

NAME OF WORK :- MAINTENANCE AND REPAIRS TO ROADS (ASPHALT PATCH WORK) UNDER THE JURIDICTION OF R & B (P) SUB DIVISION RADHANPUR.

SPECIFICATION

Item No. 1 :- Providing and laying 37.50 mm thick open graded Bituminous grouting with B.T. aggregate 0.66 Cum/10 Smt and using asphalt grade VG-30 for mixing at the rate of 1.99 % . ie 19.90 Kg / M.T. of total mix & bitumen for tack coat @ 4.00 Kg / 10 Smt. on B.T. surface including heating the asphalt and aggregate by continuous batching drum mix plant, transporting and spreading Manually and consolidation with Kuba . including providing all materials, equipment's, tools and plant, oil, kerosene fire wood labour charge etc comp. using contractors own machineries , drum mix plant & equipment etc .comp.

Scope:The work shall consist of construction, in a single course, of compacted crushed aggregates premixed with a bituminous binder, to serve as base/binder course, laid immediately after mixing, on a base prepared previously in accordance with the requirement of these Specifications and in conformity with the lines, grades and cross-sections shown on the drawing or as directed by the Engineer. Thickness of the course shall be **37.5mm thick** materials.

Materials:

Bitumen: The bitumen shall be paving bitumen of suitable penetration Grade: 60/70 (VG-30) as per IS: 73. The actual grade of bitumen to be used shall be decided by the Engineer appropriate to the region, traffic, rainfall and other environmental conditions. Guidelines on selection of the grade of bitumen are given in Appendix-4.

Aggregates:The aggregates shall consist of crushed stone, crushed gravel/shingle or other stones. They shall be clean, strong, durable, of fairly cubical shape and free from disintegrated pieces, organic or other deleterious matter and adherent coating. The aggregates shall preferably be hydrophobic and of low porosity. If hydrophilic aggregates are to be used, the bitumen shall preferably be treated with anti-stripping agents of approved quality in suitable dose as per *Appendix-5*. The aggregates shall satisfy the physical requirements set forth in Table 500-3.

TABLE 500-3. PHYSICAL REQUIREMENTS OF AGGREGATES FOR BITUMINOUS GROUT

Sr. No.	Test	Test Method	Requirement
1.	Los Angeles Abrasion value	IS: 2386 (Part-4)	40 Percent Maximum
2.	Aggregate Impact Value	IS: 2386 (Part-4)	30 Percent Maximum
3.	Flakiness and Elongation Indices (Total)***	IS: 2386 (Part-1)	30 Percent Maximum
4.	Coating and Stripping of Bitumen aggregate Mixtures	AASHTO T 182	Minimum retained coating 95 %
5.	Soundness (i) Loss with sodium Sulphate 5 cycles (ii) Loss with magnesium sulphate 5 cycles	IS: 2386 (Part-5)	12 Percent Maximum 18 Percent Maximum
6.	Water absorption	IS: 2386 (Part-3)	2 Percent Maximum

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

** To determine this combined proportion, the flaky stone from representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particle is separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index so found are added up.

Proportioning of materials:

The bitumen content for premixing shall be 1.99 % (percent) by weight of the total mix except when otherwise directed by the Engineer.

The maximum compacted thickness of a layer shall be 100mm.

The quantities of aggregates to be used shall be sufficient to yield the specified thickness after compaction.

AGGREGATE GRADING FOR BITUMINOUS GROUT

IS Sieve Designation	Per cent by weight passing the IS sieve
53.00 mm	100
26.50 mm	75-100
22.40 mm	50-85
13.20 mm	20-40
05.60 mm	5-20
02.80 mm	0-5

Variation in proportioning of materials: The Contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content +0.3 per cent by weight of total mix shall however be permissible for individual specimens taken for quality control tests vide Section 900.

Construction Operations:

Weather and seasonal limitations: The work of laying shall not be taken up during rainy or foggy weather or when the base course is damp or wet, or during dust storm or when atmospheric temperature in shade is 10 degree C or less.

Preparation of base: This work shall consist of preparing an existing granular or black topped surface bituminous course. The work shall be performed on such widths and lengths as shown in application drawing or as directed by the Engineer. The existing surface shall be firm and clean and treated with prime or tack coat as shown on the drawings as otherwise stated in the contract.

Materials: For scarifying and re-laying the granular surface: The materials used shall be coarse aggregates salvaged from scarification of the existing granular base course supplemented by fresh coarse aggregates and screenings so that aggregates and screening thus supplemented correspond to Clause 404. Water Bound Macadam or Clause 406 wet Mix Macadam, as the case may be.

For patching potholes and sealing cracks: Where the existing surface to be overlaid is bituminous, any existing potholes and cracks shall be repaired and sealed in accordance with Clauses 3004.2 and 3004.3 or as directed by the Engineer.

For Profile Corrective Course: A profile corrective course for correcting the existing pavement profile shall be laid to varying thickness as shown on the Drawings, or as indicated in the Contract Documents. The profile corrective course shall be laid to tolerances and densities as specified for wearing course if a single layer, or base course, if it is to be covered with a wearing course layer.

Profile corrective course and its application: The type of material for use as a profile corrective course shall be as shown on the drawing. If it is to be laid as part of the overlay/strengthening course, the profile corrective course material shall be of the same specification as that of the overlay/strengthening course. However, if provided as a separate layer, it may be of the same specification as the layer over which it is to be laid or intermediate between underlying layers, as shown on the Drawing.

Surface Levels: The levels of the sub grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the engineer beyond the tolerances mentioned in Table 900-1.

Bituminous material shall not be applied to a wet surface or during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10DC. Where the tack coat consists of emulsion the surface shall be slightly damp, but not wet. Where the tack coat is of cut back bitumen the surface shall be dry.

Construction Equipment: The tack coat distributor shall be self-propelled or towed bitumen pressure sprayer, quipped for spraying the material uniformly at a specified rate. Hand spraying of small areas inaccessible to the distributor or in narrow strips shall be sprayed with a pressure and sprayer or as directed by the Engineer 503.4.2 of MORTH specification. Preparation of base : The surface on which the tack coat is to be applied shall be clean and free from dust, dirt and any extraneous material, and be otherwise prepared in accordance with the requirements of Clauses 501.8 and 902 as appropriate. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

Application of tack coat: The application of tack coat shall be at the rate specified in the Contract, and shall be applied uniformly. If rate of application of Tack Coat is not specified in the contract then it shall be at the rate specified in TABLE 500-2 of MORTH specification. The normal range of spraying.

TABLE 500-2 RATE OF APPLICATION OF TACK COAT:

The asphalt at the rate of 2.5 Kg / 10 Sq.m. shall be used for tack coat of MORTH specification shall apply. The method of application of the tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray ban and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified. Where the material to receive an overlay is a freshly laid bituminous layer that has not been subjected to traffic, or contaminated by dust, a tack coat is not mandatory where the overlay is completed within two days.

Curing of tack coat: The tack coat shall be left to cure until all the volatiles have evaporated before any subsequent construction is started. No pant or vehicles shall be allowed on the tack coat other than those essential for the construction.

Quality Control of Work:

TOLERANCES IN SURFACE LEVELS

1.	Sub Grade	+	20 mm 25 mm
2.	Sub-base 4 – 10 mm		
	(a) Flexible pavement	-	20 mm
	(b) Concrete pavement	+	6 mm
	[Dry Clean concrete or Rolled concrete]	-	10 mm
3.	Base – Course for flexible pavement		
	(a) Bituminous course	-	6 mm
	(b) Other than bituminous	+	10 mm
	(i) Machine laid	-	10 mm
	(ii) Manually laid	+	15 mm
4.	Wearing course for flexible pavement		
	(a) Machine laid	+	6 mm 6mm
	(b) Manually laid	+	10 mm 10 mm
5.	Cement concrete pavement	+	5 mm 6 mm

TACK COAT:

Scope: This work shall consist of the application of a single coat of high viscosity liquid bituminous material to an existing bituminous road surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or instructed by the Engineer.

Materials: The binder used for tack coat shall be bitumen emulsion complying with IS: 8887 of a type and grade as specified in the Section 500 of MORTH specification Contract or as directed by the Engineer. The use of cut back bitumen as per IS: 217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer.

Weather and Seasonal Limitations:

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

Specification: The rate shall cover the provision of tack coat at 0.25 kg per square meter with provision that the variation in actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

Preparation and transport of mix: Bituminous grout mix shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality with thoroughly coated aggregates.

The plant shall be drum mix type. The plant shall have coordinated set of essential units capable of producing uniform mix within the job mix formula such as laid down in Appendix 'A'.

(a) In case of drum mix plant, the cold feed system shall have variable speed conveyors/ or other suitable devices for regulating the accurate proportion of aggregate in to an even flood flow automatically from a control operation/Control Cabin.

(b) **Bitumen Control Unit:** Capable of measuring/metering and spraying required quantity of bitumen at specified temperature with automatic synchronization of bitumen and aggregate feed.

(c) **Filler System:** A fines feeder system suitable to receive bagged or bulk supply of filler materials and its incorporation to the mix in the correct quantity shall be necessary auxiliary.

(d) **Dust Control:** A suitable built in Dust Control Equipment for the dryer to contain the exhaust of fine dust in the atmosphere for environmental control wherever so specified by the Engineer.

(e) Suitable auxiliary Bitumen Boiler of Adequate capacity with self-heating arrangement and temperature control device. The boiler should be fitted with temperature indicating instruments.

The temperature of binder at the time of mixing shall be in range of 150 Degree C to 163 degree and that of the aggregate in the range of 155 degree C - 163 degree C provided that the difference in temperature between the binder and aggregate at no time exceeds 14 Degree C.

Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all particles of the aggregates are coated uniformly and the discharge temperature of mix shall be between 130 Degree C to 160 degree C.

The mixture shall be transported from the mixing place to the point of use in suitable tipper vehicles. The vehicles employed for transport shall be clean and be covered in transit if so directed by the Engineer. Any tipper causing excessive segregation of materials by its spring suspension or other contributing factors or that which shows undue delay shall be removed from the work unit such conditions are corrected.

Spreading: The mix transferred from the tipper at site to the paver shall be spread immediately by means of self-propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix true to the specified lines, grades and cross sections. The paver finisher shall have the following essential features:

- (a) Loading hoppers and suitable distributing mechanism.
- (b) All drives having hydrostatic drive/control.
- (c) The machine shall have a hydraulically extendable screed the appropriate width requirement.
- (d) The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting of otherwise marring the surface. It shall have adjustable amplitude and variable frequency.
- (e) The paver shall be equipment with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.
- (f) The paver shall be fitted with an electronic sensing device for automatic leveling and

profile control within the specified tolerances.

- (g) The screed shall have the internal heating arrangement.
- (h) The paver shall be capable of laying either 2.5 to 4.0 m width or 4.0 to 7.0 m width as stipulated in the Contract.
- (i) The paver shall be so designed as to eliminate skidding/slippage of the tyres during operation.

However, in restricted locations and in narrow widths where the available plant cannot be operated in the opinion of the Engineer, he may permit manual lying of the mix.

The temperature of the mix at the time of lying shall be in the range of 120°C to 160°C. In multi-layer construction, the longitudinal joint in one layer shall offset that in the layer below by about 150 mm. However, the joint in the top-most layer shall be at the lane line of the pavement.

Longitudinal joints and edges shall be constructed true to the delineating line parallel to the centre line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material. Longitudinal and transverse joints shall be offset by at least 250 mm from those in the lower courses and the joint on the top-most layer shall not be allowed to fall within the wheel path. All transverse joints shall be cut vertically to the full thickness of the previously laid mix with asphalt cutter/pavement breaker and surface painted with hot bitumen before placing fresh material. Longitudinal joints shall be preferably hot joints. Cold longitudinal joints shall be properly heated with joint heater to attain a suitable temperature of about 80°C before lying of adjacent material.

Compaction: After the spreading of mix, rolling shall be done by 80 to 100 kN vibratory roller. Rolling shall start as soon as possible after the material has been spread deploying a set of rollers as the rolling is to be completed in limited time frame. The roller shall move at a speed not more than 5 km/h. Rolling shall be done with care to avoid unduly roughening of the pavement surface.

Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this, the rolling shall commence at the edges and progress towards the centre longitudinally except that on super elevated and unit-directional cambered portions, it shall progress from the lower to the upper edge parallel to the centre line of the pavement.

The initial or break-down rolling shall be done with 80-100 kN static weight smooth wheel roller (3 wheels or tandem) as soon as it is possible to roll the mix without cracking the surface or having the mix pick up on the roller wheels. The second or intermediate rolling shall follow the break-down rolling with vibratory roller of 80 to 100 kN static weight or pneumatic tyred roller of 150 to 250 kN weight, with minimum 7 wheels and minimum tyre pressure of 0.7 MPa as closely as possible to the paver and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while material is still workable enough for removal of roller marks with 60 - 80 kN tandem roller. During the final rolling, vibratory system shall be switched off. The joints and edges shall be rolled with an 80 to 100 kN static roller.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding mix material. The rolling shall then be continued till the entire surface has been rolled to 95 per cent of the average laboratory density (obtained from Marshall Specimens compacted as defined in Table 500-10), there is no crushing of aggregates and all roller marks have been eliminated. Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. The roller wheel shall be kept damp if necessary to avoid bituminous material from sticking to the wheels and being picked up. In no case shall fuel, lubricating oil shall be used for this purpose, nor did excessive water pour on the wheels.

Rolling operations shall be completed in every respect before the temperature of the mix falls below 100°C.

Roller(s) shall not stand on newly laid material while there is a risk that surface will be deformed thereby. The edges along and transverse of the bituminous grout laid and compacted earlier shall be

cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of approximate binder before the new mix is placed against it.

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.

The built-up spray grout shall be provided with next surfacing without any delay. If there is to be any delay, the course shall be covered by a seal coat to the requirement of 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.

Arrangement for Traffic: During the period of construction, arrangement of traffic shall be done to Clause 112 of MORTH Specification.

Passage of Traffic along a part of the Existing Carriageway under Improvement: For widening/strengthening existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders shall be provided on the side on which work is not in progress. The treatment to the shoulder shall consist of providing at least 150 mm thick granular base course covered with bituminous surface dressing in a width of at least 1.5 m and the surface shall be maintained throughout the period during which traffic uses the same to the satisfaction of the Engineer. The continuous length, in which such work shall be carried out, would be limited normally to 500 m at a place. However, where work is allowed by the Engineer in longer stretches passing places at least 20 m long with additional paved width of 2.5 m shall be provided at every 0.5 km interval.

In case of widening existing two-lane to four-lane the additional two lanes would be constructed first and the traffic diverted to it and only thereafter the required treatment to the existing carriageway would be carried out. However, in case where on the request of the Contractor work on existing two lane carriageways is allowed by the Engineer with traffic using part of the existing carriageway, stipulations as in Para above shall apply.

After obtaining permission of the Engineer, the treated shoulder shall be dismantled the debris disposed of and the area cleared as per the direction of the Engineer.

MEASUREMENTS FOR PAYMENT: The payment shall be made on the tonnage basis of the weight of mix of aggregates and bitumen. For this purpose, the contractor shall have to install a weight bridge of suitable capacity for the purpose of weighing of dumpers at suitable place at his cost as directed. Weight of empty and weight of loaded dumper will be recorded in bound and numbered register on plant site. Department will be free to get some loaded dumpers test checked at other weight bridge. Weigh Bridge will be periodically got calibrated and verified from weight and measure authorities.

For the purpose of application of tack coat, if the theoretical area as per sanctioned estimate for basis of tone differs with the actual area of work done in the field, the reduction in or addition to payment shall have to be exceeding respectively.

Weight of mix materials will be done in presence of responsible person, not less than the rank: of supervisor of department and the measurement shall be recorded by the Deputy Engineer or Assistant Engineer or Addl. Asst. Engineer. If so authorized, Record of each dumper will be maintained separately in bound and numbered register, which will be maintained by the departmental representative and signed by the contractor. Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer, hectometer and meter in which individual dumper are unloaded shall be recorded carefully.

RATE: The contract unit rate for the work shall be payment in full for carrying out the required operations including full compensation for

- (i) Making arrangements for traffic to Clause 112 of MORTH specification except or initial treatment to verge, shoulders and construction of diversion.

- (ii) Preparation of base except for laying of profile corrective course but including filling of potholes.
- (iii) Providing all materials to be incorporated in the work including arrangement for stock yards, all royalties, fees, rents where necessary and all leads and lift.
- (iv) All labor, tools, equipment, plant including installation of hot mix plant, power supply units and all machineries, incidental to complete the work to the specifications.
- (v) Carrying out the work in part widths of the road where directed.
- (vi) Carrying out all tests for control of quality.

The Contract rate shall be for a unit of one M.T. basis of complete item.

Item No.02 :- Providing and laying 37.50 mm thick open graded Bituminous grouting with B.T. aggregate 0.66 Cum/10 Smt (0.50 Cum /10 Smt coarse aggregate & 13 Cum / 10 smt key aggregate)and using asphalt grade 60/70 for mixing at the rate of 1.99 % . ie 19.90 Kg / M.T. of total mix & bitumen for tack coat @ 4.00 Kg / 10 Smt. on B.T. surface including heating the asphalt and aggregate by continuous batching drum mix plant, transporting and spreading the same by paver finisher and consolidation with vibratory roller . including providing all materials, equipment's, tools and plant, oil, kerosene fire wood labour charge etc comp. using contractors own machineries , drum mix plant & equipment and paver finisher etc. .comp.

➤ Detailed technical specification as per Item No.1.

Item No. 3 :- Providing and laying 37.50 mm thick open graded Bituminous grouting with B.T. aggregate 0.66Cum/10 Smt (0.50 Cum /10 Smt coarse aggregate & 13 Cum / 10 smt key aggregate)and using asphalt grade 60/70 for mixing at the rate of 1.99 % . ie 19.90 Kg / M.T. of total mix & bitumen for tack coat @ 4.00 Kg / 10 Smt. on B.T. surface including heating the asphalt and aggregate by continuous batching drum mix plant, . including providing all materials, equipments, tools and plant, oil, kerosene fire wood labour charge etc comp. using contractors own machineries , drum mix plant & equipment etc .comp. (At Plant site, transporting to work site & spreading will pay seperately.)

➤ Detailed technical specification as per Item No.1.

Item No. 4 :- Providing and laying 37.50 mm thick compacted Bituminous Macadam using stone chips 0.66 Cum/ 1 M.T. mix as per gradation & using asphalt grade 60/70 for tack coat 2.50 Kg /10 smt on B.T. surface & for mixing 34 Kg / M.T.(i.e. 3.40 % of mix) including heating the asphalt and aggregate by continuous batching drum mix plant, transporting th mix material and spreading the same Manually and consolidation with Kuba . including cost of fuel ,hire charges, fire wood , kerosens, labour charge etc & with contractors own machineries , drum mix plant & equipment etc .comp.

504. BITUMINOUS MACADAM

504.1. Scope

This work shall consist of construction in a single course having 25 mm compacted crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these Specifications. Bituminous macadam is more open graded than the dense graded bituminous materials described in Clauses 507, 508 and 509.

504.2. Materials

504.2.1. Bitumen: The bitumen shall be paving bitumen of VG-30 Grade complying with Indian Standard Specifications for "Paving Bitumen" IS:73.

504.2.2. 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. 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. 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% 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 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 COARSE AGGREGATES FOR BITUMINOUS MACADAM

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: 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 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 material: 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 ± 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 900. Asphalt VG-30 @ 35 Kg. / M.T. i.e. 3.50% 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.

TABLE 590-4. COMPOSITION OF BITUMINOUS MACADAM

Grading	1	2
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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	
Grading	1	2
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
0.075	0 - 8	0 - 8
Bitumen content ** percent by mass of total mix	3.3**	3.4**

Notes: 1. Appropriate bitumen contents for conditions in cooler areas of India may be up to 0.5% higher subject to the approval of the Engineer.

* 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.

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. VG-30 @ 2.50 Kg. / 10 Sq.Mt. shall used for tack coat

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.

TABLE 500-5. MANUFACTURING AND ROLLING TEMPERATURES

Bitumen Penetration	Bitumen Mixing (°C)	Aggregate Mixing (°C)	Mixed Material (°C)	Rolling (°C)	Laying(°C)
35	160-170	160-175	170 Maximum	100 Minimum	130 Minimum
65	150-165	150-170	165 Maximum	90 Minimum	125 Minimum
90	140-160	140-165	155 Maximum	80 Minimum	115 Minimum

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, the course shall be covered by a seal coat to the requirement of Clause 513 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 by weight in m etric
tonnes,

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 as under

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

Payment shall be made on M.T. basis

503. TACK COAT

503.1. Scope

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to an existing bituminous road surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or instructed by the Engineer.

503.2. Materials

503.2.1. Binder: The binder used for tack coat shall be bitumen emulsion complying with IS 8887 of a type and grade as specified in the Contract or as directed by the Engineer. The use of cutback bitumen, as per IS 217 shall be restricted only for sites at sub-zero for emergency applications as directed by the Engineer.

503.3. Weather and Seasonal Limitations

Bituminous material shall not be applied to a wet surface or during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. Where the tack coat consists of emulsion, the surface shall be slightly damp, but not wet. Where the tack coat is of cutback bitumen, the surface shall be dry.

503.4. Construction

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

503.4.2. Preparation of base: The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirements of Clauses 501.8 and 902 as appropriate. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

503.4.3. Application of tack coat: The application of tack coat shall be at the rate specified in the Contract, and shall be applied uniformly. If rate of application of Tack Coat is not specified in the contract then it shall be at the rate specified in Table 500-2.

The normal range of spraying

TABLE 500-2. RATE OF APPLICATION OF TACK COAT

Type of Surface		Quantity of liquid bituminous material in Kg per sq. m. area
i)	Normal bituminous surfaces	0.20 to 0.25
ii)	Dry and hungry bituminous surfaces	0.25 to 0.30
iii)	Granular surfaces treated with primer	0.25 to 0.30
iv)	Non bituminous surfaces	
	a) Granular base (not primed)	0.35 to 0.40
	b) Cement concrete pavement	0.30 to 0.35

temperature for a bituminous emulsion shall be 20°C to 70°C and for a cutback, 50°C to 80°C if RC-70/MC-70 is used. Where a geosynthetic is proposed for use, the provisions of Clauses 703.3.2 and 703.4.4 shall apply. The method of application of the tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

Where the material to receive an overlay is a freshly laid bituminous layer, that has not been subjected to traffic, or contaminated by dust, a tack coat is not mandatory where the overlay is completed within two days.

503.4.4. Curing of tack coat: The tack coat shall be left to cure until all the volatiles have evaporated before any subsequent construction is started. No plant or vehicles shall be allowed on the tack coat other than those essential for the construction.

503.5. Quality Control of Work

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

503.6. Arrangements for Traffic

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

Item No. 5 :- Providing and laying 37.50 mm thick compacted Bituminous Macadam using stone chips 0.66 Cum/ 1 M.T. mix as per gradation & using asphalt grade 60/70 for tack coat 2.50 Kg /10 smt on B.T. surface & for mixing 34 Kg / M.T.(i.e. 3.40 % of mix) including heating the asphalt and aggregate by continuous batching drum mix plant, . including cost of fuel ,hire charges, fire wood , kerosene, labour charge etc & with contractors own machineries , drum mix plant & equipment and etc .comp.(At Plant site, transporting to work site & spreading will pay separately.)

- Detailed technical specification as per Item No.4.

Item No. 6 :- Providing and laying Asphalt painting on BT Surface with bitumen grade VG-30 at the rate of 5 kg per 10 Sq.M by mechanical sprayer and spreading the stone dust on prepared surface at the rate of 0.30 Cu.M. per 10 Sq.M etc complete and rolling with PTR roller and brushing etc complete.

1. Scope

This work shall consist of the application of a single coat of bitumen **VG-30** grade to an existing bituminous road surface in accordance with the following specifications.

2. Materials

2.1 Bitumen

The bitumen used for asphalt painting shall be **VG-30** grade complying with IS:73 or as directed by Engineer.

2.2 Sand

2.2.1 This shall be obtained from crushing hard black trap or equivalent. It shall not contain more than 8% of silt as determined by field test will measuring cylinder. The method of determining silt contents by fields test is give as under.

2.2.2 A sample of sand to be tested shall be placed without drying in 200mm measuring cylinder. The quantity of the sample shall be such that in fills the cylinder upto 1200mm mark. The can water shall be added upto 150mm mark. The mixture shall be silted vigorously and the content allowed to settle for 3 hours.

2.2.3. The height of silt visible as settled paver above the sand shall be expressed as percentage of the height of the sand below the sand containing more than 8% silt shall be washed so as to bring the content within the allowable limit.

2.2.4. The fineness modules of stone cast silt not be less than 1.80.

3. Weather and Seasonable Limitations

Bituminous material shall not be applied to a wet surface or during a dust storm or when the weather so rainy or windy or when the temperature in the shade is less than 10°C.

4. Construction

4.1 Equipment

The asphalt painting shall be applied through a distributor and it shall be a self propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at a specified rate. The spraying of small areas inaccessible to the distributor in narrow strips shall be sprayed with a pressure hand sprayer or as directed by the Engineer in charge.

4.2 Preparation of base

The surface on which the asphalt painting is to be applied shall be clean and free from

dust, dirt and any extraneous material and otherwise prepared in accordance with the requirement of Clause 501.8 & 513 of MORTH & if as appropriate. Immediately before the application of the asphalt painting the surface shall be swept clean with a mechanical broom and high pressure air jet or by other means as directed by the Engineer in charge.

4.3 Application of Asphalt painting

The application of asphalt for painting shall be at 5.00 Kg/10 Sq.mt. as specified in the contract and shall be applied uniformly. The asphalt shall be added in the tanker and the temperature of the asphalt at the time of spraying shall be in the range of 150°C - 177°C.

The method of application of the tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar and speed of forward movement. The contractor shall demonstrate a spraying trial that the equipment and method to be used is capable of producing a uniform spray within the tolerances specified.

5.0 Spreading of Sand

Soon after the spraying asphalt the sand shall be sprayed evenly with a twisting motion of baskets at the rate of 0.03 Cum/10 Sq.m. The entire surface shall be boomed to ensure uniform application of the sand. While the traffic is allowed on the painting surface and at later stage if additional sand is required, it shall be carried out by the contractor without any extra payment.

6.0 Opening to Traffic

Traffic may be allowed immediately after completion of flushing of sand on asphalt painting surface.

7.0 Arrangement of Traffic

The provision of MORTH specification Clause 112 shall apply as regards the flow of traffic during construction.

8.0 Mode of Measurement & Payment

The item shall be measured and paid as finished work in Square meters. The rates shall include the cost of all materials, labour, equipments etc. involved in all the operations described above. The rate shall be for a unit of one Sq.meter.

Item No. 7 :- Providing and laying 37.50 mm thick compacted Bituminous Macadam using stone chips 0.66 Cum/ 1 M.T. mix as per gradation & using asphalt grade 60/70 for tack coat 2.50 Kg /10 smt on B.T. surface & for mixing 34 Kg / M.T.(i.e. 3.40 % of mix) including heating the asphalt and aggregate by continuous batching drum mix plant, transporting the mix material and spreading the same by paver finisher and consolidation with vibratory roller of 80 KN to 100 KN static weight . including cost of fuel ,hire charges, fire wood , kerosene, labour charge etc & with contractors own machineries , drum mix plant & equipment and paver finisher etc .comp.

- Detailed technical specification as per Item No.4.

Item No. 8 :- Providing and laying Bituminous Seal Coat using stone chips 0.24 Cmt / 10 Amt i.e. 0.66 Cmt aggregate and asphalt grade 60/70 for mixing at the rate of 4.50 % weight of total mix including heating the asphalt and aggregate by continuous batching drum mix plant and transporting the mix material & spreading Manually and consolidation with Kuba and flushing sand @ 0.30 Cum / 100 Smt . including cost of fuel ,hire charges, fire wood , kerosens, labour charge etc & with contractors own machinaries & drum mix plant etc .comp.

DESCRIPTION

The work shall consist of construction of pre mix seal coat as wearing course, on a previously prepared base to the requirement of these specification.

1. MATERIALS

1.1 Binder : The shall be straight run bitumen of 60/70 or 80/100 grade satisfying the requirement of IS:73. The actual grade of the binder to be used shall be decided by the Engineer-in-charge.

1.2 Coarse aggregates : The coarse aggregates shall consist of crushed stone or crushed gravel. These shall be clean, durable of cubical shape, free disintegrated pieces, organic or other deleterious matter and adherent coatings. The aggregates shall preferably be hydrophobic and of low porosity and shall satisfy the physical requirements set forth in Table 1.

Physical requirement of aggregates for seal coat

Sr.No.	Test	Test Method	Requirement
1	Los Angles abrasion Value OR	IS : 2386 (Part - IV)	40 % maximum
	Aggregate Impact Value	---do---	30 % maximum
2.	Flakiness and Elongation Indices (Total)	IG : 2386	30 % maximum
3.	Coating and stripping of	AASTC - 7	Minimum
	Bitumen aggregates mixtures		retained Coating 95 %
	Soundness :		
i.	Loss with sodium sulphate	IS - 2386	12 %
	Maximum (Part - V) 5 Cycles		
ii.	Loss with magnesium sulphat	5 Cycles	18 % Maximum
5.	Water Absorption	IS - 2386	1 %

Maximum (Part - III)

Note

:-Aggregate may satisfy requirement of either of two tests

1.3 FINE AGGREGATES : The fine aggregates shall consist of crusher run screenings, natural sand or a mixture of both . These shall be clean, hard durable,

uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substances.

1.4 Filler : The filler, where required, shall be an inert material the whole passes 600 micron sieve at least 90 percent passing 150 micron sieve and not less than 70 percent passing 75 micron sieve. The filler shall be cement, stone dust, hydrated lime, fly ash and other non-plastic mineral matter approved by the Engineer-in-charge.

1.5 Aggregate gradation : The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to gradings set for this tables below:

Table : Aggregate gradation Pre-Mix Seal Coat

Sieve Designation	Percentage by wt passing
through sieve 12.5mm	—
10.0mm	100
4.75mm	40 - 85
2.35mm	5 - 20
75 micron	0 - 4

1.6 Proportioning of materials : The content for premixing shall be 4.50 kg per M.T. (4.50% by weight) for mixing aggregate.

The quantities of aggregates shall be sufficient to yield the specified thickness after compaction.

The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work.

1.7 **Variation in Proportioning of material** : The Contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix. A variation in binder content of 0.3 percent by weight of total mix shall

however, be permissible in individual specimen taken for quality control tests vide MOST Specification Section 900.

2. CONSTRUCTION OPERATIONS

2.1 Weather and seasonal limitation : The work of laying shall not be taken up during rainy weather or when the base course is damp or wet or during dust storm or when the atmospheric temperature in shade is 10°C or less.

2.2 **Preparation of base** : The base on which the mix materials is to be laid shall be prepared shaped and conditioned to the specified, lines, grade and cross section in accordance with MORT&H Specification Clause 601 as directed by the Engineer-in-charge. The surface shall be thoroughly swept and scraped clean and free of dust and foreign matter.

2.3 Preparation of the mix : Hot mix plant of adequate capacity and capable of producing an proper and uniform quality shall be used for preparing the mix. The plant should be continuous type

having a coordinated set of essential units such as dryer for heating the aggregates device for feeding by weight or volume the required quantities of aggregates, a binder heating and control unit for meeting out the correct quantity of heated binder together with a paddle mixer for intimately mixing of the binder and aggregates. For details regarding Hot mix plant the Annexure 'A' may be referred.

The temperature of binder at the time of mixing shall be in the range of 150°C and aggregates in the range of 150°C - 163°C provided also at no time shall the difference in temperature of the aggregates and binder exceed 14°C.

Mixing shall be throughout to ensure that a homogeneous mixture is obtained in which all the particles of the mineral aggregate are coated uniformly.

The mix shall be transported from the mixing plant to the point of use in suitable vehicles. The vehicles employed for transport shall be clean and be covered over in the transit if so directed by the Engineer-in-charge.

2.4 Spreading : The mix, transported from the hot plant to the site, shall be spread by means of self propelled mechanical paver with suitable screens capable of spreading, tamping and finishing the mix, true to specified grade, line and cross section. The temperature of mix at the time of laying shall be in the range of 121°C-163°C.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to centre line of the road. Longitudinal joints shall be offset by the at least 150 mm from those in the binder course. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

2.5 Rolling : Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of vibratory rollers moving at a speed not exceed 5 km per hour. The initial or break-down rolling shall be with 80 to 100 KN vibrating road rollers and the surface finished by final rolling with 8-10 tonne tandem rollers or suitable pneumatic rollers.

The roller wheels shall be kept damp to prevent the mix adhering to them but in no case shall fuel lubricating oil be used for this purpose. Rolling shall commence longitudinally from the edge and progress towards the centre except that at super elevated portions, it shall progress from the lower to upper edges parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimize the pushing of the mix shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

OPENING TO TRAFFIC

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

SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements of most specification Clause 901 Control on the quality of material and works shall be exercised by the Engineer-in-charge in accordance with MOST Specification Clause 902.

ARRANGEMENT FOR TRAFFIC

The provision of MOST Specification Clause 105 shall apply as regards the flow during construction.

MEASUREMENT FOR PAYMENT

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

Department will be free to get some loaded dumper test checked at other weigh bridge.

Weigh bridge will be periodically got celebrated and measure authorities.

Weigh of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assist-ant Engineer or Addl. Assistant Engineer if so authorized. Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the departmental representatives and signed by the contractor, Proper gate pass system shall be established for the vehicles coming to the plant site and out going from the plant site. The location of the kilometer hectometer in which individual dumper are unloaded will be recorded carefully.

1. RATE

The Contract unit rate for seal coat shall be for payment for carrying out he required operations including full compensation for all components listed in MOST Specification Clause 503.8

Item No. 9 :- Providing and laying Bituminous Seal Coat using stone chips 0.24 Cmt / 10 Amt i.e. 0.66 Cmt aggregate and asphalt grade 60/70 for mixing at the rate of 4.50 % weight of total mix including heating the asphalt and aggregate by continuous batching drum mix plant and transporting the mix material & spreading the same by paver finisher and consolidation with vibratory roller of 80 KN to 100 KN static weight and flushing sand @ 0.30 Cum / 100 Smt . including cost of fuel ,hire charges, fire wood , kerosens, labour charge etc & with contractors own machinaries & drum mix plant etc .comp.

➤ Detailed technical specification as per Item No.8.

Item No. 10 :- Providing and laying mix seal surface 20mm thick on pre prepared as wearing course with specified graded machine crushed aggregate pre mixed with bitumen binder of 51 kg/mt of Ashphalt in drum mix plant transporting the mix material on tipper and laying with paver finisher to the road level and rolling with vibratory roller of 80 to 100 KN static weight including providing equipment tools and plants, fire wood, lubricant, kerosine,oil, labour charges using contractors own Machinaries drum mix plant and paver finisher (R.A.)

508 CLOSE-GRADED PREMIX SURFACING /MIXED SEAL SURFACING

508.1 Scope

508.1.1 The work shall consist of the preparation, laying and compaction of a close graded Premix surfacing material of 20 mm thickness composed of graded aggregates Premixed with a bituminous binder on a previously prepared surface, in accordance with the Requirements of these Specifications, to serve as a wearing course.

508.1.2 Close graded premix surfacing shall be of Type A or Type B as specified in The Contract documents. Type A grading is recommended for use in areas having rainfall More than 150 cm per year. In other areas Type B grading may be used.

508.2 Materials

508.2.1 Binder

The provisions of Clause 510.1.2.1 shall apply.

508.2.2 Coarse Aggregates

The provisions of Clause 511.1.2.2 shall apply.

508.2.3 Fine Aggregates

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

508.2.4 Aggregate Gradation

The coarse and fine aggregates shall be so graded or combined as to conform to one or the other grading's given in Table 500-19, as specified in the contract.

Table 500-19 : Aggregate Gradation

IS Sieve Designation (mm)	Cumulative Percent 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

508.2.5 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 square metre area. The quantity of binder used for premixing shall be 22.0 kg and 19.0 kg per 10 square metre area for Type A and Type B surfacing respectively.

508.3 Construction Operations

The provisions of Clause 510.1.3.1 through Clause 510.1.3.5 shall apply.

508.4 Opening to Traffic

Traffic may be allowed after completion of the final rolling when the mix has cooled down to The surrounding temperature. Speed restrictions may be imposed at initial stages.

508.5 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 and the works carried out, the relevant provisions of Section 900 shall apply.

508.6 Arrangements for Traffic

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

508.7 Measurement 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. The area will be the net Area covered.

508.8 Rate

The contract unit rate for close-graded premix 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.

Item No. 11 :- Providing and laying mix seal surface 20mm thick on pre prepared as wearing course with specified graded machine crushed aggregate pre mixed with bitumen binder of 51 kg/mt of Asphalt in drum mix plant transporting the mix material on tipper and laying with Manually and consolidation with Kuba and flushing sand @ 0.30 Cum / 100 Smt . including cost of fuel ,hire charges, fire wood , kerosens, labour charge etc & with contractors own machinaries & drum mix plant etc .comp. (R.A.)

➤ Detailed technical specification as per Item No.10.

Item No. 12 :- Providing and laying W.B.M of B.T.M.C metal of size 45 mm to 63 mm size including 0.12 Cu.M. Stone Screening & 0.08 Cu.M. Stone dust as filler including spreading, watering & consolidation by vibratory roller 80KN to 100 KN static weight. 75 mm thick compacted. {As per R.A.}

404. WATER BOUND MACADAM SUB-BASE/BASE

404.1. Scope

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

404.1.2. It is, however, not desirable to lay water bound macadam on an existing thin black topped surface without providing adequate drainage facility for water that would get accumulated at the interface of existing bituminous surface and water bound macadam.

404.2. Materials

404.2.1. Coarse aggregates : Coarse aggregates shall be either crushed or broken stone, crushed slag, overburnt (Jhama) brick aggregates or any other naturally occurring aggregates such as kankar and laterite of suitable quality. Materials other than crushed or broken stone and crushed slag shall be used in sub- base courses only. If crushed gravel/ shingle is used, not less than 90 per cent by weight of the gravel/ shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-6. The type and size range of the aggregate shall be specified in the Contract or shall be as specified by the Engineer. If the water absorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS : 2386 (Part 5).

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

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

Test	Test Method	Requirements
1 * Los Angeles Abrasion value Or	IS:2386 (Part-4)	40 per cent (Max)

* Aggregate	IS:2386 (Part-4) or	30 per cent (Max) Impact value
IS:5640**		
2 Combined Flakiness and	IS:2386 (Part-1)	35 per cent (Max) Elongation

Indices (Total)

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

** Aggregates like brick metal, kankar, laterite etc. which get softened in presence of water shall be tested for Impact value under wet conditions in accordance with IS: 5640.

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

TABLE 400-7. GRADING REQUIREMENTS OF COARSE AGGREGATES

Grading No	Size Range	IS Sieve Designation	weight passing er Percent by
1	63 mm to 45 mm	75 mm	100
		63 mm	90-100
		53 mm	25-75
		45 mm	0 - 15
		22.4 mm	0-5

Note : The compacted thickness for a layer with Grading 1 shall be 100 mm while for layer with other Gradings i.e. 2 & 3, it shall be 75 mm.

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

Screenings shall conform to the grading set forth in Table 400-8. The consolidated details of quantity of screenings required for various grades of stone aggregates are given in Table 400-9.

The table also gives the quantities of materials (loose) required for 10 m² for sub-base/base compacted thickness of 100/75 mm.

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

TABLE 400-8. GRADING FOR SCREENINGS

Grading Classification	Size of Screenings	IS Sieve Designation	Per cent by weight passing the IS Sieve
A	13.2	13.2 mm	100

	mm	11.2 mm	95-100
		5.6 mm	15-35
		180 micron	0-10

TABLE 400-9. APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS REQUIRED FOR 100/75 MM COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SUB-BASE/BASE COURSE FOR 10M² AREA

Classification	Size Range	Compacted thickness	Lose Qty.	Screenings			
				Stone Screening		Crushable type such as Murrum or Gravel	
				Grading Classification & Size	For. WBM Sub-base/ base course (Loose quantity)	Grading Classification & Size	Loose Qty.
Grading 2	63 mm to 45mm	75 mm	0.91 to 1.07 m ³	Type A 13.2mm	0.12 to 0.15 m ³	-do	0.22 to 0.24 m ³

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

The quantity of binding material where it is to be used, will depend on the type of screenings. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be 0.06-0.09 m³/10m² and 0.08-0.10m³/10m² for 100 mm compacted thickness.

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

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

404.3. Construction Operations

404.3.1. Preparation of base: The surface of the subgrade/ sub-base/base to receive the water bound macadam course shall be prepared to the specified lines and crossfall (camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained if necessary by sprinkling water. Any sub-base/base/surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (levelling course) to Clause 501 of these Specifications.

As far as possible, laying water bound macadam course over an existing thick bituminous layer may be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous wearing course where water bound macadam is proposed to be laid over it. However, where the intensity of rain is low and the interface drainage facility is efficient, water bound macadam can be laid over the existing thin bituminous surface by cutting 50 mm x 50 mm furrows at an angle of 45 degrees to the centre line of the pavement at one metre intervals in the existing road. The directions and depth of furrows shall be such that they provide adequate bondage and also serve to drain water to the existing granular base course beneath the existing thin bituminous surface.

404.3.2 Inverted choke : If water bound macadam is to be laid directly over the subgrade, without any other intervening pavement course, a 25 mm course of screenings (Grading B) or coarse sand shall be spread on the prepared subgrade before application of the aggregates. It is taken up. In case of a fine sand or silty or clayey

subgrade, it is advisable to lay 100 mm insulating layer of screening or coarse sand on top of Fine grained soil, the gradation of which will depend upon whether it is intended to act as a drainage layer as well. As a preferred alternative to inverted choke, appropriate geosynthetics performing functions of separation and drainage may be used over the prepared subgrade as directed by the Engineer. Section 700 shall be applicable for use of geosynthetics.

404.3.3 Spreading coarse aggregates : The coarse aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base/ base to proper profile by using templates placed across the road about 6 m apart, in such quantities that the thickness of each compacted layer is not more than 100 mm for Grading 1 and

75 mm for Grading 1 and 3, as specified in Clause 404.2.5. Wherever possible, approved mechanical devices such as aggregate spreader shall be used to spread the aggregates uniformly so as to minimise the need for manual rectification afterwards. Aggregates placed at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any approved means so as to achieve the specified results.

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

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

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

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

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

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

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

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

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

404.3.5 Application of screenings: After the coarse aggregate has been rolled to Clause 404.3.4, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done

while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motions of hand shovels or by mechanical spreaders, or directly from tipper with suitable grit spreading arrangement. Tipper operating for spreading the screenings shall be so driven as not to disturb the coarse aggregate.

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

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

404.3.6. Sprinkling of water and grouting : After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operation shall be continued, with additional screenings applied as necessary until the coarse aggregate has been thoroughly keyed, well-bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or subgrade does not get damaged due to the addition of excessive quantities of water during construction.

In case of lime treated soil sub-base, construction of water bound macadam on top of it can cause excessive water to flow down to the lime treated sub-base before it has picked up enough strength (is still "green") and thus cause damage to the sub-base layer. The laying of water bound macadam layer in such cases shall be done after the sub-base attains adequate strength, as directed by the Engineer.

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

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

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

404.4. Surface Finish and Quality Control of Work

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

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

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

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

404.5. Arrangement for Traffic

During the period of construction, the arrangement of traffic shall be done as per Clause 112.

404.6. Measurements for payment

Water bound macadam shall be measured as finished work in position in **cubic metres**.

404.7. Rate

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

- (i) malting 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 part widths of road where directed; and
- (v) carrying out the required test for quality control.

The payment shall be made on Cmt. Basis.

Item No. 13 :- Providing laying spreading and compacting 150mm thick granular sub base (G.S.B.) with specified material MC BT Metal of size 75 to 26.5mm 35%, 26.5mm to 4.75mm 45% and below 2.36mm stone dust 20% mix (Grade-I) having C.B.R. not less than 30 incl. mixing the material at OMC at site and spreading in uniform layer base and compacting with power roller to achieve the desired density incl. all materials, labour and machinery, lighting guarding, bracketing and maintenance of diversion etc. complete as per MORT&H clause 401.12.50 (R.A.)

401 GRANULAR SUB-BASE

401.1 Scope

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

402 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	Percent by Weight Passing the IS Sieve					
Designation	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0 mm	100	-	-	-	1100	-
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

401.2 Construction Operations

401.2.1 Preparation of Sub-grade

Immediately prior to the laying of sub-base, the subgrade already finished to Clause 301 or 305 as applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water, if necessary and rolled with two passes of 80-100 km 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, up to 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, arrangements for the traffic shall be provided and maintained in accordance with Clause 112.

401.6 Measurements for Payment

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

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

401.7 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. supplying all materials to be incorporated in the work including all royalties, fees, rents where applicable with all leads and lifts;
- iii. all labour, tools, equipment, and incidentals to complete the work to the Specifications;
- iv. carrying out the work in part widths of road where directed; and
- v. carrying out the required tests for quality control.

Item No. 14:- Providing hard side shoulder of 100 mm thick for embankment using quarry spall with all lead and lift and including watering and rolling and consolidation of sub grade in layers at OMC to required dry density including filling depression which occur during the process using vibratory roller of 80 KN to 100 KN (selected quarry spall having CBR value not less than 20.0).

1. The stone metal shall be of approved quarry as shown on the quarry chart as well as approved by the Executive Engineer prior to collection.
2. The quarry spall shall be hard, rough, sound, durable black trap field metal of close texture, free from decay and weathering. Each piece of the stone shall be angular and roughly cubical in shape and round elongated or flaky materials shall be rejected. No. round or oblong pebbles or angular chips larger or smaller than specified size shall be allowed.
3. All unsound, weathered or disintegrated stone obtained from the upper surface layer of the quarry or other layer of boulder shall be rejected.
4. The Physical requirement for standard size metal shall confirm to the test result indicated in the table below.
5. For road work complete stacking of quarry spall as per requirement shall be carried out in 2 Km. Length before spreading. The Q.S. stack shall be measured as per rules before spreading. The collection shall always, commence at one end of the Km. And be carried continuously towards the other and unless the engineer in charge shall direct otherwise.
6. The payment shall be on cubic meter bases without deduction for voids. The contractor shall maintain all stacks in regular and proper size till the whole material shall not measured and finally accepted by the department. The spreading of material shall not be allowed till material are fully stacked and completed Kilometer wise.
7. The rate includes cost of collection, conveyance to the site with all lead lift and filling the boxes including all labor, tools, equipment and other incidental expense. The rate quoted are inclusive of all such tools, duties, fees, royalties taxes etc. complete.

Spreading the quarry spall material on road crust filling the gaps in metal and leveling to camber and gradient as directed.

be seen that the formation is dressed to the required camber and grade. If the quarry spall is to be spread over the method surface then the spreading shall uniform and as it's has to act as binding surface, it shall be used for filling the interstices of metal / earthwork on side shoulder and forming a smooth running surface as far as possible. Murrum / quarry spall blindage shall be spread evenly with a twisting motion of the baskets. No more Murrum / quarry spall shall be used then specified as blindage. The rate is for gross measurements and no deduction of voids shall be made. , the Murrum / quarry spall is to be spread over earthen embankment as a sub-base or for side shoulders or as blindage, it shall be spread in a manner as directed by the Engineer-incharge and as per required width and thickness. The contractor shall make good all unevenness, depression, projections etc, during consolidation work. Rate of this item includes all these operation except consolidation. The payment shall be made on cmt. Basis.

Rolling and consolidation of Quarry spall in layers not exceeding 150mm thickness (main layer) including filling in depression which occurs during the process with vibratory roller 80 to 100 KN static weight

1. Immediately following the spreading of the coarse aggregates rolling shall be with

three wheeled power rollers of 8 to 10 tonne capacity or tandem roller or equivalent vibratory roller. The weight of the roller shall depend upon the types of the aggregate and be indicated by Engineer-in-charge.

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

3. Rolling shall continue until the aggregate is thoroughly keyed and the creeping of the aggregate ahead 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.

4. The rolled surface shall be checked transversely and longitudinal with templates and any irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate and re rolling until; the entire surface conforms to desired camber and grade. In no case shall the use of screening be permitted to make up depression.

5. 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 shall be resulting slurry swept in with hand brooms or mechanical brooms to fill the voids properly and rolled, during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the moving roller.

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

Payment will be made on cmt. basis of the finished work and shall include cost of watering, rent of machinery cost fuel, wages of drivers and cleaners and Murrum bund etc.

Item No. 15:- Providing and laying 100 mm avg. thick wet mix macadam (W.M.M.) GR-II using machine crushed black trap aggregate of 40 to 50 mm size in the material with water OMC in mechanically mix (pug mill) carriage of mix material by contractors own tipper to site of work including laying, spreading and compacting in sub base, base course on well prepared under base of compacting as per MOST Specification to achieve the desired density (RA).

406. WET MIX MACADAM SUB-BASE/BASE

406.1. Scope

This work shall consist of laying and compacting clean, machine crushed chips and granular material, premixed with water, to a dense mass on a prepared sub grade/sub-base/base or existing pavement as the case may be in accordance with the requirements of these specifications. The material shall be laid in single layer as necessary to lines, grades and cross-sections shown on the approved drawings or as directed by the Engineer.

The thickness of a single compacted Wet Mix Macadam layer shall not be less than 75mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be up to 75 mm with the approval of the Engineer.

406.2. Materials

406.2.1. Aggregates

406.2.1.1. Physical requirements :

Coarse aggregates shall be crushed stone. If crushed gravel / single is used, not less than 90 percent by weight of the gravel / single pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-12 below.

If the water absorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 2386 (Part-5).

**TABLE - 400-12. PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR
WET MIX MACADAM FOR SUB-BASE/BASE COURSES**

Test	Test Method	Requirements
1. * Los Angeles Abrasion value or *Aggregate impact value. (Max)	IS: 2386 (PART-4) IS: 2386 (PART-4) or IS: 5640	40 percent (Max) **30 percent
2. Combined Flakiness and Elongation indices (Total)	IS: 2386 (PART-I)	35 percent (Max)**

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

* To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles are separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index so found are added up.

406.2.1.2. Grading requirements:

The aggregates shall conform to the grading given in Table 400.13.

**TABLE 400.13
GRADING REQUIREMENTS OF AGGREGATES FOR WET MIX MACADAM**

IS Sieve Designation	Percent by weight passing the IS sieve
53.00 mm	100
45.00 mm	95-100
26.50 mm	-
22.40 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.00 Micron	8-22
75.00 Micron	0-8

Materials finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.

The final gradation approved within these limits shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

406.3. Construction Operations

406.3.1. Preparation of base: The surface of the subgrade/sub-base/base to receive the wet mix macadam course shall be prepared to the specified lines and crossfall (camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained if necessary by sprinkling water. Any sub-base/base/surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (levelling course) to Clause 501 of these Specifications.

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

406.3.2. Provision of lateral confinement of aggregates: While constructing wet mix macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described in Clause 404.3.3.

406.3.3. Preparation of mix: Wet Mix Macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pug mill or pan type mixer of concrete batching plant. The plant shall have following features:

- i. For feeding aggregates- three/ four bin feeders with variable speed motor
- ii. Vibrating screen for removal of oversize aggregates
- iii. Conveyor Belt
- iv. Controlled system for addition of water
- v. Forced/positive mixing arrangement like pug-mill or pan type mixer
- vi. Centralized control panel for sequential operation of various devices and precise process control
- vii. Safety devices

Optimum moisture for mixing shall be determined in accordance with IS: 2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size. While adding water, dew allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

406.3.4. Spreading of mix: Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared sub grade/sub- base/base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.

The mix may be spread either by a paver finisher or motor grader. For portions where mechanical means cannot be used, manual means as approved by the Engineer shall be used. The motor grader shall be capable of spreading the material uniformly all over the surface. Its blade shall have hydraulic control suitable for initial adjustments and maintaining the same so as to achieve the specified slope and grade.

The mix may be spread by a paver finisher. The paver finisher shall be self-propelled of adequate capacity with following features:

- i. Loading hoppers and suitable distribution system, to provide a smooth uninterrupted material flow for different layer thicknesses from the tipper to the screed.

- ii. Hydraulically operated telescopic screed for paving width up to 8.5 m and fixed screed beyond this. The screed shall have tamping and vibrating arrangement for initial compaction of the layer.
- iii. Automatic levelling control system with electronic sensing device to maintain mat thickness and cross slope of mat during laying procedure.

In exceptional cases where it is not possible for the paver to be utilized, mechanical means like motor grader may be used with the prior approval of the Engineer. The motor grader shall be capable of spreading the material uniformly all over the surface.

The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during construction. No segregation of larger and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.

The Engineer may permit manual mixing and /or laying of wet mix macadam where small quantity of wet mix macadam is to be executed. Manual mixing/laying in inaccessible / remote locations and in situations where use of machinery is not feasible can also be permitted. Where manual mixing/laying is intended to be used, the same shall be done with the approval of the Engineer.

406.3.5. Compaction:

After the mix has been laid to the required thickness, grade and cross fall / camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, a smooth wheel roller of 80 to 100 KN weight may be used. For a compacted single layer up to 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 KN or equivalent capacity roller. The speed of the roller shall not exceed 5 km/h.

In portions having unidirectional cross fall / super elevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the centre line of the road, uniformly over-lapping each preceding track by at least one third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.

In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the centre parallel to the centre line of the road uniformly overlapping each of the preceding tracks by at least one-third width until the entire surface has been rolled.

Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.

Along forms, kerb, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

Rolling should not be done when the sub grade is soft or yielding or when it causes a wave-like motion in the sub-base / base course or sub grade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 metre straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and cross fall. In no case should the use of unmixed material be permitted to make up the depressions.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material as determined by the method outlined in IS: 2720 (Part-8).

After completion, the surface of any finished layer shall be well closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of the layer and recomputed.

406.3.6. Setting and drying :

After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

406.4. Opening to Traffic

Preferably no vehicular traffic of any kind should be allowed on the finished wet mix macadam surface till it has dried and the wearing course lay.

406.5. Surface Finish and Quality Control of Work

406.5.1. Surface evenness : The surface finish of construction shall conform to the requirements of Clause 902.

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

406.6. Rectification of Surface Irregularity

Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to sub grade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, reshaped with added premixed material or removed and replaced with fresh premixed material as applicable and recomputed in accordance with Clause 406.3. The area treated in the aforesaid manner shall not be less than 5 in long and 2 in wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

406.7. Arrangement for Traffic

During the period of construction, arrangement of traffic shall be done as per Clause 112.

406.8. Measurements for Payment

Wet mix macadam shall be measured as finished work in position in **cubic metres**,

406.9. Rates

The Contract unit rate for **wet mix macadam** shall be payment in full for carrying out the following operations including full compensation for all components listed below.

1. Making arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions;
2. Supplying all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts;
3. All labour, tools, equipment and incidentals to complete the work to the Specifications;
4. Carrying out the work in part widths of road where directed and
5. Carrying out the required tests for quality control.

Item No. 16:- Supplying and stacking of hard morrow/sand/yellow earth/ binding material approved quality on road site including royalties & filling measure boxes with all lead and lift etc. road work.

1. Stone chips shall consist of regular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be obtained by crushing rock, and shall be free of elongated and

flaky pieces, soft and disintegrated materials, and vegetable or deleterious matter they shall satisfy the quality requirements set forth as shown hereafter

Sr.No.	TEST	Test Method	Requirement
1	Los Angeles Abrasion Value	S: 2386 (part IV)	35% Maximum
2	Aggregate Impact Value	DO	30% Maximum
3	Flakiness Index	S: 2385 (Part 1)	30% Maximum
4	Stripping Value	S:6241	25% Maximum
5	Water Absorption	S: 2386 (Part iii)	2% Maximum

Aggregate may satisfy requirement of either of the two tests.

(a) Kapchi: 12 mm size: Passing 20 mm sieve and retained on 10 mm sieve

(b) Grit 5 mm size: Passing 10 mm sieve and retained on 2.36 mm sieve.

The samples of stones chips collected from approved quarries shall be got tested at Government recognised laboratory as may be directed to the contractor at his own cost. The result shall conform to the standard requirements laid down in para (1) above. Collection of stone chips as per approved samples shall be allowed by the Engineer-in-charge. Testing charges shall be borne by the contractor. Payment at full rates for the stones chips shall not be made till the test results from the laboratory are received and found acceptable.

4 Stacking shall be done by filling in standard steel boxes of 2.0 m x 15m x 0.5 m size which shall be supplied by the Department if available on rent, otherwise contractor shall make his own arrangements. No deduction for voids shall be made from the gross measurements. Where any doubt exists as to whether the quantity of stacks in any hectometre is not conforming with the cubic content of the standard pharas (2.5 m x 1.5 m x 0.5 m) it shall be got corrected by the Contractor if so ordered by the Engineer-in-charge for which no extra payment shall be claimed by the Contractor. If the quantity in any stack in a particular hectometre is found to be less than the standard measurements viz. 1.5 cmt, the entire collection in the hectometre shall be paid on the quantity of the smallest stack so found. Regular stacks shall be done by the Contractor on a fairly level ground. Stacking shall be done in a manner as directed by the Engineer-in-charge.

5. The collection shall always commence at one end of the kilometre and be carried out continuously towards the other end, unless the Engineer-in-charge directs otherwise.

6. Control on quality of material shall be exercised by the Engineer-in-charge by carrying out the following tests at the frequencies shown against each.

Sr No.	Type of Construction Material	Test	Frequency
1	Grit/kapachi for open graded Carpet and seal coat	(1) Aggregate impact value	One set per 100 cu.m.
		(ii) Flakiness Index of aggregate	One set per 100 cu.m.
		stripping value & water absorption of aggregates	
		iv Grading of aggregates Frequency	Initially one set of 3 representative specimens for each source of supply subsequently when warranted by changes in the quality of aggregates One test per 100 cu.m. of aggregate

8. The payment shall be made on cubic metre basis without deduction for voids. The contractor shall be responsible for preserving the materials throughout the period the contract remains in force. The use of materials shall not be allowed till the materials conveyance to the site with all lead and lift and filling boxes including all labour, tools, equipment and other incidental expenses.

Item No. 17:- Spreading the binding material on road crust filling the gaps in metal and leveling to camber and gradient as directed.

1. Scope and Definition

This specification covers the work of spreading, brooming, and compacting binding material (stone dust) to fill interstices of coarse aggregates used in the Water Bound Macadam (W.B.M.) surface course. The work ensures a compacted, well-bound surface finished to the required camber and gradient. All works shall conform to MoRTH Clause 404 and relevant IS standards.

2. Materials

The binding material (bindage) shall be stone dust obtained from approved crusher sources. It shall be clean, free from organic matter, clay lumps, or other deleterious materials. The material shall pass through a 6 mm sieve and preferably retain 10-20% on a 150-micron sieve.

Excess fines shall not exceed 10% passing 75-micron sieve.

- Source: Approved stone crusher producing clean stone dust.
- Fineness modulus: Between 1.5 and 2.0.
- Water absorption: Not more than 2%.
- Free from silt and clay content exceeding 8%.

3. Construction Methodology

1. After the coarse aggregate layer (40-63 mm size) is properly spread and rolled dry, stone dust shall be spread uniformly over the surface.
2. The material shall be applied in thin layers (not exceeding 10 mm at a time).
3. Each application of blindage shall be broomed into the interstices of the coarse aggregate using hand brooms or mechanical brooms.
4. Sufficient water shall be sprinkled to assist in binding and compaction.
5. Rolling shall be continued with a 3-wheel static roller (80-100 kN capacity) until the blindage fills the voids and the surface is well bound.
6. Additional quantities of stone dust shall be applied and broomed in as required to ensure tight interlocking of aggregates.
7. Final rolling shall be carried out to achieve the desired camber and gradient, ensuring a smooth, dense, and uniform surface.

4. Quality Control

- Ensure stone dust meets gradation and cleanliness requirements before use.
- Check uniform distribution and brooming to fill voids completely.
- Confirm proper camber and gradient using camber templates and straightedges.
- Ensure adequate moisture before and during rolling to achieve full compaction.
- Inspect the surface for any loose or unbound areas after final compaction.

5. Measurement

Measurement shall be made in cubic metres (m^3) or square metres (m^2) as specified in the Bill of Quantities, based on the finished layer after spreading and compaction. The quantity shall be determined from stack measurements of blindage material before spreading, applying standard MoRTH deduction factors for voids.

6. Rate and Payment

The contract unit rate shall include the cost of materials, collection, loading, carting, unloading, spreading, brooming, watering, compaction, finishing to camber and gradient, and all incidental works necessary to complete the job as specified. The rate also includes all leads, lifts, labour, tools, taxes, octroi, and contractor's profit. Payment shall be made for the quantity of blindage applied and accepted by the Engineer-in-Charge.

7. References

- MoRTH Specification for Road and Bridge Works (5th Revision) - Clause 404: Water Bound Macadam.
 - IS:383 - Specification for Coarse and Fine Aggregates from Natural Sources for Concrete.
 - IS:2386 (Part I-IV) - Methods of Test for Aggregates for Concrete.
- IRC:19 - Standard Specifications and Code of Practice for Water Bound Macadam.

Item No. 18:- Supplying and stacking of machine crushed stone coarse aggregate chippings etc of hard stone of size 45mm to 63mm size free of disintegrated pieces, deleterious and organic matter including royalties & filling measure boxes with all lead and lift etc. completed for road work.

1. The rubble stones shall be black in color, shall be hard, tough, sound durable and of close texture, free from cracks and it shall be obtained from the approved quarries.
 2. The rubble obtained from the top surface of the quarry is soft one and hence such soft variety shall not be accepted. All unsound weathered or disintegrated stones obtained from the upper portion of the quarry shall be rejected.
 3. The quarry shall be well protected shall be dug by removing all the katcha and weathered stuff till approved quality of materials is available.
 4. The length and breadth shall not exceed 1/t (f.2) times the thickness of the stones.
 5. The rubble stacks shall be made on a fairly level ground and stacks shall be so made that rubble stones are stacked as close as possible so as to leave no excessive voids and no hollows are left out.
 6. The tendency to prepare the stacks by keeping excessive voids or keeping hollow places shall not be tolerated.
 7. The stacks shall be uniform in length and breadth and top portion shall be in level so that height at any point is uniform.
- B All the stacks shall be of standard dimensions which shall be prescribed by the Executive Engineer deduction for voids shall not be made.
9. The rubble shall be got approved by the Executive engineer, prior to collector on site or otherwise it is liable to rejection for which no claim shall be entertained.
 10. The contractor shall maintain all stacks in regular and proper sizes till the whole material is collected Measured and finally accepted by the department. 15 percent spauls will be allowed for filling in interstices.
 11. The rubble shall be stacked in quantities as per hectometer wise requirement as directed by the Executive Engineer or his agent.
 - 12 Measurement shall be given only when the full quantity of a half kilometer is stacked measurements shall be recorded and paid only once in a hectometer and no piecemeal measurements shall be recorded and paid.

Item No. 19:- Spreading the stone aggregate for rolling and W.B.M. including filling the interstices to required camber and gradient (excluding spreading of Blind age)(ii) 40mm to 63mm size aggregates.

404. WATER BOUND MACADAM SUB-BASE/BASE

404.8. Scope

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

404.8.2. It is, however, not desirable to lay water bound macadam on an existing thin black topped surface without providing adequate drainage facility for water that would get accumulated at the interface of existing bituminous surface and water bound macadam.

404.9. Materials

404.9.1. Coarse aggregates: Coarse aggregates shall be either crushed or broken stone, crushed slag, overburnt (Jhama) brick aggregates or any other naturally occurring aggregates such as kankar and laterite of suitable quality. Materials other than crushed or broken stone and crushed slag shall be used in sub- base courses only. If crushed gravel/ shingle is used, not less than 90 per cent by weight of the gravel/ shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 400-6. The type and size range of the aggregate shall be specified in the Contract or shall be as specified by the Engineer. If the water absorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS : 2386 (Part 5).

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

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

Test	Test Method	Requirements
3 * Los Angeles Abrasion value Or	IS:2386 Part-4)	40 per cent (Max)

* Aggregate cent (Max) Impact value IS:5640**	IS:2386 (Part-4) or	30 per
4 Combined Flakiness and cent (Max) Elongation Indic es (Total) ***	IS:2386 (Part-1)	35 per

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

** Aggregates like brick metal, kankar, laterite etc. which get softened in presence of water shall be tested for Impact value under wet conditions in accordance with IS: 5640.

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

TABLE 400-7. GRADING REQUIREMENTS OF COARSE AGGREGATES

Grading No	Size Range	IS Sieve Designation	weight passing er Percent by
1	63 mm to 45 mm	75 mm	100
		63 mm	90-100
		53 mm	25-75
		45 mm	0 - 15
		22.4 mm	0-5

Note : The compacted thickness for a layer with Grading 1 shall be 100 mm while for layer with other Gradings i.e. 2 & 3, it shall be 75 mm.

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

Screenings shall conform to the grading set forth in Table 400-8. The consolidated details of quantity of screenings required for various grades of stone aggregates

are given in Table 400-9. The table also gives the quantities of materials (loose) required for 10 m² for sub-base/base compacted thickness of 100/75 mm. The use of screenings shall be omitted in the case of soft aggregates such as brick metal, kankar, laterites, etc. as they are likely to get crushed to a certain extent under rollers.

TABLE 400-8. GRADING FOR SCREENINGS

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

TABLE 400-9. APPROXIMATE QUANTITIES OF COARSE AGGREGATES AND SCREENINGS REQUIRED FOR 100/75 MM COMPACTED THICKNESS OF WATER BOUND MACADAM (WBM) SUB-BASE/BASE COURSE FOR 10M² AREA

Classification	Size Range	Compacted thickness	Loose Qty.	Screenings			
				Stone Screening		Crushable type such as Murrum or Gravel	
				Grading Classification & Size	For. WBM Sub-base/base course (Loose quantity)	Grading Classification & Size	Loose Qty.
Grading 2	63 mm to 45mm	75 mm	0.91 to 1.07 m ³	Type A 13.2m m	0.12 to 0.15 m ³	-do	0.22 to 0.24 m ³

404.2.9. Binding material : Binding material to be used for water bound macadam as a filler material meant for preventing ravelling, shall

comprise of suitable material approved by the Engineer having a Plasticity Index (PI) value of less than 6 as determined in accordance with IS: 2720 (Part-5).

The quantity of binding material where it is to be used, will depend on the type of screenings. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be $0.06-0.09 \text{ m}^3/10\text{m}^2$ and $0.08-0.10\text{m}^3/10\text{m}^2$ for 100 mm compacted thickness.

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

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

404.10. Construction Operations

404.10.1. Preparation of base: The surface of the subgrade/ sub-base/base to receive the water bound macadam course shall be prepared to the specified lines and crossfall (camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained if necessary by sprinkling water. Any sub-base/base/surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (levelling course) to Clause 501 of these Specifications.

As far as possible, laying water bound macadam course over an existing thick bituminous layer may be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous wearing course where water bound macadam is proposed to be laid over it. However, where the intensity of rain is low and the interface drainage facility is efficient, water bound macadam can be laid over the existing thin bituminous surface by cutting 50 mm x 50 mm furrows at an angle of 45 degrees to the centre line of the pavement at one metre intervals in the existing road. The directions and depth of furrows shall be such that they provide adequate bondage and also serve to drain water to the existing granular base course beneath the existing thin bituminous surface.

404.10.2. Inverted choke : If water bound macadam is to be laid directly over the subgrade, without any other intervening pavement course, a 25 mm course of screenings (Grading B) or coarse sand shall be spread on the prepared subgrade before application of the aggregates is taken up. In case of a fine sand or silty or clayey

subgrade, it is advisable to lay 100 mm insulating layer of screening or coarse sand on top of Fine grained soil, the gradation of which will depend upon whether it is intended to act as a drainage layer as well. As a preferred alternative to inverted choke, appropriate geosynthetics performing functions of separation and drainage may be used over the prepared subgrade as directed by the Engineer. Section 700 shall be applicable for use of geosynthetics.

404.10.3. Spreading coarse aggregates : The coarse aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base/ base to proper profile by using templates placed across the road about 6 m apart, in such

quantities that the thickness of each compacted layer is not more than 100 mm for Grading 1 and

75 mm for Grading 1 and 3, as specified in Clause 404.2.5. Wherever possible, approved mechanical devices such as aggregate spreader shall be used to spread the aggregates uniformly so as to minimise the need for manual rectification afterwards. Aggregates placed at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any approved means so as to achieve the specified results.

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

The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved drawings. The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operations.

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

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

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

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

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

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

404.10.5. Application of screenings: After the coarse aggregate has

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

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

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

404.10.6. Sprinkling of water and grouting : After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operation shall be continued, with additional screenings applied as necessary until the coarse aggregate has been thoroughly keyed, well-bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or subgrade does not get damaged due to the addition of excessive quantities of water during construction.

In case of lime treated soil sub-base, construction of water bound macadam on top of it can cause excessive water to flow down to the lime treated sub-base before it has picked up enough strength (is still "green") and thus cause damage to the sub-base layer. The laying of water bound macadam layer in such cases shall be done after the sub-base attains adequate strength, as directed by the Engineer.

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

404.10.8. Setting and drying: After the final compaction of water

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

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

404.11. Surface Finish and Quality Control of Work

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

404.11.2 Control on the quality of materials and works shall be exercised by the

Engineer in accordance with Section 900.

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

404.11.4. Reconstruction of defective macadam: The finished surface of water bound. macadam shall conform to the tolerance of surface regularity as prescribed in Clause 902. However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to subgrade soil mixing with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and recompacted. In no case shall depressions be filled up with screenings or binding material.

404.12. Arrangement for Traffic

During the period of construction, the arrangement of traffic shall be done as per Clause 112.

404.13. Measurements for payment

Water bound macadam shall be measured as finished work in position in **cubic metres.**

404.14. Rate

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

- (vi) malting arrangements for traffic to Clause 112 except for initial treatment to verges, shoulders and construction of diversions;
- (vii) furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts;
- (viii) all labour, tools, equipment and incidentals to complete

the work to the Specifications;

(ix) carrying out the work in part widths of road where directed; and

(x) carrying out the required test for quality control.

The payment shall be made on Cmt. Basis.

Item No. 20:- Providing and laying W.B.M of B.T.M.C metal of size 45 mm to 90 mm size including 0.27 Cu.m. stone screening & 0.08 Cu.M. stone dust as filler including spreading, watering & consolidation by vibratory roller 80KN to 100KN static weight. 100 mm thick compacted.

- Detailed technical specification as per Item No.12

Item No. 21:- Box cutting the road surface to proper slope and camber for making a base for road work including removing the excavated stuff and depositing on the road side slope as directed upto 50Mt.lead.

1. This work shall consist of excavation, removal and satisfactory disposal of all materials necessary for the construction of widening carriageway in accordance with requirements of these specifications and the lines, grades and cross sections shown in the drawings or as indicated by the Engineer.
2. After the site has been cleared the limits of excavation/ box cutting the road surface shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer.
3. Box cutting shall be carried out in conformity with the directions laid here in under and in a manner approved by the Engineer. The work shall be so done that the suitable materials available from box cutting/ excavation are satisfactorily utilized as directed.
4. The contractor shall not excavate outside the limits of box cutting. Subject to the permitted tolerances, any excess depth/ width excavated beyond the specified levels/ dimensions on the drawings shall be made good at the cost of the contractor with suitable material of characteristics similar to that removed and compacted as directed.

5. Cutting shall be done in proper grade & camber as shown on drawing or as directed. Care must be taken that all slopes are evenly and truly dressed. Cutting shall be done to the exact depth required and shall be as per formation level in proper grade and the camber. If extra depth of cutting is done due to negligence of contractor the same shall be refilled with approved quality of materials duly consolidated to the satisfaction of the Engineer-in-charge (without extra cost).
6. The stuff received from the cutting of existing crust shall be screened on site and stone aggregates shall be stacked at suitable place which shall be reused for modified sub base as directed by the Engineer in charge. The unsuitable materials shall be removed from the site and same shall be used for filling and correcting side slopes of bank and earthwork for embankment as directed by the Engineer in charge with lead up to 50 mtr..
7. The measurement of box cutting shall be taken on level basis & level shall be taken at 30 mt. interval. Volume shall be computed in cubic meters by average area method.
8. The payment shall be made on Cmt. basis.
9. The rate includes cost of all labour, machineries required, cost of carting and spreading the cutting stuff with all lead and lift and leveling the dumping ground/ embankment, rolling and consolidation of subgrade level etc. complete.

Item No. 22:- Cautionary Warning Sign :-Providing and fixing sing boards made out of 2mm aluminium sheet; size 90 x 90 x 90 cms. equilateral triangle as per design of IRC-67-1977. Pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint ;reflectorised with retro refiectivesheeting as per latest M.O.S.T.Specifications; 3.1m long stand postand frame fabricated from suitable sizeiron angle of 35 x 35 x 3mm, 75 x 75 x 6mm as required; painted with bestquality epoxy coatings in black andwhite bends. The details of symbol foreach board shall be as per theinstruction of engineer in charge. The fixing at site shall be in 1:2:4 CC blockof size 45 x 45 x 60 Cms. for each leg.including excavation, curing etc.complete under the supervision of engineer in charge.(A) Engineer Grade(VR)

ITEM.NO.26092A

Placement and Operation of Road Signs

Placement of road signs will be within road users' view. To aid in conveying proper meaning, road signs will be positioned with respect to the location or situation to which it applies. The location and legibility of the road sign will be

such as to provide adequate response time to road users to read and take action at the operating speed.

Orientation of Signs

The signs will be placed at right angles to the line of travel of the approaching traffic. Where light reflection from the sign face is encountered to such an extent as to reduce legibility, the sign should be turned slightly away from the road. On horizontal curves, the sign should not be fixed normal to the carriageway but the angle of placement will be determined with regard to the course of the approaching traffic.

Sign faces will be normally vertical, but on gradients it may be desirable to tilt a sign forward or backward from the vertical to make it normal to the line of sight and improve the viewing angle.

Cautionary/warning and mandatory signs will be fabricated through process of screen printing. In case the facility is not locally available in the region of work, these signs and informatory signs may have inscription /message having cut letters of non- reflective black sheeting which shall be bonded well on the base sheeting as directed by Engineer in charge.

1. Material for Signs:

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

1.1 Concrete

Concrete for footing shall be of the grade shown on the contract drawings or of minimum M15 grade conforming to section 800 of the specifications for MORD.

1.2 Reinforcing Steel

Reinforcing steel shall conform to the requirements of IS 1786 unless otherwise specified.

1.3 Bolts, Nuts and Washers

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

1.4 Plates and Supports

Plates and support sections for the signposts shall conform to IS 226 and IS 2062 or any other stated IS specification.

1.5 Substrate

Aluminium Composite Material(ACM) conforming to following subsections.

a) Aluminium Sheet

Aluminium sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminium alloy conforming to IS 736 - Material Designation 24345 or 1900.

b) Aluminum Composite Material (ACM)

ACM sheets used for sign boards is a sandwiched construction with a thermoplastic core of „Low Density Polyethylene“ (LDPE) between two thick skins/sheets of Aluminium with overall thickness of 4 mm and 3 mm, and Aluminium skin thickness of 0.4 - 0.5 mm and 0.25 - 0.3 mm respectively on both sides. The retro reflective sheeting must be applied on the top surface with aluminum surface with recommended surface preparation from sheeting manufacturer. A fluorocarbon coating may be applied over the exposed surface of aluminium to ensure corrosion resistant and weatherability and shall conform to relevant ASTM. The mechanical properties of 4mm and 3mm ACM and that of its Aluminum skin shall conform to the requirement given in Table 1.1, when tested in accordance with the test methods mentioned against each of them

Table 1.1 Specifications for Aluminum Composite Material (ACM)

Sl No.	Description	Specification for 4mm		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	0.2% 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	<i>Min. 70,000 N/mm²</i>	<i>Min. 70,000 N/mm²</i>
3	Elongation	ASTM E8	<i>A₅₀ Min. 2%</i>	<i>A₅₀ Min. 2%</i>
4	0.2 % Proof Stress	ASTM E8	<i>Min. 110 N/mm²</i>	<i>Min. 110 N/mm²</i>

c) Plate Thickness

Shoulder mounted ground signs with a maximum side dimension not exceeding 600 mm shall not be less 3 mm thick with Aluminium Composite Material. All other signs shall be at least 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. All overhead signs made with Aluminium Composite Material shall be minimum 4 mm thick to withstand wind and other loads without deformation.

1.6 Retro Reflective Sheeting

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 and in case the certificate is obtained from international agency, it should also be obtained from Indian agency within 3 years of launching of product by the manufacturer in abroad. Alternatively, a certificate conforming to ASTM Specification (D 4956-09) on artificial accelerated weathering requirements from a reputed laboratory in India will be accepted. The supplier will have to submit performance guarantee of meeting the requirement of three years outdoor weathering of the sheeting.

All micro prismatic grade sheets will be as per ASTM D 4956-09 Type IV. The reflective sheeting

shall be 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 coefficient of retro reflection (determined in accordance with ASTM D 4956-09), When totally wet, the sheeting shall show not less than 90 percent of the values, of retro-reflection indicated in 6.4. at the end of the 7 years, the sheeting shall retain at least 80 percent of its original retro-reflectance.

Table 6.4: Acceptable Minimum Coefficient of Retro-reflection for Type-IV Prismatic Grade Sheeting (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° ^B	-4°	500	380	200	70	90	42	25	400	300	150
0.1° ^B	+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

^AMinimum Coefficient of Retro reflection (R_A)(cd.lx⁻¹.m⁻²).

^BValues for 0.1° observation angles are supplementary requirements that shall apply

only when specified by the purchaser in the contract or order.

1.7 Messages/borders: The message (legends, letters, numerals etc.) letter, numerals, symbols /legend/arrow etc. in Gujarati, Hindi and /or English, should either be screen- printed or to be cut out from durable transparent Overlay Electrocutable film or cut out from the same type of reflective sheeting for the cautionary /mandatory sign boards. The screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. For the informatory and other sign boards, the messages (legends, letters, numerals etc.) and borders shall be cut out from durable transparent overlay film or cut-out from the same reflective sheeting only. Cut out 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 coefficient of retro-reflection shall not be less than 50 per cent of the values of corresponding colour in the above table. 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.

1.8 Adhesives: 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. The adhesive shall be protected by a

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.

1.9 Fabrication:

Surface to be reflectorised shall be effectively prepared to receive the retroreflective sheeting. The aluminum sheeting shall be de-greased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting. Complete sheets of the material shall be used on the signs except where it is unavoidable. At splices, sheeting with pressure-sensitive adhesives shall be overlapped not less than 5 mm. 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.

1.10 Installation

1.10.1 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 galvanized iron (G.I.). Post(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.

1.10.2 All components of sign and supports, other than the reflective portion and MS / 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.

1.10.3 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.

1.10.4 Fixing

1.10.4.1 Materials

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

4.1.1. Concrete: Concrete shall be of the M20 grade or as shown on the Contract drawings or otherwise as directed by the Engineer.

4.1.2. Water: Water shall conform to IS: 456-1978. Storage & handling of water shall be clean.

4.1.3. Cement: Cement shall conform to IS: 269-1976 or I.S: 455-1976.

4.1.4. Sand, aggregates: Sand, aggregate & its gradation shall conform to M6, M12 & M13 of General Technical Specifications for Building Works..

1.10.4.2. Installation

4.2.1. The supporting structure and signs shall be fabricated and erected as per details given in the plans.

4.2.2. The work of construction of foundation for sign supports including excavation and backfill, forms, steel reinforcement, concrete and its placement shall conform to the relevant Specifications given in these Specifications.

4.2.3. Signs posts, their foundations and sign mountings shall be so constructed as to hold signs in a proper and permanent position to adequately resist swaying in the wind or displacement by vandalism.

4.2.4 After installation of sign is complete, the sign shall be inspected by the Engineer. If specular reflection is apparent on any sign, its positioning shall be adjusted by the Contractor to eliminate or minimize this condition.

1.11 Warranty and durability: The Contractor shall obtain from the manufacture a seven-year warranty for satisfactory field performance including stipulated retroreflectance of the retro-reflectance sheeting. And submit the same to the Engineer. The Contractor/supplier shall also furnish a certification that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty. Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning, shall show no appreciable discolouration, cracking, blistering or dimensional change and shall not have less than 50 per cent 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).

1.12 Measurements for Payment

The measurement of standard cautionary, mandatory and information signs supplied and fixed, while for direction and place identification signs, these shall be measured in No. basis.

1.13 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. 23:- Regulatory/Mandatory signs : Providing and fixing sign boards made out of 2mm aluminium sheet; size 60cms. 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 bands. 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 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge. (A) Engineer Grade (VR)..

- Detailed technical specification as per Item No.22

Item No. 24:- Direction sign (Junction board):- Providing and fixing sign boards made out of 2mm aluminium sheet; size 244 x 122cms. rectangle as 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 50 x 50 x 5mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bands. the details of symbol or inscription / numerals for each board

shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)..

- Detailed technical specification as per Item No.22

Item No. 25:- Place identification sign :-Providing and fixing sign boards made out of 2mm aluminium sheet; size 150 x 90cms. rectangle as 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 bands. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)..

- Detailed technical specification as per Item No.22

Item No. 26 :- Village name/ Bump Ahead sign :-Providing and fixing sign boards made out of 2mm aluminium sheet; size 90 x 60cms. rectangle as 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 50 x 50 x 5mm painted with best quality epoxy coatings in black and white bands. the details of symbol or inscription / numerals for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of engineer in charge.(A) Engineer Grade(VR)..

- Detailed technical specification as per Item No.22

Item No. 27 Cat Eye / Road Stud / RPM: Supplying Raised Pavement Markers made of polycarbonate and ABS molded 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 body of the marker should having finger grip for easy and accurate placement and application with epoxy / bituminous Adhesive as recommended by the manufacturer of the marker. The color of the marker should be as per the IRC 35-2015 and as directed by Engineer-in-charge.

Material & Manufacturing

1. Scope

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

2. Material

2.1 Plastic body of RPM road stud shall be molded from ASA (Acylicstyreneactylonitrile) or HIPS (Impacts polystyrene) or ABS or any other suitable material approved by the Engineer in charge. The marker shall support a load of 13635 kg. tested in accordance with ASTM D 4280

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

3. Design

The slope or retro relfecting surface shall prfeably be 35. + 5degree to base. The area of each retro reflecting surface shall not be less then 13.0 sqmt.

4. Optical performance

4.1 Unidirectional and bi directional studs Each reflector or combination of reflector on each face of the stud shall have a CIL not less the given in Table 1 or 2 appropriate.

4.2 Omni directional studs

Each omni directional stud shall have a min. CIL of not less than 2mcd/lx

Table 1 min. CIL vales for category 'A' studs.

Entrance Angle	Observation Angle	C.I.L. in mcd/lx		
		White	Amber	Red
0° U 5° L&R	0.3°	220	110	44
0° U 10° L&R	0.5°	120	60	24

Table 2 min. CIL vales for category 'B' studs.

Entrance Angle	Observation Angle	C.I.L. in mcd/lx		
		White	Amber	Red
0° U 6° L&R	0.3°	20	10	4
0° U 10° L&R	0.5°	15	7.5	3

Note:

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

5. Tests

5.1 Coefficient of luminance intensity can be measured byproduce described in ASTM 809 " Practice for Measuring Photometric characteristics" or as recommended in BS 879 part 4:1973

5.2 under test conditions, a stud shall not be considered to fail the photometric requirements if the measured C.I.L at any one position of measrements is less than the values specified in Table 1 or 2 provided that

- i) average of the left and right measurements for the specific angle is greater than the specified minimum

6. Fixing of Reflective studs

6.1 Requirements

The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic. The reflecting portion of the studs shall be free from crevices or ledges where dirt might accumulate. Marker height shall not be less than 10mm and shall not exceed 20mm. and it's width should not exceed 130mm. the base of the marker shall be flat within 1.3mm. if the bottom of the marker is configured, the outer most faces of the configurations shall not deviate more than 1.3mm from the flat surface.The marker shall be fitted with two polymer shanks at appropriate places at either ends and shall be slotted along its length. The Shank Length for Each of the

shanks shall not be less than 20 millimeter.

All road studs shall be legibly marked with name, trade mark or other means of identifications of the manufacturer.

6.2 Placement

The reflective marker shall be fixed to the road surface using the adhesives and the procedure recommended by the manufacturer. No nails should be used to fix the marker so that they do not pose safety hazard on the roads. Regardless of the type of adhesive used, the markers shall not be fixed if the pavement is not surface dry and on new asphalt concrete surface until the surface has been opened to traffic for period of not less than 14 hours. The portions of the Road surface to which marker is to be bonded by the adhesive shall be free of dirt, curing compound, grease, oil, moisture, loose or any other material which would adversely affect the bond of the adhesive. The adhesive shall be placed uniformly on the Cleaned pavement surface or on the bottom of the markers in a quantity sufficient to result in complete coverage of the area of the contact of the marker with the surface with no voids present at a slight excess after the marker has been lightly pressed in place. For epoxy installations, excess adhesive around the edge of the marker, excess Adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed.

6.3 Warranty and Durability

The contractor shall obtain from the manufacturer a two year warranty for contractor held performance including stipulated retro reflectance of the reflecting panel and

submit the same to the Engineer in charge. In addition a two year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carried out the work of fixing of reflective road markers. In case the markers are displaced, damaged, get worn out or low their reflectivity compared to stipulated standards, the contractor would be required to replace all such marker within 15 days of the intimation from the Engineer at his own cost.

7. Measurement of Payment

The measurement of reflective road markers shall be in marker supplied and fixed.

8. Rate number of diff. types of

The contract unit rate for reflective road marker shall be payment in full compensation for furnishing all labor, materials, tools, equipment including incidental costs necessary for carrying out the work at site conforming to the specifications complete as per approved drawings or as directed by the Engineer.

Item no.28 Road marking with hot applied thermoplastic paints with reflectorizing glass beads on bitumen surface providing and laying a hot applied thermoplastic compound 2.5 mm thick including reflectorizing glass beads @ 250gms per sq. area, thickness of 2.5mm is excluding of surface applied glass beds as per IRC:35-2015. The finished surface to be level, uniform and free from streaks and holes. zebra patta /bump patta lane/center line/ edge line/cut patta. The white color marking should provide luminance coefficient on cement road shall be min 130 mcd/m²/lux and Asphalt road shall be min 100 mcd/m²/lux during the service life during the day time. The marking should meet the performance criteria for night time reflectivity, wet reflectivity and skid resistance as mentioned in the section-15 of IRC 35-2015. Warranty for the Retro reflectivity should be two years.

803. ROAD MARKINGS

803.1. General The color, width and layout of road markings shall be in accordance with the Code of Practice for Road Markings with paints, IRC : 35, and as specified in the drawings or as directed by the Engineer.

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

803.3. Ordinary Road Marking Paint

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

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

803.3.3. Laying thickness of road marking paint shall be as specified by the Engineer.

803.4. HOT APPLIED THERMOPLASTIC ROAD MARKING

803.4.1. General:

- (i) The work under this section consists of marking traffic stripes using a thermoplastic compound meeting the requirements specified herein.
- (ii) The thermoplastic compound shall be screened /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 produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.
- (iii) The color of the compound shall be white or yellow (IS color No. 356) as specified in the drawings or as directed by the Engineer.

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

803.4.2. Thermoplastic Material

803.4.2.1. General: The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorising beads.

803.4.2.2. Requirements

- (1) **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 900-3 PROPORTIONS OF CONSTITUENTS OF MARKING MATERIAL		
(Percentage by weight)		
Component	White	Yellow
Binder	18.0 min.	18.0 min.
Glass Beads	30-40	30-40
TABLE 900-3 PROPORTIONS OF CONSTITUENTS OF MARKING MATERIAL		
(Percentage by weight)		
Titanium Dioxide	10.0 Min.	-----
Calcium Carbonate and		
Inert Fillers	42.0 Max.	See
Yellow Pigments	-----	Note

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

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

(a) Luminance:

White: Daylight luminance at 45 degrees-65 per cent min. as per AASHTO M 249

Yellow: Daylight luminance it 45 degien-45 per cent min. as per AASHTO M 249

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

- (c) **Skid resistance:** not less than 45 as per BS 6044.

- (d) **Cracking resistance at low temperature:** The material shall show no cracks on application to concrete blocks.

- (e) **Softening point:** 102.5 ± 9.50 C as per AASTM D 36.
- (f) **Flow resistance:** Not more than 25 per cent as per AASHTO M 249.
- (g) **Yellowness Index (for white thermoplastic paint):** not more than 0.12 as per AASHTO M 249
- (iii) **Storage life:** The material shall meet the requirements of these Specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or un melted particles for the one year storage period. Any material not meeting the above requirements "I am replaced by the manufacturer/ supplier/Contractor.
- (iv) **Reflectorisation:** Shall be achieved by incorporation of beads. the grading and other properties of the bonds shall be as specified in Clause 803.4.3.
- (v) **Marking:** Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:
 1. The name, trade mark or other means of identification of manufacturer, 2. Batch number, 3. Date of manufacture, 4. Color (white or yellow) & 5. Maximum application temperature and maximum safe beating temperature.
- (vi) **Sampling and testing:** The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Employer a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

803.4.3. Reflectorising glass beads

803.4. 3.1. General: This Specification covers two types of glass beads to be used for the production of reflectorised pavement markings.

Type I 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, colour less and free from milkiness, dark particles and excessive air inclusions.

These shall conform to the requirements spelt out in Clause 803.4.3.3.

803.4.3.3. Specific requirements

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

TABLE 800-4 GRADATION REQUIREMENTS FOR GLASS BEAD
Per cent retained

Sieve size	-----	-----
	Type I	Type 2

1.18 mm	0 to 3	-----
850 micron	5 to 20	0 to 5
600 -do-	----	5 to 20
425 -do-	65 to 95	-----
300 -do-	-----	30 to 75
180 -do-	0 to 10	10 to 30
below 180 micron	-----	0 to 15

- B. Roundness:** The glass beads shall have a minimum of 70 per cent true spheres.
- C. Reflective index:** The glass beads shall have a minimum reflective index of 1.50.
- D. Free flowing properties:** The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paint striping. They shall pass the free flow-test.

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

- (i) Free-flow test: Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter desiccators which is filled within 25 mm of the top of a desiccator's plate with sulphuric acid water solution (specific gravity 1.10). Cover the desiccators and let it stand for 4 hours at 20 to 29 degree C. Remove sample from desiccators, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100 mm stem and 6 mm orifices, if necessary initiate flow by lightly tapping the funnel. The glass spheres shall be essentially free of lumps and clusters and shall flow freely through the funnel.
- (ii) The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS 6088 and BS 3262 (Part 1).
- (iii) The Contractor shall furnish to the Employer a copy of certified test reports from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified herein and shall certify that the material meets all requirements of 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 material shall readily get screened / extruded at temperatures specified by the manufacturers for respective method of application to produce a line of specified thickness which shall be continuous and uniform in shape having clear and sharp edges.

803.4.4.2. The material upon heating to application temperatures shall not

exude fumes, which are toxic, obnoxious or injurious to persons or property.

803.4.5. Preparation:

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

803.4.6. Properties of finished road marking

- (a) The stripe shall not be slippery when wet.
- (b) The marking shall not lift from the pavement in freezing weather.
- (c) After application and proper drying, the stripe shall show no appreciable deformation or discoloration under traffic and under road temperatures up to 60 degree centigrade.
- (d) The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil drippings from traffic.
- (e) The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.
- (f) The color of yellow marking shall conform to IS Color 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 requirement 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 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 material shall be applied hot either by screening

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. In addition to the beads included in the material, a further quantity of glass beads of Type 2, conforming to the above noted Specification shall be sprayed uniformly into a mono-layer on to the hot paint line in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square metre area.

803.6.4. 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 from streaks.

803.7. Measurements for Payment

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

803.8. Rate

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

Special Requirement for Hot Applied Thermoplastic Marking and Audible Vibratory Profile

Marking Application on Road

2. The application of Hot Applied Thermoplastic and Audible Vibratory marking must be done with Either Fully Automatic or Semi-Automatic Application Machine only. No Manual Machine is allowed to use for the application of the Thermoplastic marking.

3. The Applicator must have their own machines for Thermoplastic profile Marking, and the proof of ownership to be submitted to the Authority for source approval.
4. The Applicator should be either Manufacturer or authorized by the original manufacturer of the Material. The applicator should submit such authorization certificate to the Authority for the approval before commencing the work.
5. The manufacture should be ISO certified organization and the copy of the certificate should be submitted to the Authority.
6. Performance Criteria: Material should be confirming to MoRTH specification and test Certificate should be submitted as per the IRC 35-2015 for the reflectivity and luminance test time to time.
7. The Applicator should organize onsite testing for the reflectivity performance with reflectometer initially at 7 days and afterwards at interval of every 6 months up to 2 Years and performance should meet IRC 35-2015 criteria.
8. The Applicator should submit in original warranty for satisfactory in field performance as laid down in IRC 35-2015 for the period of 2 years. The warranty should be in original and jointly signed by the original manufacture and authorized applicator.

ITEM NO. 29 Providing and fixing Hectometer as per I.R.C. type design including painting, lettering etc. complete.(i) Fixing in Earth

The work shall be carried out as per the item of ordinary HECTOMETER stone except that the size of hectometer stone shall be smaller than that of ordinary kilometer stone as per I.R.C. 26 (Type design for 200 metre stones) and fixing shall be 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. The measurement for payment as well as the operations included in the unit rate shall be as per ordinary Hectometer stone. Rate includes all labour and curing etc. necessary for concrete.

ITEM NO. 30 Providing and fixing ordinary Kilometer 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 letter and paints etc. complete (For N.H., S.H. and M.D.R.)

1. Kilometer stone shall be of approved quality and shall be of precast 1:2:4 R.C.C. as specified in the item.
2. The size, manner of fixing, painting and lettering of K.M. stone shall conform specification as per I.R.C. - 8 (Type design for Highway 5th Kilometer stones). The fixing of K.M. store shall be carried cut in ordinary concrete of grade specified in the item using crushed stone aggregate. The measurement for payment shall be made per No. of K.M. stone fixed in position.

3. Unit rate for Kilometer stone includes the cost of all materials, labour, tools, fixing, finishing curing, lettering and painting as directed by the Engineer-in-charge.

ITEM NO. 31 Providing and fixing 5th Kilometer 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, lettering etc. complete (For N.H., S.H. and M.D.R.)

- Detailed technical specification as per Item No.30

ITEM NO. 32 Metal Beam Crash Barrier Type A, "W": Metal Beam Crash Barrier (Providing and erecting a "W" metal beam crash barrier comprising of 3 mm thick corrugated sheet metal beam rail, 70 cm above road/ground level, fixed on ISMC series channel vertical post, 150 x 75 x 5 mm spaced 2 m centre to centre, 1.8 m high, 1.1 m below ground/road level, all steel parts and fittings to be galvanised 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 spacer of channel section 150 x 75 x 5 mm, 330 mm long complete as per clause 810) National Highway SOR 2023-24 Ahm Item code 8.23A

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, Section 800 Traffic Signs, Markings and other Road Appurtenances 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 three 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 three beam, the posts, spacers and fasteners for steel barriers shall be galvanized by hot dip process (zinc coated, 0.55 kg per square metre; 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. Traffic Signs, Markings and other Road Appurtenances Section 800

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.

811.3.7 Measurements for Payment

811.3.7.1 Metal beam railing barriers will be measured by linear metre of completed length as per plans and accepted in place. Terminals/anchors of various types shall be paid for by numbers. Section 800 Traffic Signs, Markings and other Road Appurtenances

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, equipment's 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.

ITEM NO. 33 Providing and laying Plastic Speed Breaker with yellow and black colour material of approved quality and brand, size (350 mm x 250 mm x 50 mm), including necessary base preparation, Fastening and all complete work as per instructions of the engineer. (MR)

Material and Physical Specifications

- **Base Material:** The modules must be manufactured from high-impact **ABS (Acrylonitrile Butadiene Styrene)** or high-grade **UV-stabilized PVC**. The material must be virgin polymer to ensure maximum durability and resistance to cracking.

- **Dimensions:**
 - **Width (Transverse to Road):** 350 mm.
 - **Length (Direction of Travel):** 250 mm per module.
 - **Height:** 50 mm.
- **Coloration:** Alternating **Yellow and Black** segments. The color must be impregnated into the material during molding (pre-colored) rather than painted to prevent fading from friction or UV exposure.
- **Load Bearing Capacity:** Heavy-duty rating capable of withstanding **30 to 60 tons** of vehicle weight without deformation.
- **Weight:** Minimum weight of approximately **3.0 to 4.0 kg per running meter** (typically 4 modules per meter).

2. Design and Visibility

- **Anti-Skid Surface:** The top surface must feature a textured, **anti-skid pattern** (e.g., diamond or ribbed) to ensure tire traction in wet weather.
- **Reflectivity:** Each module must be equipped with at least **2 to 4 integrated retro-reflective lenses** (acrylic or glass beads) on both approach sides for night visibility.
- **Modular Interlocking:** Units must feature an **interlocking groove system** that allows them to be connected seamlessly, distributing load across multiple segments.

3. Installation and Execution Detail

- **Base Preparation:** The existing road surface must be cleaned of loose bitumen, dust, or oil. Minor undulations should be addressed to ensure the modular pieces sit flush with the pavement.
- **Fastening System:**
 - **Drilling:** Holes must be drilled into the pavement using a rotary hammer drill with a diameter corresponding to the anchor bolts (typically 12–16 mm).
 - **Anchoring:** Secure each module using **4 heavy-duty galvanized steel (GI) anchor bolts** or H.T. nails.

- **Adhesive (Optional):** For high-stress areas, an **epoxy compound** or industrial adhesive may be applied to the base of the breaker before bolting.
- **Completion:** All bolt heads must be recessed into the pre-molded holes of the module to prevent damage to vehicle tires.

4. Quality Control

- **Brand Approval:** All material must be of a brand approved by the Engineer-in-Charge, such as Treadsafe, Vertex, or similar.
- **Environmental Resistance:** Must be certified as moisture, oil, and temperature resistant (up to 50°C-60°C) to withstand Indian climatic conditions.
- Do you need a **cost-benefit comparison** between plastic and rubber speed breakers for this specific project?

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