excessive air inclusions. This shall conform to the requirements spelt out in clause 803.4.3.3.

803.4.3.3 Specific requirements .

Gradation : The glass beads shall meet the gradation requirements for the two types as given in Table 800-4.

TABLE 800-4 GRADATION REQUIREMENT FOR GLASS BEADS

Sieve size	Percent Retained	
	Type 1	Type 2
1.18 mm	0 to 3	-
850 micron	5 to 20	0 to 5
600 micron	-	5 to 20
425 micron	65 to 95	-
300 micron	-	30 to 75
180 micron	0 to 10	10 to 30
Below 180 Micron	-	00 to 15

Roundness : the glass beads shall have a minimum of 70 percent true spheres.

Refractive index: The glass beads shall have a minimum refractive index of 1.50.

Free flowing properties : The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paints striping. They shall pass the free flow-test.

803.4.3.4 Test methods : The specific requirement shall be tested with the following methods.

The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads obtained from a reputed laboratory showing results of all tests specified therein and shall certify that material meets all requirements of this specification. However, if so required, these tests may be carried out as directed by the engineer.

803.4.4 Application properties of thermoplastic material.

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

803.4.4.2 The materials upon heating to application temperatures shall not exude fume-, which are toxic, obnoxious or injurious to persons property.

1.3.5 Preparation : The materials shall be melted in accordance with the manufacturer's instruction- in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic materials to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer and shall on no account be allowed to exceed the maximum temperature started by the manufacturer.

ii) After transfer to the laying equipment the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.1.3.6 Properties of finished road marking:

The stripe shall be not be slippery when wet.

The marking shall not lift from the pavement in freezing weather.

After application and proper drying the stripe shall show no appreciable deformation or discoloration under traffic and under road temperatures up to 60 C.

The marking shall be deteriorate by contact with sodium chloride calcium chloride or oil drippings from traffic.

The stripe of marking shall maintain its original dimension3 and position.

The colour of yellow marking shall conform to IS colour no. 356 as given in IS : 164.

803.5 Reflectorised Paint : Reflectorised paint, if used, shall conform to the specification by the manufacturers and approved by the engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirements of clause 803.4 3

803.6 Application :

803.6.1 Marking shall be done by machine. For locations where painting cannot- be done by machine, approved manual

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Methods shall be used with prior approval of the engineer. The contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

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

803.6.3 The pavement temperature shall not be less than 10°C during application.

All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint. The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line of compatible material. Such new material shall so bond itself to the old line that no splitting or separation takes place.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed.

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

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

803.7 Measurement for Payment :

803.7.1 The painted marking shall be measured in sq. meters of actual area marked (excluding the gaps, if any).

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

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

803.9 SPECIAL TERMS AND CONDITIONS FOR THERMOPLAST PAINT WORK:

(1) Agency should carry out the such type of work by only of thermoplastic paint laying machine (power driven only) with temperature controller and automatic mixing arrangement of glass beads in required proportion.

(2) After completion of the laying of thermoplastic paint work, two years guarantee for durability and reflectivity as per M.O.S.T. specification for road and bridge works clause 803 should be given by the bidder in the writing.

(3) Guarantee security deposit shall be retained 1% of the cost of the item of thermoplast paint from the R.A. bills, which will be released after expiry of guarantee period.

(4) Agency who carry out the such type of work shall have an experience of carrying out similar type of work.

(5) Test certificates as per M.O.S.T specification for road and bridge works clause 803.3.2.2 (vi) should be furnished of reputed laboratory before.

Item No. 41 : Supplying and fixing Cat-Eye made out of ASA (Acrylic styrene acrylonitrile) injection high compressed moulding with reflector made of MMC reflector cube corner reflector design filled with tightly adhering potting compound as per ASTM D 788 size 11.5 cm x 7 cm x 1.6 cm provided with bituminous adhesive 100 gm. with each unit for fixing (Engineer Grade).

801.1 General

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

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

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

801.2 Materials

The various materials and fabrication of the cat eye shall conform to the following requirements:

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

801.2.2 The materials shall be used for the body of the delineator is of high density PVC materials.

801.2.3 The dimensions and size of the cat-eye shall be as per IS standard. The retro reflective sheeting used on the cat-eye 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.

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High intensity grade sheeting: This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent water-proof plastic having a smooth surface. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM Standard E: 810).

TABLE 800.1. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO. REFLECTION FOR HIGH INTENSITY GRADE SHEETING
(CANDELAS PER LUX PER SQUARE METRE)

Observation angle (in degrees)	Entrance Angle (in degrees)	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 per cent of the values of retro-reflectance indicated in Table 800-1. At the end of 7 years, the sheeting shall retain at least 75 per cent of its original retro-reflectance.

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

1.4 Installation

The Cat eye 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 Measurements for Payment

The measurement of Cat eye shall be in numbers, these shall be measured in NO.

1.6 Rate

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

Item No. 42 : Road Delineators

805.1 General : The work covers supplying and fixing roadway indicators, hazard markers and object markers.

805.2 The design, materials to be used and the location of the road delineators shall conform to Recommended Practice for Road Delineators, IRC: 79, and to relevant drawings or as otherwise directed by the Engineer.

805.3 Measurements for Payment : The measurement shall be made in numbers of delineators fixed at site.

805.4 Rate : The contract unit rate for road delineators shall be payment in full compensation for furnishing all labour, materials, tools, equipment for preparing supplying and fixing at site and all other incidental costs necessary to complete the work to these Specifications.

Item No. 43 : Providing and fixing Hectometer Stone as per IRC type design including painting and lettering etc. complete (ii) Fixing in CC 1:5:10

The work covers the supply, painting, lettering and fixing of Hectometer stone.

The dimensions of the stones and the size, colour, arrangement of letters and scripts shall be as per I.R.C. : 26 type designs. The Hectometer stone shall be pre cast cement concrete 1:2:4 for which relevant specification shall be followed. The stone shall be bedded into the ground with adequate foundation in C.C. 1:4:8 as indicated in the drawings or in the relevant I.R.C. Specifications or as directed by the Engineer-in-charge. The orientation and location of the stones shall be as indicated in the drawings or in the relevant I.R.C. Specifications or as directed by the Engineer-in-charge.

MEASUREMENT OF PAYMENT

The measurement will be taken in Numbers of Hectometer stone fixed at site.

RATE

The contract unit rate for Hectometer stones shall be payment in full compensation for furnishing, all labour, materials including providing necessary reinforcement, tools, equipment and making the stones, painting and lettering and fixing at site and all other incidental costs necessary to complete the work to the specifications.

Item No. 44 : Providing and fixing Guard stone as per IRC type design including white washing etc. comp. (i) Fixing in earth

The guard stone shall be approved quality of pre-cast C. C. 1:2:4 including necessary reinforcement and of 20 x 15 cm. size and its length shall not be less than 75 cms. The top portion shall be rounded. The top 38 cms. shall be chiseled dressed on all sides. The size, shape and dimensions of the guard stone shall be exact and shall be neatly dressed and finished.

The guard stone shall be fixed in earth. Rate includes all labour & curing etc. necessary for work. The exposed part of the guard stone shall be given three coats of white wash. Any excavation necessary for fixing to guard stones shall be done by the contractor at his own cost. The

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measurement for payment shall be per Number of guard stone fixed in position.

RATE

The contract unit rate for Guard Stones shall be payment in full compensation for furnishing all labour, materials including providing necessary reinforcement, tools, equipment and making the stones white washing and fixing at site and all other incidental, taxes, costs, necessary to complete the work to these specifications.

Item No. 45 :- Providing and fixing ordinary Kilometer Stone of precast C.C. 1:2:4 including necessary reinforcements as per IRC type design and fixing in C.C. 1:4:8 including lettering and paints etc. complete.

1. Ordinary Kilometer stone shall be of approved quality of precast 1:2:4 RCC. as specified in the item.
2. The size, manner of fixing, painting and lettering of KM stone shall conform specification as per IRC - 8 (Type design for Highway kilometre stones). The fixing of KM stone shall be carried out in ordinary payment shall be made per No. of KM stone fixed in position.
3. Fixing in C.C. 1:4:8

The indicator stone shall be fixed in C.C. 1:4:8 which will consist of one part of cement, five part of good sand and ten parts of good brick bats. Rate includes all labour and curing etc. necessary for concrete.

4. Unit rate for ordinary kilometre stone includes the cost of all materials labour, tools, fixing finishing curing lettering and painting as directed by the Engineer-in-charge.
5. Payment shall be made carried out on number basis.

ITEM-46 Providing and fixing fifth kilometre stone of precast C.C. 1:2:4 including necessary reinforcement as per I.R.C. type design in C. C. 1:4:8 including painting and lettering etc. complete. (for N.H., S.H. and M.D.R.)

1. The work shall be carried out as per the item of ordinary kilometre stone except that the size of the fifth kilometre stone shall be bigger than that of ordinary kilometre stone as per I.R.C.-8 (Type design for highway kilometre stones). The fixing of K. M. stone shall be in ordinary concrete of grade specified in the item. The measurement for payment as well as the operation included in the unit rate shall be as per ordinary kilometre stone.

Item No. 47 :- Providing and fixing R.C.C. Indicator Stone of approved stone as per IRC type design in C.C. 1:4:8 including white washing etc. complete (i) Fixing in C.C. 1:5:10

1. Indicator stones shall be of approved quality and of the size 20 cm x 20 cm its length shall not be less than 80 cms. The top, 38 cm shall be chisel dressed on all sides. The size, shape and dimension of the indicator stone shall be exact and stones shall be neatly dressed and finished before fixing. The indicator stones shall be fixed firmly in position in embankment or cutting as the case may be. The exposed part of the indicator stone shall be done by the contractor at his own cost. The measurement for payment shall be per number of indicator stone fixed in position.
2. The indicator stone shall be fixed in C.C. 1:5:10 which will consist of one part of cement, five part of good sand and ten parts of good brick bats. Rate includes all labour and curing etc. necessary for concrete.
3. Unit rate of indicator stone includes the cost of all materials, labour, tools, fixing and white washing as directed by the Engineer in charge.

Item No. 48 :- (Route Marker Sign) Providing & fixing sign boards made out of 2mm aluminium sheet size ____ cms. square as per the design of IRC 67 1977. Pre treated with phosphating process & acid etching. coated with one coat of epoxy primer and two coats of best quality epoxy paint reflectorised with retro sheeting as per latest M.O.S.T. Specifications. Letters & numerals should be as per IRC 30-1968, 3.1m long stand post and frame fabricated either from suitable size iron angle of ____ mm & ____ mm. Painted with best quality epoxy coating. The fixing at site shall be in 1:2:4 CC block of size ____ cms. cms. for each leg, including excavation curing etc. complete under the supervision of engineer in charge. (B) High Intensity Grade

The sign board shall conform to IRC-67-1977 and ninth schedule of the motor vehicle Act. It shall be providing and fixed as directed by the Engineer in charge.

1.2 Traffic Signs having retro-reflective sheeting :

1.2.1 General Requirements :

The retro-reflective sheetings used on the sign 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 show 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 type of sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

1.2.2 High Intensity Grade Sheetting :

1.2.2.1 Encapsulated Lens Type :

This sheeting shall be of encapsulated lens type consisting of spherical glass lens elements, adhered to a synthetic resin and encapsulated by a flexible, transparent water proof plastic having a smooth surface. The retro reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM Standard E:810) as indicated in Table 800-1.

TABLE 800-1 ACCEPTABLE MINIMUM CO-EFFICIENT OF RETRO REFLECTIVE FOR HIGH INTENSITY GRADE SHEETING (CANDELAS PER LUX SQUARE METRE).

Observation angle (in degrees)	Entrance Angle (in degrees)	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% of the values of retro reflectance indicated in Table 800-1. At the end of 7 years, the sheeting shall retain at least 75% of its original retro-reflectance.

1.3.2 Engineering Grade Sheeting:

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

TABLE 800-2 ACCEPTABLE MINIMUM CO-EFFICIENT OF RETRO REFLECTIVE FOR ENGINEERING GRADE SHEETING (CANDELAS PER LUX SQUARE METRE).

Observation angle (in degrees)	Entrance angle (in degrees)	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	14.5	7.5	2.0
0.5	+30	15	13	4.0	2.2	3.0	0.8

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

1.1.3 **Messages/Boarders:** The messages (legends, letters, numerals etc.) and borders shall either be screen-printed or of cut-outs. Screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. Cut outs shall be of materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer.

1.1.4 For screen-printed transparent coloured areas on white sheeting, the co-efficient of retro-reflection shall not be less than 50% of the values of corresponding colour in Tables 800-1(a), 800-1(b) and 800-2 as applicable.

1.1.5 Cut out messages and borders, wherever used, shall be made out of retro-reflective sheeting (as per Clause 1.1.2) except those in black which shall be of non-reflective sheeting.

1.1.6 **Colour:** Unless otherwise specified, the general colour scheme shall be as stipulated in IS:5 "Colour for Ready Mixed Paints".

Blue IS Colour No.166 : French Blue

Red IS Colour No.537 : Signal Red

Green IS Colour No.284 : India Green

Orange IS Colour No.591 : Deep Orange

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

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

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

1.1.9 Fabrication:

1.1.9.1 Surface to be reflectorised shall be prepared to receive the retro-reflective sheeting. The 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.

1.1.9.2 Complete sheets of the material shall be used on the signs, except where it is unavoidable. At splices, sheeting with pressure sensitive adhesive shall be overlapped not less than 5 mm. Sheeting with heat-activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. Where screen printing with transparent colours is proposed, only but jointing shall be used. Cut outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

1.1.10 Warranty Durability : For each lot of sheetings procured, the contractor shall obtain from the manufacturer a 7 years warranty for satisfactory field performance including stipulated retro-reflectance of the sheetings of high intensity grade and a 5 years warranty for the engineering grade and submit the same to the Engineer. In addition, a 7 years and a five years warranty for satisfactory in-field performance of the finished sign with retro-reflective sheeting of high intensity grade and engineering grade respectively, inclusive of the screen printed or cut-out letters/legends and their bonding to the retro-reflective sheeting shall be obtained from the contractor/supplier and passed on to the Engineer.

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

2 Installation :

1.2.1 Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally signs with an area upto 0.9 sq.m. shall be mounted on a single post, and for greater area two or more supports shall be provided. Sign supports may be of mild steel, reinforced concrete or galvanised iron (G.I.). Post-end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant specifications as specified.

1.2.2 All components of signs and supports, other than the reflective portion and G.I. Posts shall be thoroughly descaled, cleaned, primed and painted with two coats of epoxy paint. Any part of mild steel (M.S.) post below ground shall be painted with three coats of red lead paint.

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

1.3 Measurements for Payment :

The measurement for standard cautionary, mandatory and information sign shall be in number of different types of signs supplied and fixed as per above details and specifications.

1.4 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.

Item No. 49 : Providing and fixing Village name boards made out of 2 mm aluminium sheet size 90 x 60 cms Rectangle as per the design of IRC-67-1977 pre treated with Phosphating process and acid etching coated with one coat of epoxy primer and two coats of best quality epoxy paint reflectorised with retro reflective sheeting as per latest M.O.S.T specifications Letters and numerals should be as per IRC-30-1968-. 310m long (2 Nos) stand post and frame fabricated from suitable size iron angle of 50 X 50 X 5 mm painted with best quality epoxy coating in black and white bends The details of symbol or inscription / numerals for each boards 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 cms for each leg including excavation, curing etc. complete under the supervision of Engineer-in-charge (B) High Intensity Grade

Specification of Item No. 49 shall be followed for the execution of this item except the size of sign board made out of 2mm aluminium sheet is size 90 x 60 cm equilateral rectangle instead of size 60 x 45 cms rectangle.

Item No. 50 : For Curves / Parking ahead / speed limit / Hazard marker sign* Providing and fixing sign boards made out of 2mm aluminium sheet size ____ x ____ cms. equilateral triangle as per the design of IRC-67-1977 pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75 x 75 x 6mm as required painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per 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. (B) High Intensity Grade

Specification of Item No. 49 shall be followed for the execution of this item except the size of sign board made out of 2mm aluminium sheet is size ____ cm equilateral rectangle instead of size 60 x 45 cms rectangle, or as directed by Engineer-in-charge.

Item No. 51 : (Parking Ahead) Providing and fixing sign boards made out of 2mm aluminium sheet; size 150 x 90 cms. rectangle as per the design of IRC-67-1977 pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; Letters and numerals should be as per IRC-30-1968, 3.1m long (2 nos) stand post and frame fabricated from suitable size iron angle of 50x50x5mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg including excavation curing etc. complete under the

supervision of Engineer in charge. (B) High Intensity Grade

Specification of Item No. 49 shall be followed for the execution of this item except the size of sign board made out of 2mm aluminium sheet is size 150 x 90 cm equilateral rectangle instead of size 60 x 45 cms rectangle.

Item No. 52 : Providing and fixing Direction / Junction boards made out of 2 mm aluminium sheet size 244 x 122 cms Rectangle as per the design of IRC-67-1977 pre treated with Phosphering process and acid etching, coated with one coat of epoxy primer and two coats of best quality epoxy paint, reflectorised with retro reflective sheeting as per latest M.O.S.T. specifications Letters and numerals should be as per IRC-30-1968, 3.10 m long (2 Nos) stand post and frame fabricated from suitable size iron angle of 50 X 50 X 5 mm, & 75 x 75 x 6 mm painted with best quality epoxy coating in black and white bends The details of symbol or inscription / numerals for each boards 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 cms for each leg including excavation curing etc complete under the supervision of engineer-in-charge (B) High Intensity Grade

Specification of Item No. 49 shall be followed for the execution of this item except the size of sign board made out of 2mm aluminium sheet is size 244 x 122 cm equilateral rectangle instead of size 60 x 45 cms rectangle.

Item No. 53 : (Speed Limit) Providing and fixing sign boards made out of 2mm aluminium sheet; size 60 cms. diameter circle as per the design of IRC-67-1977 pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; 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 60cms. for each leg. including excavation curing etc. complete under the supervision of Engineer in charge. (B) High Intensity Grade.

Specification of Item No. 49 shall be followed for the execution of this item except the size of sign board made out of 2mm aluminium sheet is size 60 cm equilateral rectangle instead of size 60 x 45 cms rectangle.

Item No. 54 : (Hazard Marker Sign) Providing and fixing Sign boards made out of 2mm aluminium sheet size 90 x 30 cms. rectangle as per the design / drawing attached (IRC) pre-treated with phosphating & acid etching, coated with one coat of epoxy primer and two coats of best quality epoxy paint reflectorised with retro reflective sheeting as per latest MOST Specification 3.1m long stand post and frame fabricated either from suitable size iron angle of 35x35x3mm & 50x50x5mm painted with best quality epoxy coatings in black and white bends. The details of symbol of inscription / numerals for each board shall be as per instruction of engineer in charge the fixing at site shall be in 1:2:4 C.C. block of size 45x45x60cms for each leg including excavation curing etc. complete under the supervision of engineer in charge (B) High intensity grade

Specification of Item No. 109 shall be followed for the execution of this item except the size of sign board made out of 2mm aluminium sheet is size 90 x 30 cm equilateral rectangle instead of size 60 x 45 cms rectangle.

Item No. 55 :- Painting lines, dashes, arrows, letters etc. on roads, Air fields and like in two coats with road marking paint, brushing including cleaning the surface of all dirt, dust and other foreign matter. (i) Over 10cm in width

Materials : The Road marking paint shall be conform to IS 164-1951.

Workmanship : The painting of lines dashes arrows and letters on roads, air fields and like shall be carried out with road marking paint in two coats upto 10 cm. width.

Mode of Measurement and Payment : Letters figures and similar items etc. stops, commas, hyphens and like shall be deemed to be include in the item the rate per cm. height / width shall hold good irrespective of width of letter, figures or the thickness of lettering.

The Rate shall be for a Unit of one Sq.mt. basis.

ITEM 56 : Providing and laying uncoursed rubble masonry with hard stone of approved quality in foundations and plinth in cement mortar 1:6 (1 cement : 6 coarse sand) including levelling up etc. complete.

1. Stone shall be hard, sound, free from cracks, decay and weathering and shall be freshly quarried from an approved quarry. Stone with round surface shall not be used. The stones when immersed in water for 24 hours shall not absorb water by more than 5 percent of their dry weight when tested in accordance with IS : 1124. The length of stone shall not exceed three times its height and the breadth on base shall not be greater than three fourths of the thickness of wall nor less than 15 cm.

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

3. The mixing shall be done intimately. The operation shall be carried out on a clean water tight platform, and cement and sand shall be first mixed dry in the required proportion to obtain as uniform colour and then the mortar shall be mixed for at least two minutes after addition of water. In case of cement mortar, that has stiffened because of evaporation of water the same shall be rettempered by adding water as frequently as needed to restore the requisite consistency, but this rettempering shall be permitted only, within thirty minutes from the time of addition of water at the time of initial mixing.

4. The dressing of stone shall conform to the general requirements of dressing of stone covered in IS : 1129. Stones shall be sufficiently wetted before laying to prevent absorption of water from mortar. The bed which is to receive the stone shall be cleaned, wetted and covered with a layer of fresh mortar. All stones shall be laid full in mortar both in bed and in vertical joints and settled carefully in place with a

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wooden mallet immediately on placement so that it is solidly bedded in mortar before the same has set. Clean chips and spalls shall be edges into the mortar joints and beds wherever necessary to avoid thick beds or joints of mortar. Whenever foundation masonry is laid directly on rock, the face stones of the first course shall be dressed to fit into the rock snugly when pressed down in the mortar bedding over the rock. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faced completely covered with mortar. Vertical joints shall be staggered as far as possible. Sufficient transverse bond shall be provided by the use of bond stones extending from the front to the back of the masonry. In case of thick walls bond stones shall overlap each other in their arrangement. Bell shaped bond stones or headers shall not be used.

5. At all angular junctions, stones at each alternate course shall be well bonded into the respective course of the adjacent wall. All connected masonry in structure shall be carried up at one uniform level throughout as far as possible, but when breaks are unavoidable, the masonry shall be raked in sufficient long steps to facilitate joining or new work with old. The stepping of taking shall not be more than 45 degree with horizontal wing walls. Abutments and piers etc. shall be carved up truly plumb or with the specified batter. Face work and hearting shall be brought up evenly. The top of each course, however, shall not be levelled up by use of flat chips.

6. Stone shall be hammer dressed on the face, the sides and beds to enable it to come in proximity with the neighboring stone. The bushing on the face shall not be more than 4 cm on exposed face chips and spalls of stone may be used where necessary to avoid thick mortar beds or joints and it shall also be ensured that no hollow spaces are left anywhere in the masonry. The chips shall not be used below hearting stone to bring these up to the level of face stone. Use of chips shall be restricted to filling of interstices between the adjacent stones in hearting and they shall not exceed 20 percent of the quantity of stone masonry.

7. The hearting or interior filling of wall face shall consist of rubble stones not less than 15 cm. in any direction, carefully laid, hammered down with a wooden mallet into position and solidly bedded in the mortar. The hearting should be laid nearly level with facing and backing. Through bond stone shall be provided in masonry upto 60 cm. thickness and in case of masonry above 60 cm. thickness a set of two or more than bond stones overlapping each other at least by 15 cm shall be provided in a line from face to back. In case of highly absorbent types of stone (Porous lime stone and sand stones etc.) the bond stone shall extend only about two third into the wall, as through stone in such cases may give rise to penetration of dampness and therefore for all thickness of such masonry a set of two or more bond stones, overlapping each other by at least 15 cm shall be approved. One bond stone or a set of bond stones shall be provided for every 0.50 square metres of the masonry surface. Bond stones shall be stacked separately and marked to distinguish from other stones. Masonry work shall be started after sufficient number of bond stones are collected on site as directed by the Engineer-in-charge.

8. The quoins shall be laid header and stretcher alternately. Every stone shall be fitted to the adjacent stone so as to form neat and close joint. Face stone shall extend and bond well in the back. These shall be arranged to break joints, as such as possible and to avoid long vertical lines of joints.

9. The face joints shall not be more than 20mm thick, but shall be sufficiently thick to prevent stone to stone contact and shall be completely filled with mortar.

10. Greenwork shall be protected from rain by suitable covering. Masonry work in cement or composite mortar shall be kept constantly wet on all faces for a minimum period of seven days. The top of the masonry work shall be left flooded with water at the close of the day. During hot weather all finished or partly completed work shall be covered for wetted in such manner as will prevent rapid drying. The racking of joints where necessary shall be done at the end of day's work when mortar is green.

11. The scaffolding shall be sound and strong to withstand all loads likely to come upon it. The holes which provide resting space for horizontal members shall not be left in masonry under one metre in width or immediately near the skew backs of arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good.

12. When fresh masonry is to be placed against existing surface of structures, these shall be cleaned of all loose material, roughened and wetted as directed by the Engineer-in-charge so as to effect a good with the new work.

13. Stone masonry shall be measured cubic meters.

14. The contract unit for stone masonry work shall include the cost of all labour, materials, tools and plant, Scaffolding and other expenses incidental to the satisfactory completion of the work as described herein above.

ITEM - 57 : Providing & fixing Flood guage post of M.S. angle 75 x 75 x 6 mm incl Painting lettering & fixing in position ordinary C.C. 1:2:4 as directed

The flood guage is to be fixed as per I.R.C. Standard Specification having 75 mm x 75 mm x 6 mm size, M.S. angle having height equal to 1.43 mt. It shall be fixed in C.C. 1:2:4 as per drawing. The painting shall be done applying one primer coat & three coats of oil paint as per requirement & as per drawing using approved paints including lettering for flood guage marking as per I.R.C. std. & drawings.

The work shall be carried out and materials used shall be to the entire satisfaction of the Engineer-in-charge.

The rate inclusive of all materials and labour with carriage, fixing, painting etc. complete as per drawing and direction of the Engineer-in-charge.

The measurement & Rate paid shall be on Number basis of flood guage fixed.

ITEM-58 : Providing and fixing junction Board of R.C.C. precast as per standard design of I.R.S. including fixing in C.C. block of 1:4:8 with necessary excavation enamel painting, lettering figures etc. complete.

1. These boards should be fixed at a distance of 120 metre from the centre line of the crossing and they should be located on the left hand side of the road in the direction of the traffic and facing the traffic.

2. The board will be located in such a way that the edge of the board towards the centre of the road will be at a distance of 4.57 metres from the centre of a National Highway and 3.66 meters from the centre of State Highway or Major District Road.

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3. The bottom of the board should be 1 metre above the road surface and the board shall be at right angle to the centre line of the road facing the direction of traffic.
4. The board shall be of the size of 107 c.m. in length and 91 c.m. in height for "T" and "Y" junctions shall be 145 C.M. in length and 91 C.M. in height for cross roads.
5. The board shall be painted by two coats, the Board and posts shall be R.C.C. as shown in the type design.
6. The post shall be fixed in concrete and the projection of this above the road level shall be 45 cm x 45 cm and height of 24 cms. above the road level and the top to be finished in plaster from the height of 15 cm.
7. The size of letter and figures shall be 8 cm. for English and 10 C.M. for devnagri and Gujarati scripts.
8. The post shall be painted in black and white reflective strips 23 cm. in height.
9. The board shall be painted in white with border 2 C.M. wide.
10. On this board tablets shall be painted in yellow with black and the tablets shall have 5 cm. clear distance from the board.
11. Each such tablet shall be 61 cm. in length and 33 C.M. in height, arrow lines indicating the direction of the road at the junctions shall be painted in black and shall have a thickness of C.M. for National Highway and 4 C.M. on a State Highway and aC.M. for a Major district road.
12. All letters and figures shall be painted in black.
13. The work shall be carried out as per design as per the instructions of the Engineer-in-charge. The measurements shall be recorded and paid on number basis for board fixed in position.

ITEM-59 Providing & fixing Board of M.S. Plate with two angles iron post and fixing in C.C. Concrete 1:4:8

The size of the board shall be 110 cm in length & 60 cm in height. It shall be prepared from M.S. Plate of 6 mm thickness. The angle iron post shall be of size 75 mm x 75 mm and 6 mm thick. The length of iron post shall be 2.1 metres. The post shall be fixed to the board by welding. The welding shall be true and strong and neat in appearance.

The board shall be fixed in C.C. 1:4:8 concrete. The concrete block for each post shall be 30 cm x 30 cm in size. The depth of the concrete block shall be 85 cm of which 60 cm will be below ground and 25 cm above ground level. The exposed concrete block i.e. its portion above ground level shall be neatly finished and its shape should be truly square.

The post shall be painted with two coats of paint, alternatively in black & white strips 23 cms in height after applying one coat of anticorrosive paint. The paint shall be of approved quality. The board shall be painted with colour, as directed by Engineer-in-charge. The information as per instruction of Engineer-in-charge shall be written on board with letters & signs in accordance with I.R.C. The information may be one or more of the three script, viz. Hindi, English & Gujarati.

The board shall be fixed truly vertical & workmanship of the board shall be neat, clean & good in appearance.

The measurement for payment shall be for number of board fixed in position & complete in all respect.

The unit rate includes cost of material, labour, tools, welding, concreting, painting, lettering etc.

ITEM - 60 U.C.R. Masonry for super structure in C.M. :

Para* 1 to 14 item No. 30 of the roads specification booklet shall apply for the work of this item.

ITEM - 61 : Providing and laying coursed rubble masonry hard stone of approved quality for super structure and plinth in cement mortar 1:5 (1 cement :5 course sand) etc. complete.

1. Para 1 to 14 of item of U.C.R.masonry shall apply.

15. Masonry shall be laid with course, where there is variation is the height of course. Large courses shall be placed at lower levels with height of courses decreasing gradually towards the top.

16. In case of abutment and wing walls, weep holes shall be provided in the masonry to drain moisture from the backfilling. Weep holes shall be 8 cm wide, 15 cm high or circular of 15 cm. diameter and shall extend through the full width of the masonry with slopes of about 12 vertical to 20 horizontal towards the draining face. The spacing of weep holes shall be generally 1 metre in either direction with the lowest one at about 15 cm. above the low water level or ground level whichever is higher or as directed by the Engineer-in-charge.

ITEM-62 : Providing and laying Brick work using common burnt clay building bricks having crushing strength not less than 35 kg/sq.m. in foundation and plinth in cement mortar 1:5 (1 cement : 5 fine sand)

1. Burnt clay bricks shall confirm to the requirements of IS: 1017, except that the minimum compressive strength when tested flat shall not be less than 35 Kg/square cm. and that the size may be according to local practice with a tolerance of 5 percent.

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

3. The mixing shall be done intimately. The operation shall be carried out on a clean waster tight platform, and cement sand shall be first mixed dry in the required proportion to obtain uniform colour and then the mortar shall be mixed for at least two minutes after addition of water. In case of cement mortar, that has suffered because of evaporation of water the same shall be re-tempered by adding water as frequently as needed to restore the requisite consistency but this retempering shall be permitted only within thirty minutes from the time of addition of water at the time of initial mixing.

4. Bricks shall be soaked in water for a minimum period of one hour before use. When bricks are soaked they shall be removed from the tanks sufficiently in advance so that at the time of laying they are skin-dry. Such soaked bricks shall be stacked on a clean place where

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they are not spoilt by dirt, earth etc.

5. All brick work shall be laid in English bond, even and true to line, plumb level and all joints accurately kept. The bricks used on the face shall be selected whole ones of uniform size and with true rectangular face.

5.1 Bricks shall be laid frogs up, if any, on a full bed of mortar. When laying bricks shall be slightly pressed so that the mortar gets into all the surface pores of bricks to ensure proper adhesion. All joints shall be properly flushed and packed with mortar so that no hollow spaces are left.

5.2 Before laying bricks in foundations, a layer of not less than 12 mm. of mortar shall be spread to make the surface on which the work will be laid even.

5.3 The brick work shall be built in uniform layer, corners and other advanced work shall be racked back. Brick work shall be done true to plumb or in specified manner. No part of it, during construction, shall rise more than one metre above the general construction level to avoid unequal settlement and improper jointing.

5.4 Toothing may be done where future extension is contemplated but shall be used as an alternative to raking back.

5.5 The thickness of joints shall not exceed 12 mm.

6. When fresh masonry is to be placed against existing surface of structures, these shall be cleaned of all loose material, roughened and wetted as directed by the Engineer-in-charge so as to effect a good bond with the new work.

7. Green work shall be protected from rain by suitable covering. Masonry work is cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days. The top of the masonry work shall be left flooded with water at the close of the day.

7.1 During hot weather, all finished or partly completed work shall be covered or wetted in such manner as will prevent rapid drying of the brick work.

8. The scaffolding shall be sound and strong to withstand all loads to come upon it. The holes which provide resting space for horizontal members shall not be left in masonry under one metre in width or immediately near the skew backs or arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good.

9. In case of abutment and wing wall, weep holes as shown on the drawing or directed by the Engineer-in-charge shall be provided in the masonry to drain moisture from the backfilling. Weep holes shall be 8 cm. wide, 15 cm. high or circular 15 cm. diameter and shall extend through the full width of the masonry with slope of about 1 vertical to 20 horizontal high or circular of 15 cm towards the draining face. The spacing of weep holes shall be generally 1 m. in either direction with the lowest one at about 15 cm. above the low water level or ground level whichever is higher or as directed by the Engineer-in-charge.

10. All brick work shall be measured in cubic metres.

11. The contract unit for brick work shall include the cost of all labour, materials tools and plant, scaffolding and other expenses incidental to the satisfactory completion of the work as described herein above and provision of weep holes.

ITEM-63 : Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts carrying heavy traffic as per Indian Railway Standard specifications including setting the pipes in C.M. 1:2 watering and laying (to level or slope) of class NP3 of following internal diameters.

(i) 300 mm dia. (ii) 450 mm dia. (iii) 600 mm dia. (iv) 750 mm dia (v) 900 mm dia. (vi) 1050 mm dia. (vii) 1200 mm dia.

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

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

NP3, NP2, NP1 pipes are used for R. C. C. Pipes, where testing of pipes will not be feasible the contractors will have to produce a certificate from the manufacturers on company's letter head the given hereinafter form.

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

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

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

We have experience of manufacturing of pipes of _____ years

The pipes supplied by us to M/s. _____ satisfy the requirement of IS : 458

Date : _____

Place : _____

Manufacturer's Sign. _____

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