

1. DESCRIPTION

This work shall consist of the application of one coat of surface dressing, consisting of a layer of bituminous binder sprayed on a base prepared previously followed by a cover of stone chipping properly rolled to form a wearing course to the requirements of these specifications.

2. MATERIALS

2.1 Stone chipping : The machine crushed B.T. stone chipping shall consist of fairly cubical fragments of clean, hard, tough and durable rock of uniform quality throughout. These shall be obtained by crushing B.T. stone. The chipping shall be free of elongated or flaky pieces, soft or disintegrated stone, salt, alkali, vegetable matter, dust and adherent coatings.

2.2 Binder : The binder shall be straight run bitumen of 80/100 or 60/70 penetration and satisfying the requirement of I.S. 73 or other type of bitumen as may be approved by the Department.

Necessary storage arrangements i.e. provision of tanks etc. for bulk asphalt shall be done by the contractor without any extra charges.

In the case of bitumen is to be supplied by Department in bulk at the rate and place shown in Schedule "A" for bulk asphalt, contractor shall have to make adequate arrangement for stacking bulk asphalt at plant site, according to requirement. If the asphalt is supplied as bulk on plant site, the rate of conveyance for lead difference from store to plant site shall be recovered at S.O.R. for Qty of asphalt supplied.

2.3 Keeping Records : The Department shall keep a day account of the supply and use of the asphalt in separate bound register having numbered pages in the proforma prescribed by the Department. Day to day signature of the responsible contractor or his representative as may be directed by Engineer-in-charge shall be obtained in this register. The register shall be maintained by the Department and shall be produced with each bill.

TABLE . Physical requirements of aggregates

Sr. No.	Test	Test Method	Requirement
1	Los Angeles Abrasion Value*	IS : 2386 (Part IV)	40% Maximum
2	Aggregate Impact Value*	- do -	30% Maximum
3	Flakiness Index	IS : 2386 (Part I)	30% Maximum
4	Stripping Value	IS : 6241	25% Maximum
5	Soundness		
	(i) Loss with Sodium Sulphate 5 cycles		12%
	(ii) Loss with Magnesium		18%
6	Water Absorption	IS : 2386 (Part III)	1% Maximum

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

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

Requirements of stone chipping and binder content for surface dressing for 10 sq. mt.

Sr. No.	Type of Construction	Nominal Size of stone chipping	Specifications percent passing through sieve and retained on sieve	Quantity of materials	Binder content
1.	Single coat surface dressing of first coating of two coat surface coating	12 mm	Passing 20 mm Sieve & Retained on 10 mm Sieve	0.15 CM	18 kg
2.	Second Coat of two coat surface dressing	10 mm	Passing 12 mm Sieve & retained on 4.5 mm sieve	0.10 CM	11 kg

3. CONSTRUCTION OPERATION

3.1 Weather & seasonal limitations : The surface dressing work shall be carried on only when the atmospheric temperature in shade is above 15° C. No bituminous materials shall normally be applied when the surface of cover material is damp when the weather is foggy or rainy or during dust storms.

3.2 Preparation of base : The base on which surface dressing is to be laid shall be prepared, shaped and conditional to the specified lines, grade and cross section as directed by the Engineer-in-charge.

The surface shall be thoroughly swept and scraped cleans of dust and any other extraneous matter before the spraying of binder. As necessary the cleaning shall be done first with hard brushed, then with softer brushes and finally by blowing with sacks or gunny bags.

3.3 Application of binder : Binders shall be heated to 163° C to 177° C. and sprayed on the dry surface in uniform manner with the help of self-propelled mechanical sprayers having, self-heating arrangement and bitumen pressure pump and spray nozzle bar capable of spraying bitumen uniformly at specified rate as given in above table. Excessive deposits of binder caused by slopping or starting of the sprayer or Through leakage or any other reasons shall be suitably corrected before the stone chipping are spread.

3.4 Application of stone chippings : The cover material i.e. machine crushed B. T. chips of 11.2 mm. nominal size shall be stacked on road side by filling standard boxes of 2.0 m x 1.50 m x 0.50 m the measurement shall be recorded in the measurement book after

collection in two kilometre length is complete. The material shall be cross checked by another D.E.E. as per rules. There after, the spreading shall be allowed. The permission of Engineer in charge shall be obtained before spreading.

Immediately after the application of binder, stone chippings in a dry and clean, state shall be spread uniformly on the surface, preferably by means of mechanical gritter, otherwise, manually so as to cover the surface completely. If necessary, the surface shall be broomed to ensure uniform spread of chippings.

3.5 Rolling : Immediately after the application of the cover material, the entire surface shall be rolled with a 8-10 tonnes three wheeled roller. Rolling shall commence at the edges and progress towards the centre except in super elevated portions, where it shall proceed from the inner edge to the other. Each pass of the roller shall uniformly be not less than one third of the thickness made in the preceding pass. While rolling is in progress additional chippings shall be spread by hand in whatever quantities required to make up irregularities. Rolling shall continue until aggregate particles are firmly bedded in the binder and present a uniform closed surface.

3.6 Application of second coat of surface dressing : Where surface dressing in two coats is specified the second coat shall be applied immediately after laying the first coat. The operation shall be the same as describe in para 8.3.3 to 8.3.5.

4. OPENING TO TRAFFIC

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

5. SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to requirements of M.O.S.T. No. 902 Specification.

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

6. ARRANGEMENTS FOR TRAFFIC

During the period of construction flow of traffic shall be maintained as per clause-112.

7. MEASUREMENTS FOR PAYMENT

Surface dressing shall be measured as finished work in square metres.

8. RATE

The contract unit rate for surface dressing shall be payment in full for carrying out the required operations including full compensation for all components listed in item No. 1 para 2.8

ITEM-30 Providing and laying 20/25mm thick bituminous open graded carpet with B.T. aggregates 0.66 cm/M.T. using bitumenious for tack coat at the rate of @ rate of 10 Kg./10 Smt. on W.B.M. surface and 5 Kg./10 Smt. for B.T. surface and for mixing at the rate of 32.8 kg/M.T. of total mix i.e.3.28 per M.T. of total mix and heating asphalt & aggregate by continuous batching hot mix plant and spreading the same by paver finisher including consolidation with power road roller including providing equipment T & P oil, fire wood, kerosene labour charges etc. compt. using contractor's own machineries hot mix plant and paver finisher including flushing of sand 0.30 cmt/100 sq.mt.

1. The work shall consist of construction in a single course of 20/25 mm. thick premixed carpet as course, on a previously prepared base. Single course shall also include additional thickness if any to remove unevenness of the existing surface.
2. The coarse aggregates shall consist of crushed stone only. These shall be clean, strong durable of fairly cubical shape, free of 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 as under.

Physical Requirements of Aggregates for Bituminous Macadam.

Sr. No.	Test	Test Method	Requirement
1.	Los Angeles Abrasion Value	IS : 2386 (part IV)*	35% Maximum
2.	Aggregate Impact Value	- do - *	30% Maximum
3.	Flakiness Index	IS : 2386 (Part I)	30% Maximum
4.	Stripping Value	IS : 6241	25% Maximum
5.	Water Absorption	IS : 2386 (Part III)	2% Maximum

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

3. The fine aggregates shall consist of crusher run screening, natural sand or mixture of both. These shall be clean, hard durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or deleterious substance.
4. The filler, where required, shall be an inert material, the whole of which 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 or fly ash approved by the Engineer-in-charge.
5. The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to the grading as under.

Table Aggregate gradation for Asphalt carpet.

Sieve Size	% by weight passing the Sieve for 20/25 mm thickness
20 mm	100

12.5 mm	70-100
10.0 mm	20-40
4.75 mm	0-5
2.36 mm	

6. The samples of aggregate of requires gradings for the work shall be got approved from the Engineer-in-charge prior to transportation and collection on plant site. Unapproved materials shall have to be removed from the plant site by the contractor at his own cost. If contractor fails to remove the inferior type of materials from the plant site, the same will be removed by the Department at the cost of the Contractor. Collection of aggregate shall be in different stacks according to various sizes of aggregates.

7. For the purpose of collection of materials, plant site shall be established at suitable place, where hot mix plant shall be installed. Department will extend all necessary co-operation in helping Contractor to get nearby Government land of establishing plant site. However, department is not responsible if no such land is made available to the Contractor and in that case, the Contractor will have to make his own arrangement for the same. Incoming material shall be recorded in a register for the purpose of record.

8. The binder shall be straight run bitumen of a suitable grade satisfying the requirements of IS:73. Bitumen shall be 60/80/100 grade and shall be supplied by the department at the rate and place as mentioned in Schedule "A" of the tender and it shall have to be carted, by the Contractor to the site of work at his own cost. Empty asphalt drums shall have to be returned free of cost to P.W.D. Store from where they are issued or as directed, if so provided in Schedule 'A' Any damage caused to the asphalt drums or loss of asphalt after issue from store shall be the responsibility of the Contractor. Drums of asphalt shall be so stored so as to allow easy inspection and in such place as will not damage the drums and cause the leakage of allow water and other foreign matter to enter. For the purpose of calculating consumption, wastage will not be allowed beyond 2.5 percent. Excess consumption over 2.5 percent will be charged at a panel rate.

9. In case bitumen is to be issued by department in bulk, the same shall be issued to the Contractor at plant site by tankers at the same rate as shown in Schedule 'A'. Contractor shall have to make adequate arrangement for stacking bulk asphalt at plant site according to the requirement. No deduction in rate will be made for supplying heated bulk asphalt.

10. The asphalt should not be used as a fuel. If however, Contractor is found to be using asphalt as fuel, the quantity of asphalt utilised shall be assessed, by the Executive Engineer whose decision will be final and binding to the Contractor who will be charged at double the rate provided in Schedule 'A' of the agreement even though the total consumption of asphalt may be within the theoretical consumption.

11. Department shall keep a day to day account of the supply and consumption of bitumen in a separate bound register having numbered pages and the proforma prescribed by the Department. Day to day signature of the Contractor's representative shall be obtained in this register. Issue rate of bitumen includes (i) Obtaining asphalt from Department's store, (ii) Transporting to site, (iii) Storing and stacking, (iv) Keeping records of supply and consumption and (v) returning the empty drums in good condition to the Department.

12. Semi dense carpet shall not be laid during rainy weather or when the base course is damp or wet.

13. The base on which semidense carpet is to be laid shall be thoroughly swept and scraped clean and free of dust and foreign matter.

14. The work shall consist of application of a single coat of bituminous to an existing road surface preparatory to another bituminous construction. The temperature of bitumen at the time of application shall be in the range of 160 degree centigrade to 175 degree centigrade.

15. Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread of straight run bitumen for tack coat shall be 5 kg per 10 square meter area for an existing bitumen treated surface. The binder shall be applied uniformly. The tack coat shall be applied just ahead of the on coming bituminous construction. In case carpet is to be laid on W.B.M. surface, rate of spread of Bitumen for tack cost will be 10 kg./10smt.

16. The binder content for premixing shall be 3.28 percent by weight of the total mix unless otherwise specified. The quantities of aggregates shall be sufficient to yield the specified thickness after compaction.

17. The contractor shall get the job-mix formula for the mix approved by the Engineer-in-charge before starting the work. In order to obtain the required type of mix, the department may change the proportion of bitumen and gradings of aggregate and contractor shall have to collect the materials accordingly. In case of increase in proportion of bitumen the increased or decreased quantity will be adjusted at the rate provided in Schedule 'A' 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.

18. Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant may be either a batch type or a continuous one, having coordinated set of essential unit such as dryer for heating the aggregates, a binder heating and control unit for metering out the correct quantity of heated binder together with a paddle mixer for intimate mixing of the binder and aggregate.

19. The temperature of binder at the time of mixing shall be the range of 150° - 177° degree centigrade and of aggregates in the range of 155° - 163° degree centigrade. Provided also that at no time shall the difference in temperature between the aggregates and the binder exceed 14° degree centigrade.

20. Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which all the particles to the mineral aggregates are coated uniformly.

21. 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 during transit if so directed by the Engineer-in-charge.

22. The mix, transported from the hot mix plant to the site, shall be spread by means of a self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix, to specified grade, lines and cross sections. The temperature of mix at the time of laying shall be in range 121°-163° degree centigrade.

23. Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. Longitudinal joints shall be offset by 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.

24. Immediately after the spreading of mix, it shall be thoroughly compacted by 8-10 tonnes 3 Wheel roller moving at a speed not exceeding 5 km per hour.

25. The roller wheels shall be kept damp to prevent the mix from 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 on super elevated portions. When it shall progress from the lower to upper edge parallel to the centre line of the pavement. The roller should proceed on the fresh material with rear or mixed wheel leading or as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

26. Sand or stone dust flushing at the rate of 0.03 cmt. / 10 smt. shall be done on asphalt surface for which no separate payment will be made.

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

28. Surface finish and quality control of work : Control on the quality of materials and works shall be exercised by the Engineer-in-charge by carrying out the following test at the frequencies shown against each :-

Sr. No.	Type of Construction	Test	Frequency
1.	Tack Coat	(i) Binder temperature for application	At regular close intervals.
2.	Semi-Dense Carpet	(ii) Rate of spread of binder	Two test per day
		(i) Aggregate Impact Value	One test per 100 cu. m. of aggre.
		(ii) Flakiness Index of Aggre.	- Do -
		(iii) Stripping Value	- Do -
		(iv) Mix Grading	One set of test on individual constituents and mixed aggregates from the dryer for each 100 tonnes of mix subject to a minimum of two test per day
		(v) Temperature of binder in the boiler, aggregate in the dryer and mix at the time of laying and rolling	At regular close intervals.
		(vi) Control of binder content and gradation in the mix (Binder Content test vide ASTM D-2172)	One test for each 100 tonnes of mix subject to max. of two test per day per plant
		(vii) rate of spread mix material	Regular control through checks on layer thickness

29. The contractor shall at all times carry out work on the highway in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all work involving improvements to the existing highway, the contractor shall in accordance with the directives if the Engineer-in-charge provide and maintain, during the execution of the work, a passage for traffic either along a part of the existing carriage way under improvement or on diversion.

30. In case of the improvement works, namely widening strengthening of the existing pavement or reconstruction repairs to cross-drainage works. Where such works could be carried out on part widths at a time and the traffic could simultaneously be passed without undue delay and difficulty on the other part; the road shoulder shall be dressed and brought in-line with the pavement and maintained throughout out the duration of the work to the satisfaction of the Engineer-in-charge. Where work is continued on long stretches, passing places, at least 20 metre long and 6 metre wide inclusive of the width of the existing carriage way shall be provided at half or one kilometer intervals as directed by the Engineer-in-charge. Extra treatment to shoulders where necessary, shall be given as ordered by the Engineer-in-charge.

31. The contractor shall take the all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades including signs, marking lights and flagmen as may be required, by the Engineer-in-charge for the information and protection of traffic approaching or passing through the section, of the highway under improvement. Before taking up any construction an agreed phased programme for the control of traffic on the highway shall be drawn up in consultation with the Engineer-in-charge.

32. The barricades erected on either side of the carriage way/portion of the carriage way closed to traffic shall be strong to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset to sunrise. At the points where traffic is to deviate from its normal path the channel for traffic shall be clearly marked with the aid of pavement marking, painted drums or similar device to the direction of the

Engineer-in-charge. At night the passages shall be delineated with lanterns or other suitable light source.

33. One way traffic operation shall be established whenever the traffic is to be passed over part of the carriage way inadequate for two lane traffic. This shall be done with the help of flagmen kept positioned on opposite side during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns lights. On both sides, suitable regulatory/warning signs shall be installed for the guidance of carriage way begins and the other 120 metres away. The signs shall be of approved design and the refractory type if so directed.

34. The payment shall be made on the tonnage basis of the weight of mix of aggregate 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 site.

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

35. Weight of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department and the measurements shall be recorded by the Deputy Engineer, Junior Engineer or Supervisor, if so authorised. Record of each dumper will be maintained separately in bound and numbered register which will be maintained by the department representatives and signed by the contractor. Proper gate pass system shall be established, for the vehicles coming to the plants, site and out going from the plant site. The location of hectometre in which individual dumpers are unloaded shall be recorded carefully.

36. The contract unit rate for semidense carpet shall be in full for carrying out the required operation including full compensation for :-

1. Making arrangements of control and safety of traffic.
2. Preparation of base.
3. Providing all materials to be incorporated in the works with all lead and lifts.
4. All labour, tools, equipment and incidentals to complete the work to the specification.

ITEM-31 Providing and laying seal coat with 0.18 cum stone chips i.e. 0.2727 M. T. per 10 sq. mt. using 42.50 kgs of bitumen per M.T. (4.25% by weight) for mixing the aggregates, heating the asphalt including mixing by continuous batching of hot mix plant and spreading the same by paver finisher and consolidation with power roller including providing all equipments by the contractor and flushing sand at the rate of 0.30 cu. m / 100 sq. mt.

1 DESCRIPTION

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

2 MATERIALS

2.1 Binder : The binder 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 and it shall have to be brought by contractor to the site at his own cost unless otherwise specified in schedule 'A'.

2.2 Coarse aggregates : The coarse aggregate 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 given in Item No. 30 Para 2. Except that the upper limit for water absorption value shall be one percent.

2.3 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.

2.4 Filler : The filler, where required, shall be an inert material the whole of which 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.

2.5 Aggregate gradation : The mineral aggregates including mineral filler, shall be so graded or combined as to conform to gradings set forth in tables below :

Table : Aggregate gradation Pre-Mix Seal Coat

Sieve Designation	Percentage by wt passing through Sieve	
	For type 'A'	For Type 'B'
12.5 mm	-	100
10 mm	100	70-100
4.75 mm	40-85	20-40
2.35 mm	5-20	5-20
75 micron	0-4	0-4

2.6 Proportioning of materials : The binder content for premixing shall be 42.50 kg per M.T. (4.25% 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.

2.7 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.

3. CONSTRUCTION OPERATIONS

3.1 Weather and seasonal limitation : Premix seal coat shall not be laid during rainy weather or when the base course is damp or wet.

3.2 Preparation of base : The base on which premix seal coat is to be laid shall be prepared shaped and conditioned to the specified, lines, grade and cross section in accordance with MOST 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.

3.3 Tack coat : Application of binder : Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an existing bitumen treated surface and 10 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be applied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.

3.4 Preparation of the mix : Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant should be continuous type having a co-ordinated 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 metering 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 - 177°C and aggregates in the range of 150°C - 163°C provided also that at no time shall the difference in temperature of the aggregates and the binder exceed 14°C .

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

3.5 Spreading : The mix, transported from the hot mix 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 sections. 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 the centre line of the road, Longitudinal joints shall be offset by 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.

3.6 Rolling : Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 km per hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled rollers and the surface finished by final rolling with 8-10 tonne tandem rollers, or suitable pneumatic rollers. Rolling temperature shall not be less than 100°C in any case the rolling shall be completed the temperature of mix falls about 80°C .

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 payment. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

4. OPENING TO TRAFFIC

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

5. 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.

6. ARRANGEMENT FOR TRAFFIC

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

7. 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 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 tome differs with the actual area of work done in the field, then the reduction in or addition to payment shall have to be effected to the contractor on proportionate basis depending upon the area reduced or exceeded respectively.

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 Assistant Engineer or Addl. Assistant Engineer if so authorised. 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.

8. RATE

The Contract unit rate for seal coat shall be for payment for carrying out the required operations including full compensation for all components listed in MOST Specification Clause 503.7

Item No. 32 :- Providing and laying 25mm thick Semidense Bituminous concrete with drum mix plant using crushed stone aggregate of specified grading and stone dust as filler, premixed with asphalt / bitumen by weight of total mix at 5.00% (i.e. 50 kg/MT) and tack coat by emulsion asphalt _____ Sq.mt. transporting the hot mix to work site, laying with a paver finisher to the required grade / level and alignment, rolling with power roller / vibratory roller to achieve the desired compaction as per MoRTH specification clause No. 508 complete in all respects. Complete using contractors own machineries drum mix plant & paver finisher etc. complete or as specified.

508. SEMIDENSE BITUMINOUS CONCRETE

508.1 Scope

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

508.2. Materials

508.2.1. Bitumen: The bitumen shall be paving bitumen of Penetration grade complying with Indian Standard Specifications for "Paving Bitumen" IS: 73, and of the penetration indicated in Table 500-15, for semi dense bituminous concrete, or this bitumen as modified by one of the methods specified in Clause 521. Guidance on the selection of an appropriate grade of bitumen is given in The Manual for Construction and Supervision of Bituminous Works.

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

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

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

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

508.3. Mixture Design

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

TABLE 500-14. PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR BITUMINOUS CONCRETE PAVEMENT LAYERS

Property	Test	Specification
Cleanliness (dust)	Grain size analysis ¹	Max 5% passing 0.075 mm sieve
Particle shape	Flakiness and elongation Index (combined) ²	Max 30%
Strength	Los Angeles Abrasion Value ³	Max 35%
	Aggregate Impact value ⁴	Max 27%
Polishing	Polished stone Value ⁵	Min 55
Durability	Soundness ⁶	
	Sodium Sulphate	Max 12%
	Magnesium Sulphate	Max 18%
Water absorption	Water absorption ⁷	Max 2%
Stripping	Coating and stripping of bitumen aggregate mixtures ⁸	Minimum retained coating 95%
Water sensitivity**	Retained tensile strength ⁹	Min 80%

Notes:

1. IS:2386 Part 1

6. IS: 2386 Part 5

2. IS:2386 Part 1

7. IS: 2386 Part 3

(the elongation test may be done only on non-flaky aggregates in the samples)

3. IS: 2386 Part 4*

8. AASHTO T 283**

4. IS: 2386 Part 4*

9. IS: 6241

5. BS: 812 Part 114

* Aggregate may satisfy requirements of either of these two tests

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

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

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

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

Grading	1	2
Nominal aggregate size	13 mm	10 mm
Layer Thickness	35 - 40 mm	25 - 30 mm
IS Sieve ¹ (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5		
19	100	
13.2	90 - 100	100
9.5	70 - 90	90 - 100
4.75	35 - 51	35 - 51
2.36	24 - 39	24 - 39
1.18	15 - 30	15 - 30
0.6	-	-
0.3	9 - 19	9 - 19
0.15	-	-
0.075	3 - 8	3 - 8
Bitumen content % by mass of total mix ²	Min 4.5	Min 5.0
Bitumen grade (pen)	65*	65*

Notes: 1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.

2. Determined by the Marshall method.

* Only in exceptional circumstances, 80/100 penetration grade may be used, as approved¹ by the Engineer.

TABLE 500-16. REQUIREMENTS FOR SEMI DENSE BITUMINOUS PAVEMENT LAYERS

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

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

508.3.4. Plant Trials - permissible variation in job mix formula:

The requirements for plant trials shall be all as specified in Clause 507.3.4 and permissible limits for variation as shown in Table 500 - 13

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

509.4. Construction Operations

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

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

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

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

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

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

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

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

508.5. Opening to Traffic

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

508.6. Surface Finish and Quality Control

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

508.7. Arrangement for Traffic

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

508.8. Measurement for Payment

The measurement shall be as specified in clause 507.8

508.9. Rate : The contract unit rate shall be as specified in Clause 507.9, except that the rate shall include the provision of bitumen 4.75 percent, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted up or down, accordingly.

Item No. 33 :- Providing and laying Dense bituminous macadam of _____ thickness with B.T. Aggregates as per M.O.R.T.&H. gradation and emulsion asphalt for tack coat @ 2.50 Kg. / 10 Sq.Mt. with mechanical sprayer & bitumen grade 60/70 for mixing @ 40.00 Kg./M.T. i.e. 4% by weight of total mix including heating and mixing the aggregates and asphalt by continuous batching of drum mix plant and spreading the same by paver finisher and consolidation with vibratory roller including providing all materials, equipments, tools and plant, oil, kerosene, firewood, labour charges etc. comp. using contractor's own machineries, drum mix plant and paver finisher etc. complete.

507. DENSE GRADED BITUMINOUS MACADAM

507.1. Scope

This clause specifies the construction of Dense Graded Bituminous Macadam, (DBM) for use mainly, but not exclusively, in base/binder and profile corrective course, DBM is also intended for use as a road base material. This work shall consist of construction in a single or multiple layers of DBM on a previously prepared base or sub-base. The thickness of a single layer shall be 50mm to 100mm.

507.2. Materials

507.2.1. Bitumen: The specifications of requirements of bitumen shall be as per Clause No. 508.2.1

507.2.2. Coarse aggregates: The aggregates shall satisfy the physical requirements specified in Table 500-8, for dense bituminous macadam. The requirement shall be similar to that of Clause 504 except that aggregates shall satisfy physical requirements specified in Table 500-8.

When crushed gravels is proposed for use in 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.

507.2.3. Fine aggregates : Fine aggregates shall consists of crushed or naturally occurring mineral material, or a combination of the two, passing the 2.36mm sieve and retained on the 75 micron sieve. The fine aggregate shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS:2720 (Part 37) The plasticity index of the fraction passing the 0.425 mm sieve shall not exceed 4, when tested in accordance with IS:2720 (Part 5)

TABLE 500-8. PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR DENSE GRADED BITUMINOUS MACADAM

Property	Test	Specification
Cleanliness (dust)	Grain size analysis ¹	Max 5% passing 0.075 mm sieve
Particle shape	Flakiness and elongation Index (combined) ²	Max 30%
Strength	Los Angeles Abrasion Value ³	Max 30%
	Aggregate Impact value ⁴	Max 24%
Polishing	Polished stone Value ⁵	Min 55
Durability	Soundness ⁶	
	Sodium Sulphate	Max 12%
	Magnesium Sulphate	Max 18%
Water absorption	Water absorption ⁷	Max 2%
Stripping	Coating and stripping of bitumen aggregate mixtures ⁸	Minimum retained coating 95%
Water sensitivity**	Retained tensile strength ⁹	Min 80%

Notes:

1. IS:2386 Part 1

6. IS: 2386 Part 5

2. IS:2386 Part 1

7. IS: 2386 Part 3

* (the elongation test may be done only on non-flaky aggregates in the samples)

3. IS: 2386 Part 4*

8. AASHTO T 283**

4. IS: 2386 Part 4*

9. IS: 6241

5. BS: 812 Part 114

* Aggregate may satisfy requirements of either of these two tests

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

507.2.3. Fine aggregates: Fine aggregates shall be the fraction passing 2.36 mm sieve and retained on 75 micron sieve, consisting of crusher-run screening, gravel, sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from any injurious, soft or flaky pieces and organic or other deleterious substances.

507.2.4. Filler

Filler shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement as approved by the Engineer

The filler shall be graded within the following limits:

TABLE 500-9. GRADING REQUIREMENTS FOR MINERAL FILLER

IS Sieve (mm)	Cumulative percent passing by weight of total aggregate
0.6	100
0.3	95-100
0.075	85-100

Mineral filler shall consist of rock dust, hydrated lime or portland cement, or after inert mineral matter approved by the Engineer. It shall be dry and free from lumps.

The filler shall be free from organic impurities and have a Plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filler is cement or lime. When the coarse aggregate is gravel, 2 per cent by mass of total aggregate of portland cement or hydrated lime shall be added and the percentage of fine aggregate reduced accordingly. Cement or hydrated lime is not required when the gravel is limestone.

507.2.5. Aggregate grading and binder content: When tested in accordance with IS:2386 Part 1 (Wet sieving method), the combined grading of the coarse and fine aggregates and added filler shall fall within the limits shown in Table 500-10 for dense bituminous macadam gradings 1 or 2 as specified in the Contract. The type and quantity of bitumen, and appropriate thickness are also indicated for each mixture type.

TABLE 500-10. COMPOSITION OF DENSE GRADED BITUMINOUS MACADAM PAVEMENT LAYERS

Grading	1	2
Nominal aggregate size	40mm	25mm
Layer Thickness	80-100 mm	50-75 mm
IS Sieve ¹ (mm)	Cumulative % by weight of total aggregate passing	
45	100	100
37.5	95-100	100
26.5	63-93	90-100
19	-	71-95
13.2	55-75	56-80
9.5	-	-
4.75	38-54	38-54
2.36	28-42	28-42
1.18	-	-
0.6	-	-
0.3	7-21	7-21
0.15	-	-
0.075	2-8	2-8
Bitumen content % by mass of total mix ²	Min. 4.0	Min. 4.5
Bitumen grade (pen)	65 to 90	65 to 90

Notes: 1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.
2. Determined by the Marshall method.

507.3. Mixture Design

507.3.1. Requirements for the mixture: Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 500-11.

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

TABLE 500-11. REQUIREMENTS FOR DENSE GRADED BITUMINOUS MACADAM

Minimum stability (kN at 60°C)	9.0
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Percent air voids	3 - 6
Percent voids in mineral aggregate (VMA)	See Table 500-12
Percent voids filled with bitumen (VFB)	65 - 75

507.3.2. Binder content: The binder content shall be optimised to achieve the requirements of the mixture set out in Table 500-11 and the traffic volume as specified in the Contract. Where 40 mm dense bituminous macadam mixture is specified, the modified Marshall method described in MS2 shall be used. This method requires modified equipment and procedures; particularly the minimum stability values in Table 500-11 shall be multiplied by 2.25, and the minimum flow shall be 3 mm.

507.3.3. Job mix formula: The contractor shall inform the Engineer in writing at least 20 days before the start of the work. The approved job mix formula shall remain effective unless and until a revised Job Mix Formula is approved. Should a change in the source of materials be proposed, a new job mix formula shall be forwarded to the Engineer for approval before the placing of the material.

507.3.4. Permissible variation from job mix formula: It shall be the responsibility of the Contractor to produce a uniform mix conforming to the approved job mix formula subject to the permissible variations of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used within the limits as specified in Table 500-11. These variations are intended to apply to individual specimens taken for quality control tests vide Section 900.

TABLE 500-13 PERMISSIBLE VARIATIONS FROM THE JOB MIX FORMULA

S. No.	Description of ingredients	Permissible variation	
		Base/binder course	Wearing course
1.	Aggregate passing 19 mm sieve or larger	±8%	±7%
2.	Aggregate passing 13.2 mm, 9.5 mm	±7%	±6%
3.	Aggregate passing 4.75 mm	±6%	±5%
4.	Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm,	±5%	±4%
5.	Aggregate passing 0.3 mm, 0.15 mm	±4%	±3%
6.	Aggregate passing 0.075 mm	±2%	±1.5%
7.	Binder content	±0.3%	±0.3%
8.	Mixing temperature	±10°C	±10%

507.3.5. Laying Trials: Once the plant trials have been successfully completed and approved, the Contractor shall carry out laying trials, to demonstrate that the proposed mix can be successfully laid, and compacted all in accordance with Clause 501.

The Contractor shall previously inform the Engineer of the proposed method for laying and compacting the material. The plant trials shall then establish if the proposed laying plant, compaction plant, and methodology is capable of producing satisfactory results. The density of the finished paving layer shall be determined by taking cores, no sooner than 24 hours after laying, or by other approved method.

Once the laying trials have been approved, the same plant and methodology shall be applied to the laying of the material on the project, and no variation of either shall be acceptable, unless approved in writing by the Engineer who may at his discretion require further laying trials.

507.4. Construction Operations

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

507.4.2. Preparation of base: The base on which Dense Graded Bituminous Macadam is to be laid shall be prepared in accordance with Clause 501 or as directed by the Engineer. The surface shall be thoroughly swept clean free from dust and foreign matter using mechanical broom and dust removed or blown off by compressed air. In portions where mechanical broom cannot reach, other approved method shall be used as directed by the Engineer.

5.7.4.3 Geosynthetics: Where Geosynthetics are specified in the Contract this shall be in accordance with the requirements stated in Clause 70.3

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

507.4.5. Prime Coat: Where the material on which the dense bituminous macadam is to be laid is other than a bitumen bound layer, a prime coat shall be applied as specified, in accordance with the provisions of Clause 502 or as directed by the Engineer.

507.4.6. Tack Coat: Where the material on which the dense bituminous macadam is to be placed is bitumen bound surface, a tack coat shall be applied as specified, in accordance with the provisions of Clause 503 or as directed by the Engineer.

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

507.4.8. Spreading: The provisions of Clause 501.5.3 and 501.5.4 shall apply.

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

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

507.6 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 work shall be exercised by the Engineer in accordance with Section 900.

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

507.8 Measurement for Payment : Dense Graded Bituminous Materials shall be measured as finished work either in cubic metres, tons or by the square metre at a specified thickness as detailed on the Contract drawings, or documents, or as directed by the Engineer.

507.9 Rate : The Contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out the all required operations as specified, and shall include, but not necessarily limited to all components listed in Clause 501.8.2 (i) to (xi). The rate shall include the provision of bitumen, at 4.25 per cent by weight of the total mixture.

The variance in actual percentage of bitumen used will be assessed and the payment adjusted up or down accordingly.

ITEM-34 : Providing and laying bituminous 37.5 mm thick lean bound macadam in one or two layers considering 0.66 cum. per M.T. mix materials with machine crushed stone aggregate and asphalt for tack coat @ the rate of 4 Kg / 10 sq. mt. (on metaled surface) / 2.5 kg per 10 sq. mt. (on existing B. T. surface) using 30 kg. of bitumen per asphalt including mixing the aggregate, heating the asphalt including mixing by continuous batching of hot mix plant and spreading the same by paver finisher and consolidation with power roller including providing all equipments by the contractor and flushing sand at the rate of 0.30 cu.m / 100 sq. mt.

1. DESCRIPTION

The work shall consist of construction in one layers each 37.5 mm thick LBM on previously prepared base, to the requirements of these specifications.

2. MATERIALS

2.1 Binder : The binder 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 and it shall have to be brought by the contractor to the site of work at his own cost.

2.2 Coarse aggregates : The coarse aggregate 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 given in Item No. 18 Para 2.

2.3 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.

2.4 Filler : The filler, where required, shall be an inert material the whole of which 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.

2.5 Aggregate gradation : The mineral aggregates, including mineral filler, shall be so graded or combined as to conform to gradings set forth in tables below :

Table : Aggregate gradation For LBM

Sieve Size		%by weight passing the Sieve		Sieve Size		%by weight passing the Sieve	
		37.5	75 m.m.			37.5	75 m.m
40 mm		-	100	-		-	-
25 mm		100	75-100	4.75 mm		15-35	15-35
20.0 mm	70-100	60-95	2.36 mm		5-20	5-20	
10.0 mm	35-60	30-55	0.75 mm		0-5	0-5	

The above gradation is tentative. To achieve Correct quantity the contractor shall get the job mix formula for the mix approved by Engineer-in-charge before starting the work.

2.6 Proportioning of materials : The binder content for premixing shall be 3.0 percent by weight of the total mix. 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.

2.7 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.

3. CONSTRUCTION OPERATIONS

3.1 Weather and seasonal limitation : Lean Bound Macadam shall not be laid during rainy weather or when the base course is damp or wet.

3.2 Preparation of base : The base on which LBM is to be laid shall be prepared shaped and conditioned to the specified, lines, grade and cross section in accordance with MOST 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.

3.3 Tack coat : Application of binder : Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer-in-charge and sprayed on the base at the rate specified hereafter. The rate of spread in terms of straight run bitumen shall be 2.5 kg per 10 square metre area for an existing bitumen treated surface and 4 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be applied uniformly with the aid of sprayers. At specified temperature, so as to provide uniformly rate and unbroken spread bitumen. The tack coat shall be applied just ahead of the oncoming bituminous construction.

3.4 Preparation of the mix : Hot mix plant of adequate capacity and capable of producing a proper and uniform quality shall be used for preparing the mix. The plant should be continuous type having a co-ordinated 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 metering 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 - 177° C, and aggregates in the range of 150° C - 163° C provided also that at no time shall the difference in temperature of the aggregates and the binder exceed 14° C.

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

3.5 Spreading : The mix, transported from the hot mix 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 sections. 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 the centre line of the road. Longitudinal joints shall be offset by 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.

3.6 Rolling : Immediately after the spreading of mix, it shall be thoroughly compacted by rolling with a set of rollers moving at a speed not exceeding 5 km per hour. The initial or break-down rolling shall be with 8-12 tonne three wheeled 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 payment. The roller should proceed on the fresh material with rear or fixed wheel leading so as to minimise the pushing of the mix and each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. Rolling shall continue until the entire surface has been rolled to compaction and all the roller marks eliminated.

4. OPENING TO TRAFFIC

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

5. 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.

6. ARRANGEMENT FOR TRAFFIC

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

7. 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 weighment 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 calibrated and verified from weight and measure authorities.

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

Weight of mix materials will be done in presence of responsible person, not less than the rank of supervisor of Department, Deputy Executive Engineer or Assistant Engineer or Addl. Assistant Engineer if so authorised. 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.

7.2 In case of LBM, DBM and asphaltic concrete of thickness 50 mm and above, initial levels before commencement of the work and final levels after completion of the work will be taken as indicated below for working out the average thickness of pavement laid, also the actual area of work done will be measured and the quantity of the work actually done shall be computed in Cu.M. basis. The actual tonnage of the mix shall then be worked out based on the designed density, for broad cross check on the actual tonnage of total mix used in the works.

Surface levels before and after laying the pavement course shall be taken as below :

Cross profiles will be taken at least at every ten meters longitudinally as shown below :

- (a) For single lane : Levels at 15 Cms & 75 cms. from both the edges and centre point. (Levels at 5 points)
- (b) For double Lane : Levels at 15 Cms & 75 cms : 175 Cms. 275 Cms. from both the edges and the centre point. (Levels at 9 Points)
- (c) Widening single to double lane : Levels at 15 Cms. from both the edges and the centre Carriage way (Up to 2 meters widening point (Levels at 3 Points))

However, in special cases if necessary, the cross profiles may be taken at closer length upto 3 meters.

8. RATE : The contract unit rate for L. B. M. shall be for payment in full for carrying out the required operations including full compensation for all components listed in MOST Specification Clause 503.8.

Item No. 35 :- BITUMINOUS CONCRETE

509.1. Scope

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

509.2. Materials

509.2.1. Bitumen: The bitumen shall be paving bitumen of Penetration grade 60/70 complying with Indian Standard Specification for Paving Bitumen, IS: 73 and of the penetration indicated in Table 500.18, for bituminous concrete, or this bitumen as modified by one of the method specified in Clause 521, or as otherwise specified in the Contract, Guidance on the selection of an appropriate grade of bitumen is given in The Manual for Construction and Supervision of Bituminous Works.

509.2.2. Coarse aggregates: The coarse aggregates shall be generally as specified in Clause 507.2.2, except that the aggregates shall satisfy the physical requirements of Table 500-17.

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

509.2.4. Filler : Filler shall be generally as specified in Clause 507.2.4. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 500-17 then 2 per cent by total weight of aggregate, of hydrated lime shall be added without additional cost.

509.2.5. Aggregate grading and binder content : When tested in accordance with IS:2386 Part 1 (Wet grading method), the combined grading of the coarse and fine aggregates and added filler shall fall within the limits shown in Table 500-18 for gradings 1 or 2 as specified in the Contract.

509.3. Mixture Design

509.3.1. Requirements for the mixture: Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 500-19.

The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table 500.12.

509.3.2. Binder content: The binder content shall be optimised to achieve the requirements of the mixture set out in Table 500-19 and the traffic volume as specified in the Contract. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5mm sieve and retained on the 22.4mm sieve, where approved by the Engineer.

509.3.3. Job mix formula: The procedure for formulating the job

TABLE 500-17. PHYSICAL REQUIREMENTS FOR COARSE AGGREGATE FOR BITUMINOUS CONCRETE PAVEMENT LAYERS

Property	Test	Specification
Cleanliness (dust)	Grain size analysis ¹	Max 5% passing 0.075 mm sieve
Particle shape	Flakiness and Elongation Index	Max 30% (combined) ²
Strength*	Los Angeles Abrasion Value ³	Max 30%
	Aggregate Impact value ⁴	Max 24%
Polishing	Polished stone Value ⁵	Min 55
Durability	Soundness ⁶	
	Sodium Sulphate	Max 12%
	Magnesium Sulphate	Max 18%
Water absorption	Water absorption ⁷	Max 2%
Stripping	Coating and stripping of bitumen aggregate mixtures ⁸	Minimum retained coating 95%
Water sensitivity**	Retained tensile strength ⁹	Min 80%

Notes:

1. IS:2386 Part 1

6. IS: 2386 Part 5

2. IS:2386 Part 1

7. IS: 2386 Part 3

(the elongation test may be done only on non-flaky aggregates in the samples)

3. IS: 2386 Part 4*

8. AASHTO T 283**

4. IS: 2386 Part 4*

9. IS: 6241

5. BS: 812 Part 114

* Aggregate may satisfy requirements of either of these two tests

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

mix formula shall be generally as specified in Clause 507.3.3 and the results of test enumerated in Table 500-19 as obtained by the Contractor.

509.4. Plant trials - permissible variation in job mix formula:

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

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

509.4. Construction Operations

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

TABLE 500-18. COMPOSITION OF BITUMINOUS CONCRETE PAVEMENT LAYERS

Grading	1	2
Nominal aggregate size	19mm	13mm
Layer Thickness	50-65 mm	30-45 mm
IS Sieve ¹ (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5	100	
19	79-100	100
13.2	59-79	79-100
9.5	52-72	70-88
4.75	35-55	53-71
2.36	28-44	42-58
1.18	20-34	34-48
0.6	15-27	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content % by mass of total mix ²	5.0-6.0	5.0-7.0
Bitumen grade (pen)	65	65

Notes: 1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.

2. Determined by the Marshall method.

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

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

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

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

509.4.6 Mixing and transportation of the mixture. The provision as specified in 8 Clauses 501.3 and 501.4 shall apply.

509.4.7 Spreading: The general provisions of clauses 501.5.3 and 501.5.4 shall apply.

509.4.8 Rolling: The general provisions of clauses 501.6 and 501.7 shall apply, as modified by the approved laying trials.

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

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

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

509.8 Measurement for Payment : The measurement shall be all as specified in Clause No. 503.8

509.9 Rate : The contract unit rate shall be all as specified in Clause No. 507.9, except that the rate shall include the provision of bitumen at 5.5 per cent, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted

up or down, accordingly.

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

513.1 Scope :

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

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

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

513.2 Materials :

513.2.1. **Binder :** the requirements of Clause 511.1.2.1 and 511.2.2.1 shall apply.

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

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

513.2.3 **Aggregate for Type B seal coat :** The aggregate shall pass 2.36 mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.05 cubic metres per 10 Square metres area.

513.3. Construction Operations :

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

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

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

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

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

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

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

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

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

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

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

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

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

513.8 **Rate :** The contract unit rate for seal coat Type A or B shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 501.8.8.2 (i) to (xi).

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

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

504.2. Materials

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

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

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

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

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

TABLE 500.3 : PHYSICAL REQUIREMENTS FOR AGGREGATES FOR BITUMINOUS MACADAM

Property	Test	Specification
Cleanliness	Grain size analysis	Max 5% passing 0.075 mm sieve
Particle shape	Flakiness & Elongation Index (Combined) ¹	Max. 30 per cent
Strength	Los Angeles Abrasion value	Max. 40 per cent
	Aggregate Impact Value ²	Max. 30 per cent
Durability	Soundness ³	
	Sodium Sulphate	Max. 12 per cent
	Magnesium Sulphate	Max. 18 per cent
Water Absorption	Water absorption ⁵	Max. 2 per cent
Stripping	Coating and stripping of bitumen aggregate mixtures ⁶	Min. retained coating 95 per cent
Water Sensitivity ⁷	Retained Tensile strength	Min 80%

Notes: 1. IS:2386 Part 1

4. IS:2386 Part 5

2. IS:2386 Part I

5. IS:2386 Part 3

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

3. IS:2386 Part 4*

6. IS:6241

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

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

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

504.2.5 Proportioning of Materials : The aggregates shall be proportioned and blended to produce a uniform mixture complying with the requirements of Table 500-4. The binder content shall be within a tolerance of \pm percent by weight of total mixture when individual specimens are taken for quality control tests in accordance with the provisions of Section 900

TABLE 500.4 : COMPOSITION OF BITUMINOUS MACADAM

Mix designation Nominal aggregate size Layer thickness IS Sieve (mm)	GRADING : 1 40 mm 80-100 mm	GRADING : 2 19 mm 50-75 mm
	Cumulative Per cent Passing by Weight of Total Aggregate	
45	100	
37.5	90-100	
26.5	75-100	100
19	-	90-100
13.2	35-61	56-88
4.75	13-22	16-36
2.36	4-19	4-19
0.3	2-10	2-10

0.075	0.8	0.5
*Bitumen content, % by weight of total mixture	3.1-3.4	3.3-3.5
Bitumen Penetration Grade	35 to 90	35 to 90

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

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

504.3. Construction Operations

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

504.3.2 Preparation of the base: The base on which bituminous macadam is to be laid shall be prepared, shaped and compacted to the required profile in accordance with Clause 501.8 and 902.3 as appropriate, and a prime coat shall be applied in accordance with Clause 502 where specified, or as directed by the Engineer.

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

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

504.3.6. Rolling

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

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

504.4 Surface Finish and Quality Control of Work

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

504.5 Protection of the Layer

The bituminous macadam shall be covered with either the next pavement course or wearing course, as the case may be, within a maximum of forty-eight hours. If there is to be any delay on account of the construction procedure adopted by the Contractor, the course shall be covered by a seal coat to the requirement of Clause 509 before opening to any traffic. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

504.6 Arrangements for Traffic

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

504.7 Measurements for Payment : Bituminous macadam shall be measured as finished work in cubic metres or by weight in metric tonnes. Where used as regulating course or square meter at the specified thickness as indicated in the contract or shown on the drawing or as otherwise directed by the Engineer.

504.8 Rate : The contract unit rate for bituminous macadam shall be payment in full for carrying out the required operations as specified. The rate shall include for, all components listed in Clause 501.8.8.2 (i) to (xi).

ITEM - 38 : BUILT-UP SPRAY GROUT

506.1 Scope

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

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

506.2. Materials

506.2.1. Bitumen : Clause 504.2.1 shall apply.

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

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

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

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

13.2 mm	0-20	40-75
5.6 mm	-	0-20
2.8 mm	0-5	0-5

506.3. Construction Operations

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

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

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

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

506.3.5. Spreading and rolling coarse aggregates for the first layer: Immediately after the application of tack coat, the coarse aggregates in a dry and clean form shall be spread uniformly and evenly preferably by mechanical means at the rate of 0.5 cu.m. per 10 sq.m area. Immediately after spreading of the aggregates, the entire surface shall be rolled with a 60-100 kN smooth-wheeled roller. Rolling shall commence at the edges and progress towards the centre except in superelevated and uni-directional cambered portions where it shall proceed from the lower edge to the higher edge.

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

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

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

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

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

506.3.9. Application of key aggregate: Immediately after second application of the binder, key aggregates in a clean and dry state shall be spread uniformly and evenly, preferably by mechanical means at the rate of 0.13 cu.m./10 sq.m, so as to cover the surface completely. If necessary, the surface shall be broomed to ensure uniform application of the key aggregates. The entire surface shall then be rolled with a 60-100 kN smooth-wheeled roller to Clause 506.3.4. While rolling is in progress, additional key aggregates, where required, shall be spread by hand. Rolling shall continue until the entire course is thoroughly compacted and key aggregates are firmly in position.

506.4. Surface Finish and Quality Control

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

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

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

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

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

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

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

803.1. Scope :

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

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

512.2. Materials

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

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

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

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

TABLE 500-26. AGGREGATES GRADATION FOR MIX SEAL SURFACING

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

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

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

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

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

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

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

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

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

803.1. General

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

803.2. Materials

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

803.3 Hot Applied Thermoplastic Road Marking

803.4.1 General :

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

803.4.2 Thermoplastic materials.

803.4.2.1 General:

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

803.4.2.2 Requirement:

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

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

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

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

II Properties :

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

A) Luminance:

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

803.4.3 Reflectorizing glass beads:

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

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

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

803.4.3.3 Specific requirements .

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

TABLE 800-4 GRADATION REQUIREMENT FOR GLASS BEADS

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

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

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

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

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

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

803.4.4 Application properties of thermoplastic material.

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

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

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

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

The stripe shall be not be slippery when wet.

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

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

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

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

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

803.5 Reflectorised Paint : Reflectorised paint, if used, shall conform to the specification by the manufacturers and approved by the engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirements of clause 803.4.3

803.6 Application :

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

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

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

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

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

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

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

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

803.7 Measurement for Payment :

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

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

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

803.9 SPECIAL TERMS AND CONDITIONS FOR THERMOPLAST PAINT WORK:

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

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

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

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

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

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

801.1 General

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

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

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

801.2 Materials

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

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

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

801.2.3 The dimensions and size of the cat-eye shall be as per IS standard. The retro reflective sheeting used on the cat-eye shall consist of the white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather-resistant and show colour fastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

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

TABLE 800.1. ACCEPTABLE MINIMUM COEFFICIENT OF RETRO. REFLECTION FOR HIGH INTENSITY GRADE SHEETING

(CANDELAS PER LUX PER SQUARE METRE)

Observation angle (in degrees)	Entrance Angle (in degrees)	White	Yellow	Orange	Green/ Red	Blue
0.2	-4	250	179	100	45	20
0.2	+30	150	100	60	25	11
0.5	-4	95	62	30	15	7.5
0.5	+30	65	45	25	10	5.0

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

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

1.4 Installation

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

1.5. Measurements for Payment

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

1.6 Rate

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

Item No. 42 : Road Delineators

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

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

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

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

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

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

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

MEASUREMENT OF PAYMENT

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

RATE

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

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

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

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

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

RATE

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

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

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

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

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

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

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

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

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

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

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

1.2 Traffic Signs having retro-reflective sheeting :

1.2.1 General Requirements :

The retro-reflective sheetings used on the sign shall consist of white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather resistant and show lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory by the manufacturer of the sheeting. The type of sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

1.2.2 High Intensity Grade Sheeting :

1.2.2.1 Encapsulated Lens Type :

This sheeting shall be of encapsulated lens type consisting of spherical glass lens elements, adhered to a synthetic resin and encapsulated by a flexible, transparent water proof plastic having a smooth surface. The retro reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM Standard E:810) as indicated in Table 300-1.

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

Observation angle (in degrees)	Entrance Angle (in degrees)	White	Yellow	Orange	Green/ Red	Blue
0.2	-4	250	170	100	45	20
0.2	+30	150	100	60	25	11
0.5	-4	95	62	30	15	7.5
0.5	+30	65	45	25	10	5.0

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

1.3.2 Engineering Grade Sheeting :

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

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

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

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

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

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

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

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

Blue	IS	Colour No.166 : French Blue
Red	IS	Colour No.537 : Signal Red
Green	IS	Colour No.284 : India Green
Orange	IS	Colour No.591 : Deep Orange

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

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

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

1.1.9 Fabrication :

1.1.9.1 Surface to be reflectorised shall be prepared to receive the retro-reflective sheeting. The smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves between all cleaning and preparation operation and application of reflective sheeting/primer.

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

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

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

1.2 Installation :

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

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

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

1.3 Measurements for Payment :

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

1.4 Rate :

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

Item No. 49 : Providing and fixing Village name boards made out of 2 mm aluminium sheet size 90 x 60 cms Rectangle as per the design of IRC-67-1977 pre treated with Phosphating process and acid etching coated with one coat of epoxy primer and two coats of best quality epoxy paint reflectorised with retro reflective sheeting as per latest M.O.S.T specifications Letters and numerals should be as per IRC-30-1968. 3.1m long (2 Nos) stand post and frame fabricated from suitable size iron angle of 50 X 50 X 5 mm painted with best quality epoxy coating in black and white bends The details of symbol or inscription / numerals for each boards shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 C.C block of size 45 x 45 x 60 cms for each leg including excavation, curing etc. complete under the supervision of Engineer in-charge (B) High Intensity Grade

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

Item No. 50 : For Curves / Parking ahead / speed limit / Hazard marker sign* Providing and fixing sign boards made out of 2mm aluminium sheet size ____ x ____ x ____ cms. equilateral triangle as per the design of IRC-67-1977 pre treated with phosphating process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75 x 75 x 6mm as required painted with best quality epoxy coatings in black and white bends. The details of symbol for each board shall be as per instruction of Engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60 cms. for each leg, including excavation curing etc. complete under the supervision of Engineer in charge. (B) High Intensity Grade

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

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

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

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

Item No. 52 : Providing and fixing Direction / Junction boards made out of 2 mm aluminium sheet size 244 x 122 cms Rectangle as per the design of IRC-67-1977 pre treated with Phosphering process and acid etching, coated with one coat of epoxy primer and two coats of best quality epoxy paint, reflectorised with retro reflective sheeting as per latest M.O.S.T. specifications Letters and numerals should be as per IRC-30-1968, 3.10 m long (2 Nos) stand post and frame fabricated from suitable size iron angle of 50 X 50 X 5 mm. & 75 x 75 x 6 mm painted with best quality epoxy coating in black and white bends The details of symbol or inscription / numerals for each boards shall be as per the instruction of engineer in charge The fixing at site shall be in 1:2:4 C C block of size 45 x 45 x 60 cms for each leg including excavation curing etc complete under the supervision of engineer-in-charge (B) High Intensity Grade

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

Item No. 53 : (Speed Limit) Providing and fixing sign boards made out of 2mm aluminium sheet; size 60 cms. diameter circle as per the design of IRC-67-1977 pre treated with phospheting process & acid etching; coated with one coat of epoxy primer and two coats of best quality epoxy paint; reflectorised with retro reflective sheeting as per latest M.O.S.T. Specifications; 3.1m long stand post and frame fabricated from suitable size iron angle of 35 x 35 x 3mm 75x75x6mm as required; painted with best quality epoxy coatings in black and white bends the details of symbol for each board shall be as per the instruction of engineer in charge. The fixing at site shall be in 1:2:4 CC block of size 45 x 45 x 60cms. for each leg. including excavation curing etc. complete under the supervision of Engineer in charge. (B) High Intensity Grade.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

13. Stone masonry shall be measured cubic meters.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Para 1 to 14 item No. 56 of the roads specification booklet shall apply for the work of this item.

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

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

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

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

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

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

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

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

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

they are not spoilt by dirt, earth etc.

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

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

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

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

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

5.5 The thickness of joints shall not exceed 12 mm.

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

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

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

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

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

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

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

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

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

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

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

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

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

FORM OF CERTIFICATE FOR NP3, NP2, NP1 PIPES

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

We have experience of manufacturing of pipes of _____ years

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

Date : _____

Place : _____

Manufacturer's Sign. _____

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

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

4. The pipes shall be jointed either by collar joint or by flush joint. In the former case, the collars shall be of R.C.C., 150 to 200 mm wide and having the same strength as the pipes to be jointed. Caulking space shall be between 13 and 20 mm according to the diameter of the pipes. Caulking material shall be slightly wet mix of cement and sand in the ratio of 1:2 rammed with Caulking irons. Before caulking the collar shall be so placed that its centre coincides with that of pipe and an even annular space is left between the collar and the pipes. Flush joint may be shaped to form a self centering joint with a joining space 13 cm wide. The joining space shall be filled with cement mortar. 1 cement to 2 sand, mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. All joints shall be made with care so that their interior surface is smooth and consistent with the interior surface of the pipes. After finishing, the joint shall be kept covered and damp for at least four days.

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

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

ITEM-64 : Supplying and fixing reinforced concrete heavy duty non-pressure pipes with collars for culverts including setting and jointing the pipes in C. M. 1:2 watering and laying (to level or slope) of I.S. class of NP2 of following internal diameter, (i) 300 mm dia. (ii) 450 mm dia. (iii) 600 mm dia. (iv) 750 mm dia (v) 900 mm dia. (vi) 1050 mm dia (vii) 1200 mm dia.

1. The work shall be carried out as per item of NP3 pipes except that the pipes will be of NP2 class instead of NP3 class conforming to requirements of IS : 458 and of the dia as specified in this item.

ITEM-65 : Supplying and fixing NP1 class R.C.C. pipes

1. The work shall be carried out as per item of NP3 pipes except that the pipes will be ordinary irrigation pipes of NP 1 class instead of NP 3 class conforming to requirements of IS:458 and of the dia. as specified in this item. Please see Item No. 78 for detailed information.

ITEM-66 : Filling around the pipes with murrum including dressing, tampering etc. complete.

1. Area around pipes shall be filled with murrum, chhara or other gritty material immediately after the pipes have been laid and the joining material has hardened. The material shall be clean, free from boulders large roots, excessive amount of sods or other vegetable matter, and lumps and shall be approved by the Engineer-in-charge. Filling upto 0.3 metre above the top of the pipe shall be carefully done and the soil thoroughly rammed, tampered or vibrated in layers of not exceeding 150 mm. particular care being taken to thoroughly consolidate the materials under the haunches of the pipe. Filling shall be carried out simultaneously on both sides of the pipes in such a manner that unequal pressures do not occur. In case of high embankments, after filling upto the top in the above said manner a loose fill of a depth equal to external diameter of the pipe shall be placed over the pipe before further layers are added and compacted. Materials shall be filled in pharas 3m. x 1.5m x 0.5m size and shall be measured in cubic metres. Unit rate includes cost of materials and spreading including labour and tools needed for the above operations.

ITEM-67 : Providing and laying ordinary (unreinforced) concrete 1:2:4 (1 cement :2 coarse sand :4 crushed stone aggregate 20 mm nominal size) & curing complete including cost of form work (without reinforcement)

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

2. In the designation of a concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cube compressive strength of that mix on 150 mm cubes, expressed in kg./cm.

3. The ordinary concrete mix shall generally be specified by volume. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic metre in volume. While measuring aggregate by volume, shaking, ramming or hammering shall not be done, proportioning of sand be as per its dry volume. In case it is damp allowance for bulking shall be made as per IS:2386 (Part III).

4. In gredients required for ordinary concrete cotaining one 50 kg. bag of cement for different proportions of mix shall be as given in Table below.

TABLE

Grade of Concrete	Mix by Volume	Total quantity of dry aggregate by volume per 50 kg cement to be taken as sum of individual volume of fine & coarse aggregate maximum (1 cubic metre = 1000 Litres)	Proportion of fine aggregate to Coarse aggregate	Quantity of water per 50 kg of cement maximum
1.	2.	3.	4.	5.
Ordinary M100	1:3:6	300	Generally 1:2 for	34
Ordinary M150	1:2:4	220	fine aggregate to	32
Ordinary M200	1:1.5:3	160	coarse aggregate by	30
Ordinary M250	1:1:2	100	volume but to a upper limit of 1:1.5 and lower limit of 1:3	27

***Note :** The proportions of the aggregates shall be adjusted from upper limit to lower limit progressively as the grading of the final aggregate becomes finer and the maximum size of coarse aggregate becomes larger.

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

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

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

- | | |
|---|-------|
| i Plain C.C. | 63 mm |
| ii Solid type piers, abutments and wing walls, and their per caps.
(Coarse aggregate of size upto 40 mm shall be machine crushed.) | 40 mm |
| iii C.C. Wearing Coat M-150
(Coarse aggregate of size upto 40 mm shall be machine crushed.) | 20 mm |

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

7. All materials shall be stored as to prevent their deterioration or intrusion of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Engineer-in-charge shall not be used in the work.

8. Cement shall be stored above the ground level in perfectly dry and watertight sheds and shall be stocked not more than eight bags high. Wherever bulk storage containers are used, their capacity should be sufficient to cater to the requirements at site and should be cleaned at least once every 3 to 4 months. Cement more than 3 to 4 months old shall invariably be tested to ascertain that it satisfies the acceptability requirements. The aggregates shall be stored in such a way as to prevent admixture of foreign materials. Different sizes of fine or coarse aggregate shall be stored in separate stock piles sufficiently removed from each other to prevent intermixing the materials at edges of the piles.

9. The water for mixing shall be potable water to the satisfaction of the Engineer-in-charge. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the job.

10. For all work, concrete shall be mixed in a mechanical mixer along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and an uniform colour of the entire mass is obtained and each individual particles of the coarse aggregate shows complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer.

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

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

13. The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be so transported and placed that no contamination, segregation or loss of its constituent material takes place. All form work and reinforcement contained in it shall be cleaned and made free from standing water, dust snow or ice immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained.

14. If concreting is not started with 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting then shall proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly designed agitators, operating continuously, when this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator. Except where otherwise agreed to by the Engineer-in-charge, concrete shall be disposed in horizontal layer to a compacted depth of not more than 0.45 metre when internal vibrators are used and not exceeding 0.30 metre in all other cases.

15. Unless otherwise agreed to by the Engineer-in-charge, concrete shall not be dropped into place from a height exceeding 2 metres. When trucking or chutes are used they shall be kept clean and used in such way as to avoid segregation. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted, and cleaned with a 13mm. thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 13 mm. layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. Where concrete has not fully hardened, all laitance shall be removed by scrubbing the new surface with wire or bristle brushed. Care being taken to avoid dislodgement of particulars of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm. in thickness, and shall be well rammed against old work particular attention being given to corner and close

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spots.

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

17. Immediately after compaction, concrete shall be protected against harmful effects of weather, including rain, running water, shocks, vibrations due to traffic, rapid temperature changes, fast drying put process. It shall be covered with wet sacking hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set. It shall be kept continuously wet for a period of not less than 14 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 14 days.

18. Form work shall include all temporary or permanent forms required for forming the concrete, together with all temporary construction required for their support. Forms for concrete shall be constructed of metal or timber suitably lined and be of substantial and rigid construction true to shape and dimensions shown on the drawings. Where metal forms are used, all bolts and rivets shall be counter sunk and well ground to provided a smooth, plain surface. Where timber is used it shall be well seasoned, free from loose knots, projecting nails, splits or other defects that may mark the cement surface of concrete. For exposed concrete faces, timber for shuttering shall be wrought on all faces in contact with concrete.

19. Forms shall be mortar tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressure, ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete. Screw jacks or hardwood wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete. Suitable camber shall be provided in horizontal members of surface specially in long spans to counteract the effects of any deflection. The frame work shall be so fixed as to provide for such camber. Forms shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections. Unless otherwise specified or directed, Chamfers or fillets of size 25 mm x 25 mm shall be provided at all angles of fram work to avoid sharp corners.

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

21. Special measures shall be taken to ensure that the farmework does not hinder the shrinkage of concrete because without these cracking could occur before the form work is removed. Where applicable arrangements must be made to ensure that the form does not restrain the shortening and hogging of the beams of slabs during tensioning of the tendons. The formwork should take due account of the calculated amount at positive or negative camber so as to ensure the correct final shape of the structures having regard to the deformation of false work, scaffolding or propping and the instantaneous deformation due to various causes affecting prestressed structures. Where there are re-entrant angles in the concrete sections, the formwork should be removed at these sections as soon as possible after the concrete has set in order to avoid cracking due to shrinking of concrete. Formwork shall be tight enough to prevent any appreciable loss of cement during vibrations. Suitable tolerances should be provided in the formwork, immediately before concreting all forms shall be thoroughly cleaned. Contractor shall give the Engineer-in-charge due notice before placing any concrete in the forms to permit him to inspect and accept the false work and forms as to their strength alignment and general fitness, but such inspection shall not relieve the contractor of his responsibility for safety of machinery, materials and for results obtained.

22. The Engineer-in-charge shall be informed in advance by the contractor of his intention to strike any formwork. While fixing the time for removal of formworks, due consideration shall be given to local conditions, character of the structure, the weather and other conditions that influence the setting of concrete the removal of the load supporting or soffit forms may commence when concrete has attained strength and of the materials used in the ix. Where field operations are controlled by the strength test of concrete, the removal of the load supporting or soffit forms may commence when concrete has attained strength equal to at least twice the stress to which the concrete will be subject at the time of striking props including the effect of any further addition of loads. When field operations are not controlled by strength tests of concrete the vertical forms of beams, columns and walls may be removed after 2 days. The props of slabs and beams may be removed after 14 and 21 days respectively. All form work shall be removed without causing any damage to the concrete. Centering shall be gradually and uniformly lowered in such a manner as to avoid any shock or vibrations. Supports shall be removed in such a manner as to permit the contract the concrete to take stresses due to its own weight uniformly and gradually. Where internal metal ties are permitted they or their removable parts shall be extracted without causing any damage to the concrete and remaining holes filled with mortars. No permanently embedded metal part shall have less than 25 mm. cover to the finished concrete surface. Where it is intended to reuse the farmwork it shall be cleaned and made good to the satisfaction of the Engineer-in-charge.

23. Immediately after the removal of forms, all exposed bars or bolts passing through the Cement Concrete member and used for shuttering or any other purpose shall be cut inside the Cement Concrete member to a depth of at least 25 mm. below the surface of the concrete and the resulting holes filled by cement mortar. All fins cause by form joints, all cavities produced by the removal of form ties and all other holes and depressions, honeycomb spots, broken edges or corners and other defects, shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surface which have been pointed shall be kept moist for a period of 24 hours. If rock, pockets/ honeycombs, in the opinion of the Engineer-in-charge are of such an extent of and character as to affect structure materially or to endanger the life of the strength of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected. Joint shall be filled up with bitumen as directed by Engineer-in-charge in case of C.C. wearing surface.

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

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

Item No. 68 A : Providing & laying C.C. 1:4:8 (1-Cement, 4-coarse sand, 8-grade agg 40 m.m. nominal size) and curing comp. of form work.

Item No. 68 B : Providing & laying C.C. 1:5:10 (1-Cement, 4-coarse sand, 8-grade agg 40 m.m. nominal size) and curing comp. incl. cost of form work.

Materials : Specification for all the ingredients to be used shall be as per the details given in the central specifications for materials attached.

PROPORTION : The concrete shall consist for the part of cement, sand and metal as per (40 to 63 m.m. size) the above description of items.

MIXING : Mixing of the materials shall be done as per specified volumetric proportion as a possible after water is added, so that every place of agg. is uniformly coated by cement plaster. The concrete must be used immediately after it is prepared and in any case shall be used after the cement has attained final set. Generally concrete prepared before more than half an hour shall not be permitted to be used.

LAYING : Consolidation shall be rapidly carried out sufficient labour being employed to permit of ramming roading be spreading etc. being comp. within as short items as possible causing the mortar to cream up in no case shall ramming be prolonged after the cement has been to take its initial sets.

CURING : As soon as the concrete has set sufficiently i.e. after about an hour of laying the surface must be protected from rapid curing out by being covered with at sand wet sunny of where possible curing shall done by forming the shall be allowed pools of water by means of sand pollicies. The curing shall be continued or atleast 10 (ten) days broadly two or three weeks and where possible for longer period. The rate includes all necessary equipments, labour etc. Payment shall be made on cubic measurement of cement concrete. The entire work shall be carried out as per the specification for the PWD Hand book Vol. I Page No. 166 to the satisfaction of the Engineer-in-charge.

ITEM-69 Providing and laying ordinary (reinforced) concrete 1:2:4 (1 cement :2 coarse sand :4 crushed stone aggregate 20 mm nominal size) & curing complete (excluding cost of reinforcement)

1. Para 1 to 25 of ordinary concrete (without reinforcement) shall apply.

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

Type of work	Slumps where vibrators are used	Slumps Where vibrators are not used.
(i) Mass concrete in R.C.C. foundation, footings and retaining walls.	10mm to 25 mm	80 mm
(ii) Beams, slabs and column simply reinforced	25 mm to 40 mm	100 mm to 120 mm
(iii) Thin R.C.C. section or sections with congested steel	40 mm to 50 mm	125 mm to 150 mm

Maximum nominal size of the concrete aggregate shall be 20 mm. and shall machine crushed.

Works strength test shall be made in accordance with IS : 516. Each test shall be conducted on ten specimens five of which shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic metre to concrete or a part thereof. However, if concreting done in a day is less than 15 cubic metre, the minimum number of cubes can be reduced to 6 with the 15 cubic metre of concrete or a part thereof. However, if concreting done in a day is less than 15 cubic metre, the minimum number of cubes can be reduced to 6 with the specific permission of the Engineer-in-charge. Similar works test shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-charge, when procedure of test given above reveals a poor quality to concrete and in other special cases.

28. All necessary labour, materials, equipment, etc. for sampling, preparing test cubes, curing etc. shall be provided by the contractor. Testing of the materials and concrete may be arranged by the Engineer-in-charge in an approved laboratory at the cost of the contractor.

29. The average strength of the group of cubes for each day shall be less than the specified works cube strength 20 per cent of the cubes cast for each day may have values less than the specified strength, provided the lowest value is not less than 85 per cent of the specified strength.

30. R.C.C. work shall have exposed concrete surface. Centering design and its erection shall be approved by the Deputy Engineer-in-charge. One carpenter with helper will invariably be kept present through out the period of concreting. Movement of labour and other persons shall be totally prohibited over reinforcement laid in position. For access to different part as suitable platforms shall be provided so that steel reinforcement in positions is not disturbed. For ensuring proper cover, mortar blocks of suitable size shall be cast and tied to the reinforcement. Timber, kapachi or metal pieces shall not be used for this purpose. Concentring of important structural members shall always be done in the presence and under the supervision of department person not below the rank of Junior Engineer/Supervisor/Overseer.

After removal of form work and shuttering, the Executive Engineer shall inspect the work and satisfy by random checks that concrete of good quality. Plastering shall not be allowed to the exposed face of concrete.

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

Item No. : 70 Providing T.M.T. & Fixing Bars (Thermo Mechanically Treated Bars of Sail, Tisco, Thermex, Kamdhenu or equivalent brand) reinforcement confirmed to IS-1786 Fe-415 for R.C.C. work including bending, binding and placing in position complete upto floor two level. (B) High yield strength deformed bars reinforcement.

The work include providing and laying in position HYSD / Mild Steel / Thermo mechanically treated bar of the following grade.

Grade Designation	Bar type conforming to Governing IS specification	Characteristic strength by Mpa	Elastic modulus Gpa
S 415	IS 1786 High yield strength Deformed bar	415	200
S 240	IS 432, Part-II	240	

TMT BAR

415 TMT Bar shall conform to min. 415 Mpa yield strength, Tensile strength of min. 500 Mpa and elongation min. 22. The chemical composition of bars shall be as below :-

	% Max.
Carbon	0.25
Sulphur	0.05
Phosphorus	0.05
Sulphur and Phosphorus	0.01

1. All steel shall be procured from original producers, no re-rolled steel shall be incorporated in the work. Only new steel bars shall be delivered to the site. Every bar shall be inspected before assembling in the work and defective brittle or burnt bar shall be discarded. Cracked ends of bars shall be discarded.

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

3. Steel shall be clean and free from loose rust and loose mill scale at the time of fixing in position and subsequent concreting.

4. Reinforcing steel conform accurately to the dimensions given in the bar bender schedules shown on relevant drawings. Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer-in-charge, using a proper bar bender, operated by hand or power to attain proper radius of bends. Bars shall not be bent or straightened in a manner that will injure the material. Bars bent during transport or handling shall be straightened before being used on work, they shall be not heated to facilitate bending. Unless otherwise specified a "U" type hook at the end of each bar shall invariably provided. The radius of the bend shall not be less than twice the diameter of the round bar and the length of the straight part of the bar beyond the end of the curve shall be atleast four times the diameter of the round bar. In the case of bar which are not round and in the case of deformed bars, ten diameter shall be taken as the diameter of circle having an equivalent effective area. The hooks shall be suitably encased to prevent any splitting of the concrete.

5. All reinforcement bar shall be accurately placed in exact position shown on the drawings, and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size and conforming to I. S. 280 and by using stay blocks or metal chairs, spacers, metal hangers supporting wires or other approved device at sufficiently close intervals. Bars will not be allowed to sag between supports nor displaced during concreting or any other operation of the work. All devices used for positioning shall be of non-corrodible material. Wooden and metal supports will not extent to the surface of concrete, except as the work progresses for adjusting bar spacing will not be allowed. Pieces of broken stone or brick and wooden blocks shall not be used. Layers of bars shall be separated by spacer bar, precast motor blocks or other approved devices. Reinforcement after being placed in position shall be maintained in a clean condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete all ready placed. To protect reinforcement from corrosion concrete cover shall be provided as indicated on the drawings. All bars protruding from concrete and to which other bars are to be spliced and which are likely to be exposed for an indefinite period shall be protected by a thick coat of neat cement grout.

6. Bars crossing each other, where required, shall be secured by binding wire (Annealed) of size not less than 1 mm. and conforming to I. S. 280, in such a manner that they do not slip over each other at the time of fixing and concreting.

7. As far as possible, bars of fully length shall be used. In case this is not possible, overlapping of bars shall be done as directed by the Engineer-in-charge. When practicable, overlapping bars shall not touch each other, but be kept a part of 25 mm or 1.25 time the maximum size of the coarse aggregate whichever is greater, by concrete between them. Where not feasible, overlapping bars shall be bound with annealed steel wire, and not less than 1 mm. thickness twisted tight. The overlaps shall be staggered for different bars and located at points, along the span where neither sphere nor bending moment is maximum.

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

9. When permitted or specified on the drawings, joints of reinforcement bars shall be but welded so as to transmit their full stresses.

Welded joints shall preferably be located at points where steel not be subject to more than 75 percent of the maximum permissible stresses and welds so staggered that at any one section not more than 20 percent of the rods are welded. Only electric arc welding using a process which excludes air from the molten metal and conforms to any oral other special provisions for the work will be accepted. Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding and when welding is done in 2 or 3 stages, previous surface shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding shall conform to IS 814. Welded pieces of reinforcement shall be tested. Specimen shall be taken from the actual site and their number and frequency of tests shall be as directed by the Engineer-in-charge.

10. Reinforcement shall be measured in length including overlaps, separately for different diameters as actually used in the work, where welding or coupling is resorted in place of lap-joints such joints shall be measured for payment as the equivalent length of overlap as per design requirement. From the length so measured the weight of reinforcement shall be calculated in tones on the same basis of IS 1732. Length shall include hooks at ends. Wastage and annealed steel wire for binding shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

11. Rate for reinforcement shall include cost of all steel, its carting to work-site, cutting, bending, placing, binding and fixing in position as shown on the drawings and as directed by Engineer-in-charge. It shall also include cost of all devices for keeping reinforcement in approved position, cost of jointing as per approved methods and all wastage, and spacer bars.

12. Payment shall be made on Kg. basis.

Item No. : 71 : Providing & Laying Controlled Cement Concrete M : 150 & Curing Complete (excluding Cost of reinforcement)

Relevant Specification of Item 67 shall be followed except that ingredients of concrete shall be of mix Design.

ITEM-72 : Providing Cement Pointing on uncoursed/coursed stone/brick wall masonry with cement mortar 1:3 (1 cement :3 sand) (A) Flush Pointing (B) Ruled Pointing

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

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

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

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

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

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

7. The work of pointing shall be measured in square metres of the surface treated.

8. The rate for pointing shall include erecting the removal of scaffolding all labour, materials and equipment incidental to complete the pointing, raking out joints, wetting filling with mortar, troweling, point and watering.

ITEM-73 Providing and laying 22.50 cms. thick rubble stone pitching including preparing surface, laying 15 cms thick murrum layer over prepared surface and arranging rubbles on it by hand packing and in level & lined surface in slope camber including filling the interstices between adjacent stone by spalls of proper size & wedged for right packing as directed etc complete without cement pointing.

1. The work shall consist of covering the slopes of guide banks, training works and road embankment with stone or boulders, over a layer of murrum bedding.

2. Stone subject to marked deterioration by water or weather will not be accepted. The stone shall be sound, hard, durable and fairly regular in shape and its thickness in any one direction shall not be less than the thickness of pitching as specified in the item and thickness of the stone at any place shall not be less by 15% of the thickness specified. The largest stones procurable shall be supplied on site. The sizes of spalls shall be minimum 25 mm and shall be suitable to fill the voids in the pitching. Thickness of the pitching shall be as specified in the pitching item.

(G.C.No. SSR/2080 IB 547/28/C, dated 6th March, 1982)

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

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

5. The stone pitching shall commence in a trench below the toe of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the drawings. Stones shall be set normal to the slope and placed so that the largest dimensions is perpendicular to the face of the slope, unless such dimensions are greater than the specified thickness of pitching. The largest stones shall be placed in the bottom courses and for use as headers for subsequent course. When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interstices between adjacent stones shall be filled in with spalls of the proper size and wedged in with hammers to ensure tight packing. Pitching shall be done in panes of 3.0 M x 3.0 M with a 30 CM wide and 8 Cm. deeper band all around.

6. Payment shall be made on Square Meter basis of the finished work. If directed by the Engineer-in-charge, for measurement the materials may have to be stacked at site before laying and nothing extra will be paid to the Contractor for this stacking. Preparation of base for laying bedding shall be deemed indicated to the work.

7. The rate shall include the cost of preparing the base, putting to the profiles, providing, laying and compacting the murrum bedding and stone pitching of dry rubble as per embankment slopes to specified thickness, lines, curves, slopes levels and all labour and materials as well as tools and plant required of the work.

ITEM-74 Providing 12 mm thick premoulded asphalt filler joints as per drawings.

1. Open joints shall be constructed at the location as directed by the Engineer-in-charge using a wood strip metal plate or other suitable material which is subsequently removed. When removing the material, care shall be exercised to avoid chipping or breaking the corners of the concrete. The edge of the concrete, at the joints, shall be well finished. Reinforcement shall not extend across an open joint.

2. When preformed filler is to be provided, the filler shall be placed in correct position before concrete is placed against the filler. The filler material shall form part of the joint and while concreting the slab. Care shall be taken to prevent the former form being displaced. After the work is completed, the exposed face of the joint shall be cleaned of all loose materials sticking to it.

3. The material used for filling expansion joint shall be bitumen impregnated felt. Impregnated felt shall conform to the requirement of IS:1838, and shall be got approved from the Engineer-in-charge. The joint shall consist of large pieces and assembly of small pieces to make up the required size shall be avoided.

4. The expansion joint shall be measured in running metres. Thickness of the expansion joint will be 20 to 25 mm. Width of expansion joint shall be equal to full depth of the slab.

5. The rate shall include the cost of all materials, labour, equipments incidental charges for fixing the joints complete in all respects as per these specifications and as shown on the drawings.

ITEM-75 Providing parapet of controlled cement concrete M 150 as per detailed drawing with necessary reinforcement including shuttering laying, vibrating & finishing to line level complete precast consistency.

1. Railings shall not be placed until the centering or false work for the span has been released, and is self supporting. The type of railing to be constructed shall be as shown on the drawing. The railing shall be carefully erected true to the line and grade. Posts shall be vertical with a tolerance not to exceed 6 mm in 3 metres.

2. The portion of the railing or parapet which is to be casting in place shall be constructed in accordance with the relevant specification for reinforced cement concrete. Forms shall either be of single width boards or shall be lined with suitable materials duly approved by the Engineer-in-charge. Form joints in plane surfaces will not be permitted. All mouldings, panels in the finished work shall be constructed according to the details shown on the drawings. All corners in the finished work shall be true, sharp and clean cut and shall be free from cracks, spall or other defects.

3. Railing shall be measured in running metres.

4. The rate of railing shall include the cost of all labour, material, tools and plant required, for doing the work complete in all respects in accordance with these specifications, and as shown on the drawing.

ITEM-76 Providing 15 mm thick cement plaster in single coat on brick/Concrete wall for interior plastering up to floor two level finished even and smooth in (i) Cement mortar 1:3 (1 cement :3 sand) (ii) Cement mortar 1:4 (1 cement :4 sand) (iii) Cement mortar 1:6(1 cement :6 sand)

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

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

3. The mixing shall be done intimately by hand mixing. The operation shall be carried out on a clean watertight platform, and cement and sand shall be first mixed dry in the required proportion to obtain a uniform colour and then the mortar shall be mixed thoroughly after addition of water. In case of cement mortar that has stiffened because of evaporation of water, the same shall be retempered by adding

water as frequently as needed to restore the requisite consistent but this retampering shall be permitted only within thirty minutes from the time of addition of initial mixing.

4. Plastering shall be started from top and worked down. All pitting holes shall be properly filled in advance of the plastering as the scaffolding is being taken down. Wooden screeds 75 mm wide and of the thickness of the plaster shall be fixed vertically 2.5 metres to 4 meters apart to act as gauges and guides in applying the plaster. The mortar shall be laid on the wall between the screeds using the plaster float and pressing the mortar to the racked joints are properly filled.

The plaster shall then be finished off with a wooden straight edge reaching across the screeds. The straight edge shall be worked on the screeds with a small upward and sideways motion 50 mm or 75 mm at a time. Finally, the surface shall be finished off with a plaster's wooden float. Metal floats shall not be used.

5. When recommencing plastering beyond the work suspended earlier the edge of the old plaster shall be scrapped, cleaned and wetted before plaster is applied to the adjacent areas. No portion of the surface shall be left out initially or be patched by later on. The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required by the Engineer-in-charge. The average thickness of plaster shall not be less than the thickness specified in the item with a tolerance of 3 mm thickness which appear in the surface and all portions, which sound hollow when tapped, or are found to be otherwise defective, shall be cut out in rectangular shape and re-done as directed by the Engineer-in-charge.

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

7. Stage scaffolding shall be provided for the work. This shall be independent of the structure.

8. The work of plastering shall be measured in sq. metre of the surface treated.

9. The rate of plastering shall include the cost of all labour, materials tools and plant scaffolding and all incidental expenses as described herein above.

ITEM - 77 White washing :

White washing with lime on wall surface two coat to give an even shade including thoroughly brooming the surface to remove all dirt, and mortar drops and other foreign matter.

1. **General :** Lime shall be hydraulic lime of approved quality.

The slaked lime, if stored, shall be kept in a weather proof and damp roof shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All lime that has been damaged in any ways shall be rejected and all rejected materials shall be removed from site of work.

2. **Workmanship :** The fat lime shall be slaked at site and shall be mixed and stirred with about five liters of water and 1 Kg of unslaked lime to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be added to each cubic meter of lime cream. Small quantity of ultra marine blue shall also be added to the last two coat of white wash solution and the whole solution shall be stirred thoroughly before use.

3. **Preparation of surface :** The surface shall be thoroughly cleaned of all dust mortar dropping and other foreign matter before white wash is to be applied. Oil or grease spots shall be removed by suitable chemicals and smooth surface shall be rubbed with wire brush.

All unsound portion of the surface plaster shall be removed to full depth of plaster in rectangular patches and plastered again after raking the masonry joints properly.

4. **Application of white wash :** On the surface so prepared the white wash shall be applied with brush. The first stroke of the brush shall be from top to downwards and another from bottom to upwards over the first stroke and similarly one stroke from the right and another from the left over the first stroke before it dries.

Each coat shall be allowed to dry before next coat is applied number of coats as specified in item shall be applied.

5. **Mode of Measurement & Payment :** All work shall be measured in the decimal system i.e. in sq. meters. Deduction for pipe openings shall be made fully both sides of openings. The rates shall includes the cost of all materials, labour, scaffolding protective etc. involved in all the operations described. The rate shall be for a unit of one sq. meter.

ITEM-78 (A) Providing & laying C.C. 1:5:10 (1 Cement : 5 Coarse sand : 10 graded stone aggregate of 40 mm nominal size) and curing etc. complete excluding cost of formwork in foundation and plinth.

1.0 Material

1 Water

1.1 Water shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of slit and traces of oil and injurious alkalis, salts organic matter and other deleterious material which will either weaken the mortar or concrete or our cause

efflorescence or attack the steel in RCC contrainer for transport, storage and handling of water shall be clean water shall conform to the standards specifications in I.S. 456-1978

1.2 If required by the Engineer-in-charge it shall be tested by comparison with distilled water. Compression shall be and means of standard cement tests for soundness, time of setting and mortar strength as specified in I.S. 269-1976. Any indication on unsoundness, change in time of setting by 30 minutes or more of decrease or more than 10 percentage of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water under test.

1.3 Water for curing mortar, concrete or masonry should not be too acidic or too alkaline. It shall be free of elements which significantly effect the hydration reaction or otherwise interface with the hardening of mortar or concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces.

1.4 Hard and bitter water shall not be used for curing.

1.5 Portable water will generally be found suitable for curing mortar or concrete.

2.0 SAND

2.1 Sand shall be natural sand, clean well graded, hard strong durable and gritty particles free from immures amounts of dust, clay kanker modules, soft or flaky particles shall alkali salts, organic matter, learn mica or other deleterious substance and shall be got approved from the Engineer-in-charge. The sand shall not contain more than 8 percent of slit as determined by field test. If necessary the sand.

2.2 **Course Sand :** The fineness modules of coarse sand sand shall not be less than 2.5 and shall not exceed 3.0. The sieve analysis of coarse sand shall be as under :-

I.S. Sieve Designation	% by wt. passing
4.75 mm	100
2.36 mm	90 to 100
1.18 mm	70 to 100
600 MC	30 to 100
300 MC	85 to 70
150 MC	00 to 50

2.3 Fine Sand

The fineness module shall not exceed 1.0 the sieve analysis of fine sand be as under :-

I. S. Sieve Designation	% by wt. passing
4.75 mm	100
2.36 mm	100
1.18 mm	75 to 100
600 MC	40 to 85
300 MC	05 to 50
150 MC	00 to 10

3.0 Cement

3.1 Cement shall be ordinary portland slab cement as per I.S. 1975 pr portlar alag cement as per I.S. 455 1976.

4.0 Stone coarse Aggregate for Nominal Mix Concrete :

Coarse aggregate shall be or machine crushed stone of black trap of equivalent and hand, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.

4.1 The aggregate shall be generally be cubical in shape unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the best blacktrap or equivalent hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement concrete and ordinary reinforced cement. The concrete shall generally be as per the table given below. However in case of reinforced cement concrete the Minimum limit may be restricted to 6 mm less than the minimum lateral clear distance between bars or 6 mm. less than the cover whichever is smaller.

IS Sieve designation	Percentage passing for single sized aggregate of nominal size		
	40 mm	20 mm	16 mm
80 mm	-	-	-
63 mm	100	-	-
40 mm	85-100	100	-
20 mm	0-20	85-100	100
16 mm	-	-	85-100

IS Sieve designation	Percentage passing for single sized aggregate of nominal size		
	40 mm	20 mm	16 mm
12.5 mm	-	-	-
10 mm	0.5	0.20	0.30
4.75 mm	-	0.5	0.5
2.35 mm	-	-	-

Note : This percentage may be varied some what by the Engineer-in-charge when considered necessary containing better density and strength of concrete.

4.3 The grading test shall be taken in the beginning and at the change of source of material. This necessary that indicates in I.S. 383-1970 and I.S. 456-1978 shall have to be carried out to ensure the acceptability. Aggregate shall be stored separately and handled in such a manner as to prevent the intermixing diff. aggregate if the aggregate are covered with dust, they shall be washed with water to make them clean.

2.00 Workmanship :-

2.1 General :-

2.1.1 Before starting concreting the bed of foundation trenches shall be cleared of all loose materials, level, watered and rammed as directed.

2.2 Proportion of Mix :

2.2.1 The proportion of cement sand and coarse aggregate shall be one part of cement 5 parts of sand and 10 parts of bricks bats aggregate and shall be measured by volume.

2.3 Mixing :-

2.3.1 The concrete shall be mixed in a mechanical mixer at the site of hand mixing may however be allowed for collar quantity work if approved by the Engineer-in-charge when hand mixing is permitted by Engineer-in-charge in case of break down of machineries and in the interest of work it shall be carried out on water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. However in such cases 10% more cement extra case. One mixing in mechanical mixer shall be done period of 1.5 to 2 minutes and the quantity of water shall be just sufficient to provide a dense concrete of required workability for the purpose.

2.4 Transporting and Placing the Concrete :-

2.4.1 The concrete shall be handled from the place of mixing to the final position in not more than 15 minutes by the method as directed and shall be placed into its final position, completed and finished within 30 minutes of mixing with water i.e. before the setting commences.

2.4.2 The concrete shall be laid in layer of 15 cms to 20 cms.

2.5 Compacting

2.5.1 The concrete shall be rammed with heavy iron rammer and rapidly to get the require compaction and to allow all the interstices to be filled with mortar.

2.6 Curing :-

2.6.1 After final set the concrete shall be kept continuously wet if required by ponding for a period of not less than 7 days the date of placement.

2.7 Mode of Measurements and Payments :

2.7.1 The concrete shall be measured for its length, breadth and depth limiting dimensions to those specified on plan or as directed.

2.7.2 The rate shall be for a unit of one cubic metre.

ITEM 78 (B) : Providing & laying C.C. 1:5:10 (1 cement : 5 coarse sand : 10 graded brick bats of 40 to 50 mm. nominal size) & curing complete excluding cost of form work in foundation and plinth.

The specification shall be same as per item No.77 (A) except that coarse aggregate shall be brick bats of 40 mm to 50 mm nominal size instead of graded metal.

ITEM - 78(C) : Providing & laying C.C. 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate of 40 to 63 mm. nominal size) including curing etc. complete excluding cost of form an work in the foundation and plinth.

The specification shall be same as per item No. 77 (A).

ITEM-79 Providing and fixing 4" (100 mm) dia, C.I. water spouts 2'6" long in CM necessary iron grating as per design etc. complete (10 CM dia pipe)

The galvanized water spouts of the size 10 cm dia and the Galvanize iron gritting shall be of the approved quality and type, and shall be first got approved from the Engineer-in-charge before actual use.. The G.I. pipe shall be of sufficient length projecting. Out beyond the concrete surface for sufficient discharge. Iron grating shall be fixed rigidly into the concrete. The galvanized pipe iron as well as gratings shall be painted with two coats of anticorrosive paint.

The measurement shall be recorded and paid on the basis of each No. of pipe fixed in position.

ITEM-80 Providing and laying weep holes in abutments and returns by jointing A.C. pipe of 100 mm. dia including laying in proper grade and joining etc. complete as per detailed specification.

Weep holes shall be provided in solid plain concrete/reinforced concrete, brick/stone masonry, abutment, wing wall and return walls as shown on the drawing or directed by the Engineer to drive moisture from the back filling. Weep holes shall be provided with 100 mm dia AC pipe for structures in plain/reinforced concrete or brick masonry. In case of stone masonry, weep holes shall be 80 mm wide, 150 mm high or circular with 150 mm diameter. Weep holes shall extend through the full width of concrete/masonry with slope of about 1 vertical:20 horizontal towards the draining face. The spacing of weep holes shall generally be 1 m in either direction or as shown in the drawing with the lowest at about 150 mm above the low water level or ground level whichever is higher or as directed by the Engineer.

The payment shall be made per number of weep holes provided in structure like abutment and returns, wing walls etc.

Unit rate shall be include cost of all materials, labour and equipment to complete the job.

ITEM-81 Providing and fixing 30 cm x 22 cm x 2.5 cm thick year plate of marble stone set in cm 1:4 including finishing and engraving letters etc complete.

Providing and fixing 30 cms x 22 cms x 2.5 cms No and year plate of marble and of standard lettering with leads or paint including finishing etc, complete.

Marble plate shall be white and of approved quality and shall be 25 mm thick and of standard size as directed by the Engineer-in-charge of the work.

Lettering shall be done by U-shape engraving and shall be filled with black paint of approved quality. Lettering shall be done as directed by the Engineer-in-charge. The marble plate shall be fixed in neat cement at a place as directed by the Engineer-in-charge. Cement shall conform to relevant I.S. specification.

Measurement shall be per number of marble plate fixed.

Unit rate includes cost of all material, labour etc. for complete work.

ITEM-82 Numbering the C.D. works with approved paint including all materials for painting etc. complete.

Numbering the C.D. works shall be carried out as per relevant I.R.C. specification. Oil paint of approved quality and make shall be used for the purpose. Numbering shall be very neat and clean Arrow shall be marked on the Head wall in the correct direction of flow of water. Payment shall be made on the number basis. Unit rate includes the cost of all materials, labours for painting & lettering as directed by Engineer-in-charge.

**ITEM-83 : Providing & fixing Boundary stone as per I.R.C. type design including painting, carving, lettering etc. complete.
(i) Fixing in earth / Fixing in C.C. 1:5:10**

1. Boundary stone shall be of the size 20 x 15 x 75 cms. true to all the faces.
2. Boundary stones shall be neatly finished shall be chisel dressed on all the sides and at top.
3. Boundary stones shall be fixed at the border line of acquired length so that the land width is properly demarcated. The width between boundary stones shall be fixed at a distance of 330 feet (100 mt.) a part in the direction of length of the road.
4. The letter B.B. of (Border) as directed by the Engineer-in-charge shall be carved on the face of the boundary stone & letter shall be painted with black Japan.
5. The measurement shall be recorded per No. of boundary stone fixed in position and paid accordingly.

ITEM-84 Providing and fixing junction Board of R.C.C. precast as per standard design of I.R.S. including fixing in C.C. block of 1:4:8 with necessary excavation enamel painting, lettering figures etc. complete.

1. These boards should be fixed at a distance of 120 metre from the centre line of the crossing and they should be located on the left hand side of the road in the direction of the traffic and facing the traffic.
2. The board will be located in such a way that the edge of the board towards the centre of the road will be at a distance of 4.57 metres from the centre of a National Highway and 3.66 meters from the centre of State Highway or Major District Road.
3. The bottom of the board should be 1 metre above the road surface and the board shall be at right angle to the centre line of the road facing the direction of traffic.
4. The board shall be of the size of 107 c.m. in length and 91 c.m. in height for "T" and "Y" junctions shall be 145 C.M. in length and 91 C.M. in height for cross roads.
5. The board shall be painted by two coats, the Board and posts shall be R.C.C. as shown in the type design.
6. The post shall be fixed in concrete and the projection of this above the road level shall be 45 cm x 45 cm and height of 24 cms. above the road level and the top to be finished in plaster from the height of 15 cm.
7. The size of letter and figures shall be 8 cm. for English and 10 C.M. for devnagri and Gujarati scripts.
8. The post shall be painted in black and white reflective strips 23 cm. in height.
9. The board shall be painted in white with border 2 C.M. wide.
10. On this board tablets shall be painted in yellow with black and the tablets shall have 5 cm. clear distance from the board.
11. Each such tablet shall be 61 cm. in length and 33 C.M. in height, arrow lines indicating the direction of the road at the junctions shall be painted in black and shall have a thickness of C.M. for National Highway and 4 C.M. on a State Highway and a C.M. for a Major district road.
12. All letters and figures shall be painted in black.
13. The work shall be carried out as per design as per the instructions of the Engineer-in-charge. The measurements shall be recorded and paid on number basis for board fixed in position.

ITEM-85 Supplying and fixing rough kota stone 60 to 80 mm size including fixing in line & level etc. complete.

The stone to be used shall be approved quality kota stone. It shall be sound, hard, durable and fairly regular in shape and its thickness of the stone at any place shall not be less by 15% of the thickness specified.

The stone shall be laid in line and level with camber as directed & set properly in sand. The whole work shall be generally carried out to the entire satisfaction of Engineer-in-charge of the work.

The rate shall include the cost of all materials and labour involved in all the operations described above. The kota stone flooring shall be measured in square metre correct to two places of decimal. Length and breadth shall be measured correct to be centimeter & between the finished faces of skirting or Dado and no deduction shall be made for extra paid for any opening in floor of a unit of one Sq. M.

ITEM-86 Providing & laying Kota stone for kerbing on both sides of stone paving Incl. fixing kota stone kerbing in 0.30 Mtrs.. depth (Kerbing stone of 60 to 80 MM thick size)... etc. complete.

The stone shall be of approved quality kota stone. Specifications for the materials & laying as per item No. 83 above. The rate shall per unit of one Rmt.

ITEM-87 White stone Bela masonry in C.M. 1:5 including curing etc. complete.

The stone shall be fine dressed chisel draft one incl. the drafts on all beds and joints.

The stone shall be laid in regular course. The height of the course shall be as approved by the Executive Engineer. All the course shall be of same height unless otherwise ordered but no course will be thicker than any course below it. No stone shall be less in breadth than in height and less in length than twice the width.

The stone shall break the joints in each course and to carried out in cement mortar 1:6 and thickness of the joints shall not be more than 10 mm. The side joints and beds of all stone shall be vertical and horizontal respectively and all stones shall be rough, true and square.

The work shall be measured and paid for cubic measurements of the work carried out as per approved drawing or as directed by the Engineer-in-charge.

SCHEDULE FOR TESTING OF MATERIALS

For ensuring quality control and workmanship, Various tests prescribed below for materials shall be taken at periodical intervals as stipulated below.

The materials shall be got tested at Government recognised Laboratory, (R & B) or field Laboratory of GERI (R & B) for which 1% of the estimated amount put to Tender shall be recovered from the contractor from the R. A. bills and final bills at the testing charges shall be paid to the GERI by the Government. However if the charges increase over 1% no excess recovery shall be made from the contractor as per resolution of B & C Department dated 10th May, 1985 Vide TNC/1085 (4) s.

Item No. as per schedule 'B'	Brief Description of Materials to be tested	Qty. of Materials	Prescription of test which shall be carried out	Frequency @ which test shall be carried out	Total No. of Test to be taken
1	25 to 90 H. B. Metal 40 to 63 H. B. Metal 40 to 50 M. C. Metal 20 to 50 M.C. Metal Kapachi		- Gradation Test - Impact value - Flakiness Index	0 to 100 Cmt - 1 Test 100 to 500 Cmt - 3 Test 500 to 1500 Cmt - 5 Test 1500 to 5000 Cmt - 7 Test)	
2	Grit		- Stripping Value	— As Above —	
3	Murrum		- P. L Value	One test per / 50 cmt.	
4	Sand Quarry Spaul CBR test per work		- Silt Content - Gradation	One test per work One test per 200 cmt.	
5	Asphalt		1 Penetration Test as per IS. 1203 2 Ductility Test 3 Specification Gravity Test 4 Softening point Test 5 Viscosity Test	No. of Tanker Test 1 to 10 1 11 to 20 2 21 to 50 3 51 to 100 4 Remaining every 50 tanker 1 As per IS. 1208 As per IS. 1202 As per IS. 1204 As per IS. 1206	
6	Tack coat		- Binder temperature for application. - Rate of spread of binder.	Irregular close in intervals Two tests per day.	
7	Carpet & seal coat mix		- grading - temperature of binder in boiler, aggregates in the dryer and mix at the time of laying and rolling (binder content vide 45 IMD 2172) - Rate of Spreaded mix materials	One Test on individual constituents and mixed aggregates from the dryer for each 100 tonnes of mix subject to minimum of Two tests per plant per day. One Test for each 100 tons of mix subjects to mini. of Two per day plant Regular control through checks on layer thickness.	
8	Bricks		- Water absorption - Efflorescence - Size - Compressive Strength	1 test per 50,000 Bricks	

Item No. as per schedule 'B'	Brief Description of Materials to be tested	Qty. of Materials	Prescription of test which shall be carried out	Frequency @ which test shall be carried out	Total No. of Test to be taken
9.	Cement		<ul style="list-style-type: none"> - Consistency - Setting time - Compressive Strength - Fineness - Chemical analysis - Soundness 	Upto 50 T 1 test (As per 100 T 2 tests GERD 200 T 3 tests Manual 300 T 4 tests 2002) 500 T 5 tests 800 T 6 tests 1300 T 7 tests and 8 test for larger consignment	
10.	Steel		<ul style="list-style-type: none"> - Tensile Strength - Yield Stress - Elongation - Size 	1 test / 40 tonnes / per category	
11.	C.C. cube 124		<ul style="list-style-type: none"> - Compressive Strength (IS. 516 - 1959) 	Qty. C.C.M ³ No. of test 1 to 5 1 no. 6 to 15 2 no. 16 to 30 3 no. 31 to 50 4 no. 51 & above 4+1 (For each additional 50 M ³ or part thereof).	

The number of tests will be as per Manual of Quality Control or latest Govt. G.R. / Circulars will be final.

The contractor shall have to pay 1% of the estimate cost put to tender towards all testing of materials & the same shall be deducted from their bills for the works. The testing of various materials shall be carried out in GERD and result received shall be binding to all i.e. the contractor and Govt.

Testing charges of GERD shall be born by Govt. No refund be made nor extra charges over 1% shall be recoverable from the contractor.

SIGNATURE OF CONTRACTOR

EXECUTIVE ENGINEER

_____ : Also Available at : _____



Arrow Marketing

Plot : 238/2, Sector - 1/C, Gandhinagr - 382 001