

Section 6: Employer’s Requirements

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Particular Specifications

Particular specification for all items shall be as per Bhutanese standards like SBRW, MORTH revision 5, FAA, ICAO specifications unless and otherwise specified. If any item is not available in these standards, equivalent standards like CPWD specifications/relevant /International standards can be referred with mutual consent from the Engineer-In-Charge. The order of preference will be in the order mentioned above.

Item: Providing and laying of **Hot Mix Dense Asphaltic Concrete (DAC)** using crushed stone aggregate of quality, size and grading as specified and 2% cement by weight of aggregates as filler of quality as specified and Viscosity Grade Bitumen in proportions as per job mix formula and laid to specified levels, grade and camber as per specification, drawings and as directed by the Engineer-in-Charge including compacting with 8-10 tonne, preferably vibratory road roller of adequate capacity to achieve the specified values of compaction, strength, surface accuracy complete (for tendering purpose VG bitumen of grade (VG-10) content shall be taken as 135 kg/m³ of mix supplied in drum/bulk produced by Govt. Refineries and 2% cement by weight of aggregates as filler Material).

1 Materials

1.1 Coarse Aggregates

This shall consist of a crushed or broken from hard stone obtained from approved quarry. These shall be clean, strong, durable of fairly cubical shape and free from disintegrated, soft, friable, thin elongated or laminated pieces. This shall also be free from dirt, organic, deleterious material and any other foreign matter and adherent coatings. The grading of coarse aggregates shall conform to IS:383.

1.1.1 Physical Properties of Coarse Aggregate

The aggregate shall conform to the following Physical Properties:

<i>S. No.</i>	<i>Property</i>	<i>Tests</i>	<i>Test Method</i>	<i>Frequency</i>	<i>Acceptance Criteria</i>
1.	Cleanliness	Grain Size Analysis	IS:2386 (Part.I)	Before approval of the quarry and at every subsequent change in the source of Supply	Max.5% passing 0.075mm sieve

S. No.	Property	Tests	Test Method	Frequency	Acceptance Criteria
2.	Strength*	Aggregate impact value	IS:2386 (Part.IV)	Before approval of the quarry and at every subsequent change in the source of supply and one test for every 100m ³ of aggregates	Max.24%
		Los Angeles Abrasion value	IS:2386 (Part IV)	-do-	Max. 30%
3.	Durability	Soundness	IS:2386 (Part V)	-do-	Max. 12%
		Loss with Sodium Sulphate for 5 cycles Loss with Magnesium Sulphate with 5 cycles			Max. 18%
4.	Particle Shape	Flakiness & Elongation Index (Combined)	IS:2386 (Part I)	-do-	Max. 30%
5.	Stripping	Coating and Stripping of Bitumen Aggregate	IS:6241	-do-	Minimum Retained Coating 95%
6.	Water absorption	Water absorption	IS:2386 Part III	-do-	Max. 2%
7.	#Water Sensitivity	**Retained Tensile strength	AASHTO 283	-do-	Minimum 80%

* The aggregate may satisfy either of the two tests.

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

The water sensitivity test is only required, if the minimum retained coating in stripping test is less than 95%. Where anyone or some of the above conditions cannot be satisfied, the Engineer-in-Charge may allow reasonable tolerances, with the approval of Competent Authority.

1.1.2 Anti-stripping Agent: Anti-stripping agent or additive if required shall be heat stable, shall not change the viscosity of the binder beyond specifications, shall contain no harmful ingredients, shall be added in recommended proportion by approved method and shall satisfy the requirements as stipulated in MORT&H Appendix-5. The cost of providing anti-stripping agent shall be borne by the contractor and nothing extra shall be paid on this account to the contractor.

1.2 Fine Aggregates

Fine aggregate shall consist of crushed or naturally occurring mineral material or combination of two, passing 2.36mm sieve and retained on 0.075mm sieve. No natural sand will be allowed in the wearing course. The fine aggregate shall be clean, hard, durable, dry, and free from dust and soft organic and other deleterious substances. Fine aggregates shall have sand equivalent value not less than 50 when tested in accordance with the requirement of IS:2720 Part 37. The Plasticity Index of fraction of passing the 0.425mm sieve shall not exceed 4 when tested in accordance with IS:2720 Part 5.

1.3 Filler

The filler shall consist of cement of quality conforming to relevant IS code as approved by the Engineer-in-charge.

1.3.1 Cost Adjustment for Filler

For the purpose of tendering the contractor may base his rate assuming 2% cement as filler by weight of aggregates. If the actual quantity of cement required to be used, as per the design mix, is found to be different from the quantity of cement assumed above, necessary adjustment in cost of extra/short cement shall be made.

1.4 Bitumen

The Viscosity Grade Bitumen shall conform to IS:73 and shall be supplied in drum/bulk by Govt. Refineries. The agencies shall submit copies of the purchase vouchers of the Bitumen to the Engineer-in-Charge. Selection of VG grade bitumen shall be based upon the climatic conditions of the area as per below table.

<i>Lowest Daily Mean Air Temperature</i>	<i>Highest Daily Mean Air Temperature</i>		
	<i>Less than 20°C</i>	<i>20° to 30°C</i>	<i>More than 30°C</i>
More than -10°C	VG-10	VG-20	VG-30
-10°C or Lower	VG-10	VG-10	VG-20

2 Combined Grading of Aggregates

In order to satisfy the design requirements for the Dense Asphaltic Concrete (DAC) as laid down in para 3.0, the mix shall contain coarse aggregates, fine aggregates and filler in suitable proportions. True and representative samples of the aggregates proposed to be used on specific job shall be tested in material testing lab (approved by Govt. institutions) and proper blend of individual aggregates normally available shall be worked out so that the gradation of the final composition shall satisfy the limits laid down in below Table:

<i>Nominal Maximum Aggregate Size*</i>	<i>13.2 mm</i>
<i>IS Sieve (mm)</i>	<i>Percentage by weight passing</i>
19	100
13.2	79-99
9.5	68-88
4.75	48-68
2.36	33-53
1.18	20-40
0.6	14-30
0.3	9-21
0.15	6-16
0.075	3-6

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

3 Job Mix Formula (JMF)

Twenty days prior to the start of work at site, the job mix formula shall be got determined by the contractor in empanelled or Govt. Institute/laboratory, as directed by the Engineer-in-Charge, by Marshall Design Method. The Job Mix Formula (JMF) so determined shall be submitted by the contractor, in writing, to the engineer-in-charge for his acceptance before the actual paving work starts at site. The Contractor also shall intimate, in writing, to the Engineer-in-Charge the details of source and location of all materials, their sizes, grading and test results. Besides conforming to the requirements of grading and quality for individual ingredients, the mix shall meet the requirements enumerated as mentioned in the below Table.

S.No.	Criteria	Value
1	No. of compaction blows on each side of Marshall specimen	75
2	Marshall stability in kN at 60°C	Not less than 12
3	Marshall flow value in mm for VG Bitumen	2-4
4	Marshall Quotient for Viscosity Grade Paving Bitumen(Ratio of Stability/Flow)	2-5
5	Percentage Voids in Mix (VIM)	3-5
6	Percentage voids in mineral aggregates filled with bitumen (VFB)	65-75%
7	Bitumen(Viscosity Grade) content by weight of mix	As determined in the Lab.
8	Design laboratory density (Bulk density of the Marshall mold)	As determined in the Lab.
9	Retained Marshall Stability on Immersion Test	Not less than 75%
10	Tensile Strength Ratio	Not less than 80%

Note: Design of mix should also meet the following criteria:

- a) **A test track** of minimum 7 m wide and 90m length and shall be of the same depth specified for the construction of the course which it represents, laid and tested by the contractor before commencement of actual work. The core cut from the test track on testing shall give a stability and density of not less than 98% of the respective design values.
- b) **Texture depth** shall be measured by sand patch method and depth obtained by this test shall not be less than 1.0 mm.

- c) The texture depth shall be determined by the Sand Patch Test as described below. This test shall be performed at least once for each day's paving and wherever the Engineer-in-Charge consider it necessary at times after construction as under:

Five individual measurement of the texture depth shall be taken at least 2m apart anywhere along a diagonal line across a lane completed between points 50m apart along the pavement. No measurement shall be taken within 300mm of the longitudinal edges of a bituminous slab constructed in one pass.

d) Measurement of Texture Depth – **Sand Patch Method**

The following apparatus shall be used:

- i. A cylindrical container of 5 ml internal capacity.
- ii. A flat wooden disc 64mm diameter with a hard rubber disc, 1.5mm thick, stuck to one face, the reverse face being provided with a handle.
- iii. Dry natural sand with a rounded particle shape passing a 300micron IS sieve and retained on a 150 micron IS sieve.

Method: The surface to be measured shall be dried, any extraneous mortar and loose material removed and the surface swept clean using a wire brush both at right angles and parallel to the carriageway. The cylindrical container shall be filled with the sand, tapping the base 3 times to the surface to ensure compaction, and striking off the sand level with the top of cylinder. The sand shall be poured into a heap on the surface to be treated. The sand shall be spread over to surface, working the disc with its face kept flat in a circular motion so that the sand is spread into a circular patch with the surface depressions filled with sand to the level of peaks. The diameter of the patch shall be measured to the nearest 5mm. The texture depth of concrete surface shall be calculated from $31000/(D \times D)$ mm where D is the diameter of patch in mm.

In case of any deficiency, necessary adjustment in Job Mix formula, plant operation, placing procedures and/or rolling procedure shall be made and the test section shall be re-laid & tested. No extra payment shall be made on this account of making test track or changes in grading or any other changes, if any. Full production shall not begin until acceptable test track has been constructed and accepted, in writing, by the Engineer-in-Charge.

3.1 Revision of Job Mix Formula

The Job Mix Formula shall be revised if there is change in source of material and/or if it is noticed by the Engineer-in-Charge that grading of Individual aggregates has changed. The Job Mix Formula (JMF) so determined shall be submitted by the contractor, in writing, to the engineer-in-charge for his acceptance before the actual paving work starts at site with new source of material/grading. No extra payment shall be made to the contractor on this account.

3.2 Permissible Tolerances in the Job Mix Formula

S.No.	Description	Permissible Variation
1.	Aggregate passing 19mm sieve or larger	±7%
2.	Aggregate passing 13.2mm, 9.5mm	±6%
3.	Aggregate passing 4.75mm	±5%
4.	Aggregate passing 2.36mm, 1.18mm, 0.6mm	±4%
5.	Aggregate passing 0.3mm, 0.15 mm	±3%
6.	Aggregate passing 0.075mm	±1.5%
7.	Binder content	±0.3%

All the above tolerances are with respect to the Job Mix Formula as the datum.

4 Bitumen Content

The bitumen content of the mix shall be tested periodically and as directed by the Engineer-in-Charge using centrifugal extraction method or such method approved by the Engineer-in-Charge. The test shall generally be carried out in accordance with established practices and as directed by the Engineer-in-Charge. Whenever, there is a deviation in the resultant bitumen content from approved job-mix- formula values, it shall be reported to the Engineer-in-Charge immediately and necessary correction made at the job-mix plant as directed.

4.1 Cost adjustment for Bitumen

For the purpose of tendering, the Contractor may base his rate on the assumption that the bitumen content of the mixture shall be 135 Kg of bitumen per Cum. of total mix compacted to 100% density in Marshall mold. If the actual quantity of bitumen required to be used as a result of the laboratory test is found different from the quantity of bitumen that is assumed above, necessary adjustment in the cost of extra/short bitumen used shall be made from the rate specified at the time of tender and to the rate of purchase price of bitumen at the nearest IOC/HP/BP/Govt.Refinery. The procurement price of bitumen (Basic rate plus excise duty and sales tax & transportation charges) shall be ascertained by the Engineer-in- Charge on submission of documentary proof by the contractor. The rate of bitumen decided by the Engineer-in-Charge shall be final and binding. Except adjustment in cost due to variation in bitumen consumption as stated above, no other factor whatsoever shall be considered for adjustment in quoted rates.

In the event of change in materials available at site due to unforeseen exigencies, a fresh job mix formula shall be arrived at within the specified limits in the empanelled laboratory or Govt. Institute/laboratory as approved by the Engineer-in-Charge. Nothing extra is payable due to this.

Laboratory charges for the Job-mix formula design, costs of materials, its cartage and other incidental expenses shall be borne by the Contractor.

5 Mixing

All plants used by the contractor for the preparation of Dense Asphaltic Concrete should be equipped with the following:

- a) Means for accurately weighing or measuring each batch of aggregates.
- b) Bitumen tanks with arrangement of heating the material under effective and positive control at all times.
In addition there should be satisfactory devices for weighing, metering of volumetric measurement of the bitumen to be used.
- c) A mixer unit capable of producing uniform mixture.

The hot aggregate and binder shall be thoroughly and intimately mixed together in the correct proportion for at least 30 seconds or longer and until every particle of aggregates is completely coated and homogenous mixer is obtained. The total mixing time may be reduced but not less than 30 seconds in any case, if the Engineer-in-Charge is satisfied that thorough mixing can be achieved in less time. In such cases the contractor shall obtain prior written permission of the Engineer-in-charge.

6 Hot Mix Plant

The Hot Mix Plant (HMP) employed by the contractor shall be a weigh batch plant having a minimum capacity of 100 TPH. Hot Mix Plant with electronic control of minimum capacity of 100 TPH and capable of producing a proper quality mix shall be used for preparing the mix. The plant may be a batch type having a coordinative set of essential units such as drier for heating the aggregate, devices for grading and batching/feeding by weight or volume the required quantities of aggregates. The plant shall also have a binder heating and control unit for metering out the correct quantities of heated binder together with the mechanical mixer for thorough mixing of the binder and the aggregates. It should preferably have a separate feeder for incorporating the correct quantity of filler by weight.

7 Temperature

7.1 Following temperatures shall be adhered to at the different stages of work as mentioned in Table below:

<i>Bitumen Viscosity Grade</i>	<i>Bitumen Temperature °C</i>	<i>Aggregate Temperature °C</i>	<i>Mixed Material Temperature °C</i>	<i>Laying Temperature °C</i>	<i>*Rolling Temperature °C</i>
VG-40	160-170	160-175	160-170	150 Min.	100 Min.
VG-30	150-165	150-170	150-165	140 Min.	90 Min.
VG-20	145-165	145-170	145-165	135 Min.	85 Min.
VG-10	140-160	140-165	140-160	130 Min.	80 Min.

* Rolling must be completed before the mat cools to these minimum temperatures. At no time, shall the difference in temperature between the aggregates and the binder exceed 14°C, at no time shall bitumen or aggregates be overheated.

8 Transportation of Hot Mix

The Hot Dense Asphaltic Concrete shall be transported from mixing plant to the site in clean vehicle. Every precaution shall be taken to avoid segregation of the hot mix and to ensure that they do not become contaminated with dust or foreign materials. In order to maintain satisfactory temperature of mix in transit, particularly in cold weather and to prevent undue loss of heat adequate precautions shall be taken by covering the material so that the materials are well protected during transportation. The temperature of the mix in every transporting vehicle shall be checked immediately prior to discharge of mix into the spreader and shall be ensured that the temperature is within the limits as specified in clause 7.0 above. If the temperature of mix in any transporting vehicle is not as per the limits specified in clause 7.0 above, the mix shall be rejected and shall be removed from site immediately.

9 Laying

Mix transported from the Hot Mix Plant to the site be spread by means of self-propelled electronic paver with electronic sensor & hydraulic control with suitable screeds capable of spreading, temping and finishing the mix true to the specified width and profile without calling segregation, dragging, bringing irregularities or other surface defects. The paver shall be capable of being operated at a speed consistent with a character of mix and the thickness of the course being laid so as to produce a surface of having uniform density and surface texture. The thickness of the single compacted layer shall not exceed 50mm. The temperature of the mix at the time of laying shall be as per clause 7.0 above.

10 Weather Limitation

The bituminous mixture shall not be placed:

- i) In presence of standing water on the surface
- ii) When the rain is imminent and during rains, fog or dust storm.
- iii) When the binder course is damp.
- iv) When the air temperature on the surface on which it is to be laid is below 10°C.

11 Rolling

After the mix being spread, rolling shall be carried in three consecutive stages as below:

- a) Break down rolling
- b) Intermediate rolling
- c) Finish rolling

11.1 The initial or Break down rolling shall be done with 8-10 tonne dead weight smooth wheeled roller. The intermediate rolling will be done with smooth wheel pneumatic tyred roller of 12 to 15 tonne capacity having tyre pressure 7 kg/cm². Finish rolling shall be done with 8 to 10 tonne steel wheel roller.

Alternatively all the compaction operations i.e. break down rolling, intermediate rolling and finished rolling can be accomplished by using vibratory roller of 8 to 10 tonnes static weight. During the initial or breakdown rolling and finished rolling, the vibratory system shall be switched off. The joints and edges shall be rolled with 8 to 10 tonnes three wheeled static roller.

11.2 Rolling shall commence longitudinally at the sides and proceed towards center of the pavement, overlapping on successive trips by at least half the width of the rear wheels. Alternative trips of the roller shall be slightly of different lengths.

11.3 Break-down rolling shall preferably commence as soon as practicable after the mix is spread. The maximum break down temperature at which rolling can commence shall be determined by field trials. The attempt should be to obtain the maximum possible density

11.4 The principal function of finish rolling is to remove roller marks. The surface shall be carefully examined for residual marks which should be cleanly rolled out. A neat finished appearance shall be obtained. Finish rolling shall be accomplished with tandem roller.

11.5 Cold Rolling

The final compaction will be carried out with a pneumatic tyred roller of 12 to 15 tonne capacity having tyre pressure 7 kg/cm² after the entire paving operations are completed. This should be done on bright sunny days such that entire airfield is rolled minimum five times.

11.6 Speed of Rolling

The speed of rolling shall not exceed 4 - 5 km/hr to prevent adhesion of the mixture to the roller. The wheels shall be kept moist but excess of water shall not be permitted. The line of rolling shall not suddenly be changed, thereby displacing the mix. Roller shall not be left standing on the new surfacing.

11.7 Rolling Temperature

The range of temperature during rolling shall be as per clause 7.0 above.

12 Joints

12.1 Longitudinal Joints

Longitudinal joints and edges shall be constructed true to the delineating line parallel to the centre line of runway. The longitudinal lane joints shall be truly vertical in straight lines which shall be continuous for the full length of the pavement, or in smooth curves around bends. The exposed vertical edges of the longitudinal lane joints shall be carefully cut back and trimmed to firm material in the compacted lane, or for a minimum of one and a half times the layer thickness, whichever is the greater. All debris/loose material arising from this operation shall be removed from the pavement and the underlying surface cleaned and painted with hot bitumen immediately before laying of the adjacent lane. Nothing extra shall be paid on this account.

12.2 Transverse Joints

They shall be formed at right angles to the longitudinal joints, and shall be truly vertical. The exposed vertical edges of the transverse joints shall be cut back and trimmed to firm material or for a distance of not less than 1-1/2 times the thickness of layer whichever is greater. All debris/loose material arising from this operation shall be removed from the pavement and the underlying surface cleaned. The exposed joints shall then be cleaned and painted with hot bitumen immediately before the laying of the lane continues. Nothing extra shall be paid on this account.

13 Pavement Edges

Pavement shall be laid to correct width and alignment. To achieve straight and vertical edge, Contractor shall either use adequate side shuttering or cut back the edges to correct width and alignment by removing extra mix spread. Nothing extra shall be paid on this account.

13.1 Temporary Ramps

Temporary ramps at the end of each day work shall be made to allow smooth movement of air traffic and removal of ramp before start of next day work as per direction of Engineer-in-charge. Nothing extra shall be paid on account of provision / dismantling of ramps and nothing shall be deducted in case ramps are not required to be provided.

14 Determination of Field Density

The field density shall be determined by core cutting method using core cutting machine or by sand replacement method. Metallic tray of field density unit shall be kept on level spot of the finished pavement surface and a hole of 10cm dia. is cut in the entire thickness of the layer. All materials removed from the hole is carefully collected and weighed. A known weight of dry standard sand, passing 710 micron IS sieve and retained on 355 micron I.S. Sieve is taken in the sand pouring cylinder. The cylinder is kept directly over the hole and the shutter of the cylinder is released without any jerk and closed when the hole is filled with the sand. The quantity of the residual sand in the cylinder is weighed and the quantity filling the cone of the cylinder is determined.

The in-situ Field density of the layer is calculated as follows:

$$\text{Field Density} = \frac{A}{\{W - (W1 + W2)\}/d} \text{ gm/cm}^3$$

where,

A = Weight of the materials removed from the hole.

W = Initial weight of sand taken in the cylinder.

W1 = Weight of the sand filling the cone of the cylinder.

W2 = Weight of the sand remaining in the cylinder.

d = Bulk density, gm/cm³ of sand.

15 Quality Control Tests for Dense Asphaltic Concrete (DAC):

Apart from the quality control tests given in clause 1.1.1, following additional tests shall be carried out as mentioned in table below:

S.No.	Test	Test method	Frequency	Acceptance Criteria
1.	Quality of binder	IS:73	Number of samples as per lot.	As per IS:73.
2.	Deleterious materials	IS:2386 (Part-III)	As required by the Engineer- in-charge.	As required by engineer-in-charge
3.	Mix grading	IS:2386 (Part-I)	One test for individual constituent and mixed aggregate from dryer for each 400 tonnes of mix subject to minimum of two tests per day per plant.	

S.No.	Test	Test method	Frequency	Acceptance Criteria
4.	Stability of mix, flow value, density and void content.	ASTMD1559	3 tests for stability, flow value, density and void contents for each 400 tonnes of mix subject to minimum of two tests per day per plant.	
5.	Binder content	As per clause 4.0	One test for each 400 tonnes of mix subject to minimum of two tests per day per plant.	As per clause 3.2
6.	Density of compacted layer	As per clause 14.0	One test per 500m ² area.	As per clause 16.1

Note: One test shall consist of 3 samples.

16 Acceptance Criteria

16.1 Field Density

The work shall be accepted as of quality, measured and paid in full if the field density does not work out to be less than 98% of the Design Laboratory Density worked out in Job Mix Formula in Clause 3.0 above. When the field density achieved in the Field is between 95% and 98% of the Design Laboratory Density, the work shall be accepted as not up to the standard and paid at reduced rate on pro-rata basis of Design Laboratory Density with full rate for 98% density as base.

When the field density works out to be less than 95% of the Design Laboratory Density, the surface shall be further consolidated till the required field density is achieved. If this is not found possible, the work represented by the sample shall be dismantled and redone by the Contractor at his own cost.

16.2 Surface Accuracy

The finished surface of Dense Asphaltic Concrete shall be true to level, grade and camber as per the approved drawings and the directions of the Engineer-in-Charge. When a straight edge of 3 metres length is placed longitudinally or transversely, the maximum deviation shall not be more than 3 mm in longitudinal and transverse directions.

The surface accuracy shall be checked immediately after rolling. Surface irregularities which fall outside specified tolerance limits as stipulated in above para shall be rectified by removing to full depth the affected area which shall not be less than 10 Sqm and relaying with fresh materials. In no case shall depressions be filled up with screenings or binding material.

17 Measurements:

- 17.1** Before commencement of laying of Dense Asphaltic concrete, levels shall be taken jointly by the Engineer-in-Charge or his representative and the Contractor at 3 m intervals both ways or closer as directed by the Engineer-in-Charge. These levels shall be recorded in the level book and plotted on the plan on tracing of polyester film/graph paper/plain computer sheet, as decided by the Engineer-in-Charge, by the Contractor at his own cost and the same shall be signed by the Contractor. Proposed formation levels of the finished Dense Asphaltic Concrete surface shall be marked at corresponding points. Tack coat shall then be applied and Dense Asphaltic Concrete shall then be laid and compacted to required levels (Tack coat shall be paid separately in the respective item of BOQ). Levels of the compacted bituminous surface shall be taken at grid points at which levels were recorded earlier in the level book and also plotted on the plan. Level books as well as the plan shall be signed by the Contractor as token of acceptance of the levels.
- 17.2** The volume of compacted mix shall be worked out in cubic meter correct to two places of a decimal as the product of the measured surface area and average thickness laid. Average thickness shall be worked out on the basis of actual levels. The length and breadth shall be measured correct to cm.
- 17.3** In case DAC is to be laid on SDAC newly laid under this contract, the finished levels of previous surface shall be taken as initial levels for this purpose.
- 17.4** Quantity for payment shall be the theoretical quantity (Based on Proposed formation levels) or the actual quantity (based on actual finished levels) whichever is less.

18 Rate

The rate shall include the cost of all materials, plant machinery and labour required in all operations described above including all carriage and lifts involved. The rate also includes all cost of setting up the laboratory at site and carrying out the quality control measures/tests enumerated above by the Contractor at his own cost in the presence of Engineer-in-Charge or his authorized representative and submission of test results on completion of tests to the Engineer-in-Charge thereof (The item of Tack Coat shall be paid separately and is not included in this item).

Item: Providing and laying of Hot Mix **Semi Dense Asphaltic Concrete (SDAC)** using crushed stone aggregate of quality, size and grading as specified and 2% cement by weight of aggregates as filler of quality as specified and Viscosity Grade Bitumen in proportions as per job mix formula and laid to specified levels, grade and camber as per specification, drawings and as directed by the Engineer-in-Charge including compacting with 8-10 tonne, preferably vibratory road roller of adequate capacity to achieve the specified values of compaction, strength, surface accuracy complete (for tendering purpose VG bitumen of grade (VG-10) content shall be taken as 114 kg/m³ of mix supplied in drum/ bulk produced by Govt. Refineries and 2% cement by weight of aggregates as filler material).

1 Materials

1.1 Coarse Aggregates

This shall consist of a crushed or broken from hard stone obtained from approved quarry. These shall be clean, strong, durable of fairly cubical shape and free from disintegrated, soft, friable, thin elongated or laminated pieces. This shall also be free from dirt, organic, deleterious material and any other foreign matter and adherent coatings. The grading of coarse aggregates shall conform to IS:383.

1.1.1 Physical Properties of Coarse Aggregate

The aggregate shall conform to the physical properties as mentioned in the table below:

S. No.	Property	Tests	Test Method	Frequency	Acceptance Criteria
1	Cleanliness	Grain Size Analysis	IS:2386 (Part.I)	Before approval of the quarry and at every subsequent change in the source of supply	Max. 5% passing 0.075mm sieve
2	Strength*	Aggregate impact value	IS:2386 (Part.IV)	Before approval of the quarry and at every subsequent change in the source of supply and one test for every 100m ³ of aggregates	Max.24%
		Los Angeles Abrasion value	IS:2386 (Part IV)	-do-	Max.30%

S. No.	Property	Tests	Test Method	Frequency	Acceptance Criteria
3	Durability	Soundness Loss with Sodium Sulphate for 5 cycles Loss with Magnesium Sulphate with 5 cycles	IS:2386 (Part V)	-do-	Max. 12% Max. 18%
4	Particle Shape	Flakiness & Elongation Index (Combined)	IS:2386 (Part I)	-do-	Max. 30%
5	Stripping	Coating and Stripping of Bitumen Aggregate	IS:6241	-do-	Minimum Retained Coating
6	Water absorption	Water absorption	IS:2386 Part III	-do-	Max.2%
7	#Water Sensitivity	**Retained Tensile strength	AASHTO 283	-do-	Minimum 80%

* The aggregate may satisfy either of the two tests.

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

The water sensitivity test is only required, if the minimum retained coating in stripping test is less than 95%. Where anyone or some of the above conditions cannot be satisfied, it is left to the Engineer-in-Charge to allow reasonable tolerances, with the approval of Competent Authority.

1.1.2 Anti-stripping Agent: Anti-stripping agent or additive if required shall be heat stable, shall not change the viscosity of the binder beyond specifications, shall contain no harmful ingredients, shall be added in recommended proportion by approved method and shall satisfy the requirements as stipulated in MORT&H Appendix-5. The cost of providing anti-stripping agent shall be borne by the contractor and nothing extra shall be paid on this account to the contractor.

1.2 Fine Aggregates

Fine aggregate shall consist of crushed or naturally occurring mineral material or combination of two, passing 2.36mm sieve and retained on 0.075mm sieve. The fine aggregate will be clean, hard, durable, dry, and free from dust and soft organic and other deleterious substances. Fine aggregates shall have sand equivalent value not less than 50 when tested in accordance with the requirement of IS:2720 Part 37. The Plasticity

Index of fraction of passing the 0.425mm sieve shall not exceed 4 when tested in accordance with IS:2720 Part 5.

1.3 Filler

The filler shall consist of cement of quality conforming to relevant IS code as approved by the Engineer-in-charge.

1.3.1 Cost Adjustment for Filler

For the purpose of tendering the contractor may base his rate assuming 2% cement as filler by weight of aggregates. If the actual quantity of cement required to be used, as per the design mix, is found to be different from the quantity of cement assumed above, necessary adjustment in cost of extra/short cement shall be made.

1.4 Bitumen

The bitumen shall be, Viscosity Grade Bitumen conforming to IS:73, supplied by Govt. refineries. The agencies shall submit copies of the purchase vouchers of the bitumen to the Engineer-in-Charge. Selection of VG grade bitumen shall be based upon the climatic conditions of the area as per below table:

<i>Lowest Daily Mean Air Temperature</i>	<i>Highest Daily Mean Air Temperature</i>		
	<i>Less than 20°C</i>	<i>20 to 30°C</i>	<i>More than 30°C</i>
More than -10°C	VG-10	VG-20	VG-30
-10°C or Lower	VG-10	VG-10	VG-20

2 Combined Grading of Aggregates

In order to satisfy the design requirements for the Semi Dense Asphaltic Concrete (SDAC) as laid down in para 3.0, the mix shall contain coarse aggregates, fine aggregates in suitable proportions. True and representative samples of the aggregates proposed to be used on specific job shall be tested in material testing lab (approved by Govt. institutions) and proper blend of individual aggregates normally available shall be worked out so that the gradation of the final composition shall satisfy the limits laid down in Table below:

Nominal Maximum Aggregate Size*	19mm
IS Sieve (mm)	Percentage by weight passing
26.5	100
19	90-100
13.2	59-79
9.5	52-72
4.75	35-55
2.36	28-44
1.18	20-34
0.6	15-27
0.3	10-20
0.15	5-13
0.075	2-8

3 Job Mix Formula (JMF)

Twenty days prior to the start of work at site, the job mix formula shall be got determined by the contractor in empanelled or Govt. Institute/laboratory as directed by the Engineer-in-Charge, by Marshall Design Method. The Job Mix Formula (JMF) so determined shall be submitted by the contractor, in writing, to the engineer-in-charge for his acceptance before the actual paving work starts at site. The Contractor also shall intimate, in writing, to the Engineer-in-Charge the details of source and location of all materials, their sizes, grading and test results. Besides conforming to the requirements of grading and quality for individual ingredients the mix shall meet the requirements enumerated below in Table below.

S.No.	Criteria	Value
1	No. of compaction blows on each side of Marshall specimen	75
2	Marshall stability in kN at 60°C	Not less than 9.0
3	Marshall flow value in mm for VG Bitumen	2-4

S.No.	Criteria	Value
4	Marshall Quotient for Viscosity grade Paving Bitumen(Ratio of Stability/Flow)	2-5
5	Percentage Voids in Mix (VIM)	3-5
6	Percentage voids in mineral aggregates filled with bitumen (VFB)	65-75%
7	Bitumen(Viscosity Grade) content by weight of mix	As determined in the Lab.
8	Design laboratory density (Bulk density of the Marshall mould)	As determined in the Lab.
9	Retained Marshall Stability on Immersion Test	Not less than 75%
10	Tensile Strength Ratio	Not less than 80%

Note: Design of mix should also meet the following criteria:

- a) A test track of minimum 7m wide and 90m length and shall be of the same depth specified for the construction of the course which it represents, laid and tested by the contractor before commencement of actual work. The core cut from the test track on testing shall give a stability and density of not less than 98% of the respective design values.

In case of any deficiency, necessary adjustment in Job Mix formula, Plant operation, placing procedures and rolling procedure shall be made and the test section shall be re-laid & tested. No extra payment shall be made on this account of making test track or changes in grading or any other changes, if any. Full production shall not begin until acceptable test track has been constructed and accepted, in writing, by the Engineer-in-Charge.

3.1 Revision of Job Mix Formula

The Job Mix Formula shall be revised if there is change in source of material and/or if it is noticed by the Engineer-in-Charge that grading of Individual aggregates has changed. The Job Mix Formula (JMF) so determined shall be submitted by the contractor, in writing, to the engineer-in-charge for his acceptance before the actual paving work starts at site with new source of material / grading. No extra payment shall be made to the contractor on this account.

3.2 Permissible Tolerances in the Job Mix Formula

S.No.	Description	Permissible Variation
1	Aggregate passing 19mm sieve or larger	±7%
2	Aggregate passing 13.2mm, 9.5mm	±6%
3	Aggregate passing 4.75mm	±5%
4	Aggregate passing 2.36mm, 1.18mm, 0.6mm	±4%
5	Aggregate passing 0.3mm, 0.15 mm	±3%
6	Aggregate passing 0.075mm	±1.5%
7	Binder content	±0.3%

4 Bitumen Content

The bitumen content of the mix shall be tested periodically and as directed by the Engineer-in-Charge using centrifugal extraction method or such method approved by the Engineer-in-Charge. The test shall generally be carried out in accordance with established practices and as directed by the Engineer-in-Charge. Whenever, there is a deviation in the resultant bitumen content from approved job-mix- formula values, it shall be reported to the Engineer-in-Charge immediately and necessary correction made at the job-mix plant as directed.

4.1 Cost adjustment for Bitumen

For the purpose of tendering, the Contractor may base his rate on the assumption that the bitumen content of the mixture shall be 114 Kg of bitumen per Cum. of total mix compacted to 100% density in Marshall mold. If the actual quantity of bitumen required to be used as a result of the laboratory test is found different from the quantity of bitumen that is assumed above, necessary adjustment in the cost of extra/short bitumen used shall be made from the rate specified at the time of tender and to the rate of purchase price of bitumen at the nearest IOC/HP/BP/Govt. Refinery. The procurement price of bitumen (Basic rate plus excise duty and sales tax & transportation charges) shall be ascertained by the Engineer-in-Charge on submission of documentary proof by the contractor. The rate of bitumen decided by the Engineer-

in-Charge shall be final and binding. Except adjustment in cost due to variation in bitumen consumption as stated above, no other factor whatsoever shall be considered for adjustment in quoted rates.

In the event of change in materials available at site due to unforeseen exigencies, a fresh job mix formula shall be arrived at within the specified limits in the empanelled laboratory as approved by the Engineer-in-Charge. Nothing extra is payable due to this.

Laboratory charges for the Job-mix formula design, costs of materials, its cartage and other incidental expenses shall be borne by the Contractor.

5 Mixing

All plants used by the contractor for the preparation of Semi Dense Asphaltic Concrete should be equipped with the following:

- i) Means for accurately weighing or measuring each batch of aggregates.
- ii) Bitumen tanks with arrangement of heating the material under effective and positive control at all times. In addition there should be satisfactory devices for weighing, metering of volumetric measurement of the bitumen to be used.
- iii) A mixer unit capable of producing uniform mixture.

The hot aggregate and binder shall be thoroughly and intimately mixed together in the correct proportion for at least 30 seconds or longer and until every particle of aggregates is completely coated and homogenous mixer is obtained. The total mixing time may be reduced but not less than 30 seconds in any case, if the Engineer-in-Charge is satisfied that thorough mixing can be achieved in less time. In such cases the contractor shall obtain prior written permission of the Engineer-in-charge.

6 Hot Mix Plant

The Hot Mix Plant (HMP) employed by the contractor shall be a weigh batch plant having a minimum capacity of 100 TPH. Hot Mix Plant with electronic control of minimum capacity of 100 TPH and capable of producing a proper quality mix shall be used for preparing the mix. The plant may be a batch type, having a coordinative set of essential units such as drier for heating the aggregate, devices for grading and batching/feeding by weight or volume the required quantities of aggregates. The plant shall also have a binder heating and control unit for metering out the correct quantities of heated binder together with the mechanical mixer for thorough mixing of the binder and the aggregates.

7 Temperature

7.1 Following temperatures shall be adhered to for VG bitumen at the different stages of work as mentioned in below Table:

<i>Bitumen Viscosity Grade</i>	<i>Bitumen Temperature °C</i>	<i>Aggregate Temperature °C</i>	<i>Mixed Material Temperature °C</i>	<i>Laying Temperature °C</i>	<i>*Rolling Temperature °C</i>
VG-40	160-170	160-175	160-170	150 Min.	100 Min.
VG-30	150-165	150-170	150-165	140 Min.	90 Min.
VG-20	145-165	145-170	145-165	135 Min.	85 Min.
VG-10	140-160	140-165	140-160	130 Min.	80 Min.

* Rolling must be completed before the mat cools to these minimum temperatures. At no time, shall the difference in temperature between the aggregates and the binder exceed 14°C, at no time shall bitumen or aggregates be overheated.

8 Transportation of Hot Mix

The Hot Semi Dense Asphaltic Concrete shall be transported from mixing plant to the site in clean vehicle. Every precaution shall be taken to avoid segregation of the hot mix and to ensure that they do not become contaminated with dust or foreign materials. In order to maintain satisfactory temperature of mix in transit, particularly in cold weather and to prevent undue loss of heat adequate precautions shall be taken by covering the material so that the materials are well protected during transportation. The temperature of the mix in every transporting vehicle shall be checked immediately prior to discharge of mix into the spreader and shall be ensured that the temperature is within the limits as specified in clause 7.0 above. If the temperature of mix in any transporting vehicle is not as per the limits specified in clause 7.0 above, the mix shall be rejected and shall be removed from site immediately.

9 Laying

Mix transported from the Hot Mix Plant to the site be spread by means of self-propelled electronic paver with electronic sensor & hydraulic control with suitable screeds capable of spreading, temping and finishing the mix true to the specified width and profile without calling segregation, dragging, bringing irregularities or other surface defects. The paver shall be capable of being operated at a speed consistent with a character of mix and the thickness of the course being laid so as to produce a surface of having uniform density and surface

texture. The thickness of the single compacted layer shall not exceed 75mm. The temperature of the mix at the time of laying shall be as per clause 7.0 above.

10 Weather Limitation

The bituminous mixture shall not be placed:

- i) In presence of standing water on the surface
- ii) When the rain is imminent and during rains, fog or dust storm.
- iii) When the binder course is damp.
- iv) When the air temperature on the surface on which it is to be laid is below 10°C.

11 Rolling

After the mix being spread, rolling shall be carried in three consecutive stages as below:

- a) Break down rolling
- b) Intermediate rolling
- c) Finish rolling

11.1 The initial or Break down rolling shall be done with 8-10 tonne dead weight smooth wheeled roller. The intermediate rolling will be done with smooth wheel pneumatic tyred roller of 12 to 15 tonne capacity having tyre pressure 7 kg/cm². Finish rolling shall be done with 8 to 10 tonne steel wheel roller.

Alternatively all the compaction operations i.e. break down rolling, intermediate rolling and finished rolling can be accomplished by using vibratory roller of 8 to 10 tonnes static weight. During the initial or breakdown rolling and finished rolling, the vibratory system shall be switched off. The joints and edges shall be rolled with 8 to 10 tonnes three wheeled static roller.

11.2 Rolling shall commence longitudinally at the sides and proceed towards center of the pavement, overlapping on successive trips by at least half the width of the rear wheels. Alternative trips of the roller shall be slightly of different lengths.

11.3 Break-down rolling shall preferably commence as soon as practicable after the mix is spread. The maximum breakdown temperature at which rolling can commence shall be determined by field trials. The attempt should be to obtain the maximum possible density.

11.4 The principal function of finish rolling is to remove roller marks. The surface shall be carefully examined for residual marks which should be cleanly rolled out. A neat finished appearance shall be obtained. Finish rolling shall be accomplished with tandem roller.

- 11.5** Rolling shall commence longitudinally at the sides and proceed towards center of the pavement, overlapping on successive trips by at least half the width of the rear wheels. Alternative trips of the roller shall be slightly of different lengths.
- 11.6** Break-down rolling shall preferably commence as soon as practicable after the mix is spread. The maximum breakdown temperature at which rolling can commence shall be determined by field trials. The attempt should be to obtain the maximum possible density.
- 11.7** The principal function of finish rolling is to remove roller marks. The surface shall be carefully examined for residual marks which should be cleanly rolled out. A neat finished appearance shall be obtained. Finish rolling shall be accomplished with tandem roller.

11.8 Speed of Rolling

The speed of rolling shall not exceed 4 - 5 km/hr to prevent adhesion of the mixture to the roller. The wheels shall be kept moist but excess of water shall not be permitted. The line of rolling shall not suddenly be changed, thereby displacing the mix. Roller shall not be left standing on the new surfacing.

11.9 Rolling Temperature

The range of temperature during rolling shall be as per clause 7.0 above. No rolling shall be allowed below 100°C in case of VG bitumen.

12 Joints

12.1 Longitudinal Joints

Longitudinal joints and edges shall be constructed true to the delineating line parallel to the centre line of runway. The longitudinal lane joints shall be truly vertical in straight lines which shall be continuous for the full length of the pavement, or in smooth curves around bends. The exposed vertical edges of the longitudinal lane joints shall be carefully cut back and trimmed to firm material in the compacted lane, or for a minimum of one and a half times the layer thickness, whichever is the greater. All debris/loose material arising from this operation shall be removed from the pavement and the underlying surface cleaned and painted with hot bitumen immediately before laying of the adjacent lane. Nothing extra shall be paid on this account.

12.2 Transverse Joints

They shall be formed at right angles to the longitudinal joints, and shall be truly vertical. The exposed vertical edges of the transverse joints shall be cut back and trimmed to firm material or for a distance of not less than 1-1/2 times the thickness of layer whichever is greater. All debris/loose material arising from this operation shall be removed from the pavement and the underlying surface cleaned. The exposed joints shall then be

cleaned and painted with hot bitumen immediately before the laying of the lane continues. Nothing extra shall be paid on this account.

13 Pavement Edges

Pavement shall be laid to correct width and alignment. To achieve straight and vertical edge, Contractor shall either use adequate side shuttering or cut back the edges to correct width and alignment by removing extra mix spread. Nothing extra shall be paid on this account.

13.1 Temporary Ramps

Temporary ramps at the end of each day work shall be made to allow smooth movement of air traffic and removal of ramp before start of next day work as per direction of Engineer-in-charge. Nothing extra shall be paid on account of provision / dismantling of ramps and nothing shall be deducted in case ramps are not required to be provided.

14 Determination of Field Density

The field density shall be determined by core cutting method using core cutting machine or by sand replacement method. Metallic tray of field density unit shall be kept on level spot of the finished pavement surface and a hole of 10cm dia. is cut in the entire thickness of the layer. All materials removed from the hole is carefully collected and weighed. A known weight of dry standard sand, passing 710 micron IS sieve and retained on 355 micron I.S. Sieve is taken in the sand pouring cylinder. The cylinder is kept directly over the hole and the shutter of the cylinder is released without any jerk and closed when the hole is filled with the sand. The quantity of the residual sand in the cylinder is weighed and the quantity filling the cone of the cylinder is determined.

The in-situ Field density of the layer is calculated as follows:

$$\text{Field Density} = \frac{A}{\{W - (W1 + W2)\}/d} \text{ gm/cm}^3$$

where,

- A = Weight of the materials removed from the hole.
- W = Initial weight of sand taken in the cylinder.
- W1 = Weight of the sand filling the cone of the cylinder.
- W2 = Weight of the sand remaining in the cylinder.
- d = Bulk density, gm/cm³ of sand.

15 Quality Control Tests for Semi Dense Asphaltic Concrete (SDAC):

Apart from the quality control tests given in clause 1.1.1, following additional tests shall be carried out as mentioned in the Table below:

S.No.	Test	Test method	Frequency	Acceptance Criteria
1.	Quality of binder	IS:73	Number of samples as per lot.	As per IS:73.
2.	Deleterious materials	IS:2386 (Part-III)	As required by the Engineer- in- charge.	As required by engineer-in-charge
3.	Mix grading	IS:2386 (Part-I)	One test for individual constituent and mixed aggregate from dryer for each 400 tonnes of mix subject to minimum of two tests per day per plant.	
4.	Stability of mix, flow value, density and void content.	ASTMD1559	3 tests for stability, flow value, density and void contents for each 400 tonnes of mix subject to minimum of two tests per day per plant.	
5.	Binder content	As per clause 4.0	One test for each 400 tonnes of mix subject to minimum of two tests per day per plant.	As per clause 3.2
6.	Density of compacted layer	As per clause 14.0	One test per 500 m ² area.	As per clause 16.1

Note: One test shall consist of 3 samples.

16 Acceptance Criteria

16.1 Field Density

The work shall be accepted as of quality, measured and paid in full if the field density does not work out to be less than 98% of the Design Laboratory Density worked out in Job Mix Formula in Clause 3.0 above.

When the field density achieved in the Field is between 95% and 98% of the Design Laboratory Density, the work shall be accepted as not up to the standard and paid at reduced rate on pro-rata basis of Design Laboratory Density with full rate for 98% density as base. When the field density works out to be less than 95% of the Design Laboratory Density, the surface shall be further consolidated till the required field density

is achieved. If this is not found possible, the work represented by the sample shall be dismantled and redone by the Contractor at his own cost.

16.2 Surface Accuracy

The finished surface of Semi Dense Asphaltic Concrete shall be true to level, grade and camber as per the approved drawings and the directions of the Engineer-in-Charge. When a straight edge of 3 m length is placed longitudinally or transversely, the maximum deviation shall not be more than 3 mm in longitudinal and transverse directions.

The surface accuracy shall be checked immediately after rolling. Surface irregularities which fall outside specified tolerance limits as stipulated in above para shall be rectified by removing to full depth the affected area which shall not be less than 10 sqm and relaying with fresh materials. In no case shall depressions be filled up with screenings or binding material.

17 Measurements:

- 17.1** Before commencement of laying of Semi Dense Asphaltic concrete, levels shall be taken jointly by the Engineer-in-Charge or his representative and the Contractor at 3 m intervals both ways or closer as directed by the Engineer-in-Charge. These levels shall be recorded in the level book and plotted on the plan on tracing of polyester film/graph paper/plain computer sheet, as decided by the Engineer-in-Charge, by the Contractor at his own cost and the same shall be signed by the Contractor. Proposed formation levels of the finished Dense Asphaltic Concrete surface shall be marked at corresponding points. Tack coat shall then be applied and Dense Asphaltic Concrete shall then be laid and compacted to required levels (Tack coat shall be paid separately in the respective item of BOQ). Levels of the compacted bituminous surface shall be taken at grid points at which levels were recorded earlier in the level book and also plotted on the plan. Level books as well as the plan shall be signed by the Contractor as token of acceptance of the levels.
- 17.2** The volume of compacted mix shall be worked out in cubic meter correct to two places of a decimal as the product of the measured surface area and average thickness laid. Average thickness shall be worked out on the basis of actual levels. The length and breadth shall be measured correct to cm.
- 17.3** In case SDAC is to be laid on Dense Bituminous macadam (DBM) newly laid under this contract, the finished levels of previous surface shall be taken as initial levels for this purpose.
- 17.4** Quantity for payment shall be the theoretical quantity (Based on Proposed formation levels) or the actual quantity (based on actual finished levels) whichever is less.

18 Rate

The rate shall include the cost of all materials, plant machinery and labour required in all operations described above including all carriage and lifts involved. The rate also includes all cost of setting up the laboratory at site and carrying out the quality control measures/tests enumerated above by the Contractor at his own cost in the presence of Engineer-in-Charge or his authorized representative and submission of test results on completion of tests to the Engineer-in-Charge thereof (The item of Tack Coat shall be paid separately and is not included in this item).

Item: Providing and laying in position **Polysulphide sealant** of approved make conforming to BS-5212-1990 or IS:11433-1995. in expansion/ construction/dummy joints including rounding off edges, applying 2 coats of approved primer compatible with the brand of Polysulphide and preparing the surface and applying masking tape along the edge of joint to prevent accidental spillage of sealant on top surface and to give neat finish to the sealant and removing the masking tape after application of sealant etc. complete as per direction of Engineer in- Charge & particular specifications.

[Note: For purpose of payment, quantity (Length x Width x Depth) of Polysulphide sealant only will be measured] unit cm³

- a) Expansion Joints of size 25 mm wide and 10 mm deep over 30 mm dia. closed-cell Polyethylene foam back-up rod, as per manufacturer's specifications and sketch at Appendix-'A'.
- b) Construction Joints of size 10 mm wide and 10 mm deep over 12 dia. closed-cell Polyethylene foam back-up rod, as per manufacturer's specifications and sketch at Appendix-'A'.
- c) Transfers Joints of size 10 mm wide and 10 mm deep over 12 mm dia. closed-cell Polyethylene foam back-up rod, as per manufacturer's specifications and sketch at Appendix-'A'.

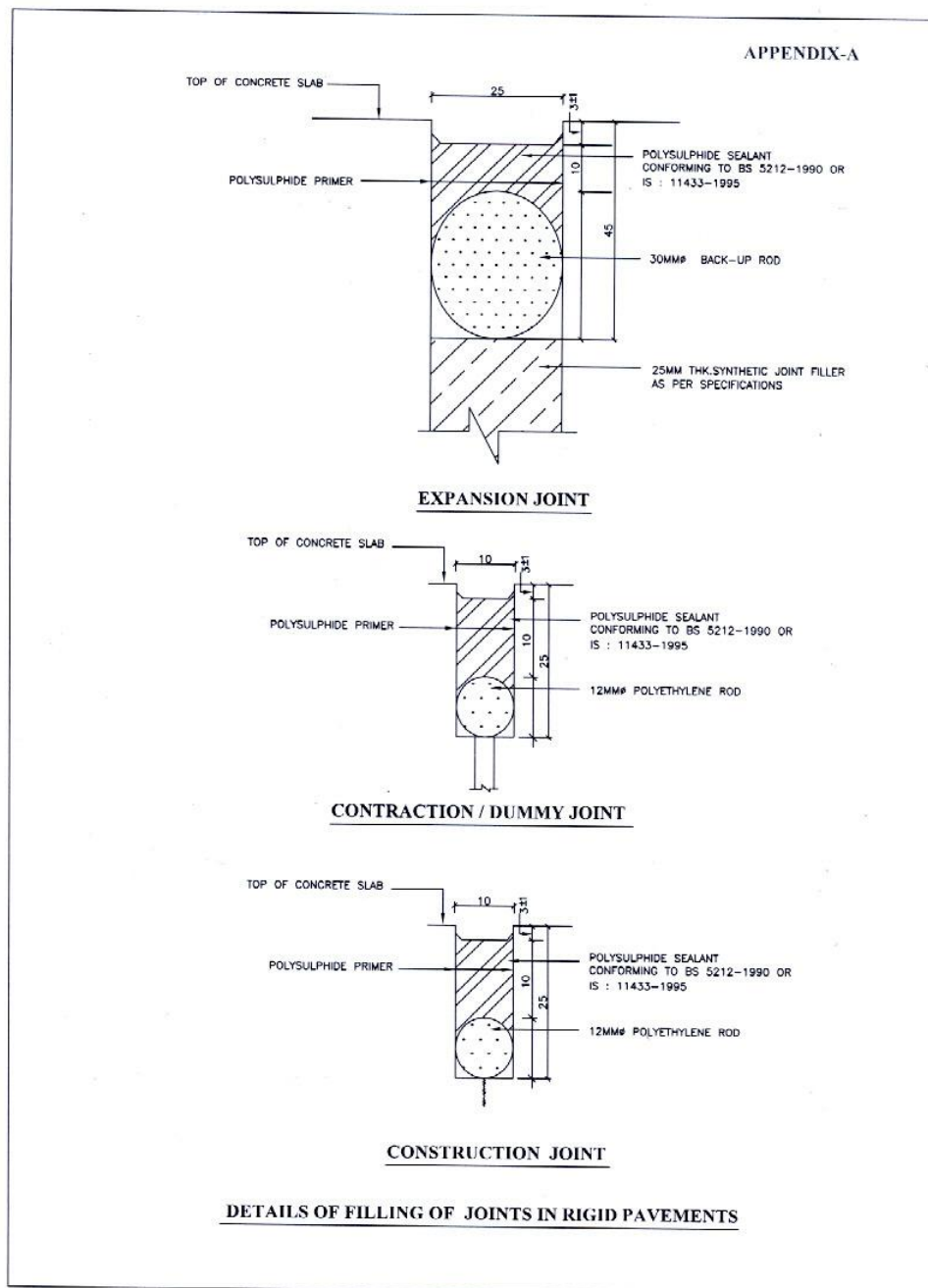
Procedure:

- Preparation of Surface: All the joint surfaces to which the sealant is to be applied should be clean, dry and free from any loose material, dirt, dust, scale, protective lacquer, grease.
- Expansion joint filler material must be checked to ensure that it is tightly packed and no gaps or voids exist at the base of the joint slot.
- Sealant should be prepared as per manufacturer's specifications.
- Before sealant is applied, primer shall be applied to secure better adhesion between sealant and the concrete surface. The surface shall be allowed to dry for at least 30 minutes but no longer than 3 hours before the sealant is applied.
- To prevent accidental spillage of sealant on the top surface and to give a neat finish, masking tape should be applied along the edge of joint before the sealant material is filled.
- Immediately after filling the joints, the sealant should be tooled either with a stainless steel or wooden spatula of the size of the joint to give a smooth surface. While tooling, the spatula should be wetted with a wetting agent like soap water. Masking tape shall be removed immediately after the sealant has been tooled. By tooling, the sealant is compressed with the result that air bubbles if any, are broken up and the sealant becomes free of voids and there is a proper adhesion of the sealant to the sides of the joints.
- Sealant of approved make shall be filled only after complete curing. Sealant shall be applied slightly to a lower level than the slab with a tolerance of 3+1mm as shown in Appendix –'A'.
- Sealant of approved make shall be filled up for a depth as specified in item. The rate of application of sealant may be calculated on the basis of the following formula:

$$\text{Number of 1 Kilogram tins required} = 0.0015 \times L \times W \times D$$

- Manufacturer's certificate shall be produced for establishing that the sealant is not more than six months old or the shelf-life of the sealant. For storage, preparation of sealant, health and safety precautions etc., manufacturer's specifications shall be applicable.

Appendix A



Item: Particular specification for **Granular Sub-base**

1 Scope

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

2 Materials

- 2.1 The material to be used for the work shall be natural sand, moorum, gravel, crushed stone, crushed stone grit / dust or combination thereof depending upon the grading required. The material shall be free from organic or other deleterious constituents and conform to one of the grading given in Table below.

IS Sieve	Per cent by weight passing the IS sieve
26.5 mm	100
9.50 mm	65 – 95
4.75 mm	50 – 80
2.36 mm	40 – 65
0.425 mm	20 – 35
0.075 mm	3 - 10
CBR Value (Minimum)	30

Note: The material passing 425 micron (0.425 mm) sieve when tested according to IS: 2720 (Part 5) shall have liquid limit and plasticity index not more than 25 and 6 per cent respectively.

2.2 Physical Requirements

The material shall have a 10 per cent fines value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS:812 (Part 111). The water absorption value of the coarse aggregate shall be determined as per IS:2386 (Part 3); if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS : 383.

3 Strength of Sub-Base

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

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

4 Construction Operations

4.1 Preparation of subgrade:

Immediately prior to the laying of sub-base, the subgrade already finished shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80 –100 kN smooth wheeled roller.

4.2 Spreading and Compacting:

The sub-base material of grading specified in the Contract shall be spread on the prepared sub grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer.

When the sub-base material consists of combination of materials mentioned in Clause 1.2.1, mixing shall be done mechanically by the mix-in-place method. Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.

Moisture content of the loose material shall be checked in accordance with IS:2770 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above to 2 per cent below the optimum moisture content corresponding to IS : 2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavator until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer up to 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum or pad foot drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7 MN/m² or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall and super-elevation and shall commence at the edges and progress towards the center for portions having crossfall on both sides.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material determined as per IS:2770 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

5 Surface Finish and Quality Control of Work

5.1 Surface Evenness

The surface finish of construction shall conform to the requirements of relevant clause(s) of MoRTH Specifications.

5.2 Quality Control

Control on the quality of materials and works shall be exercised by the Engineer-in-charge in accordance with relevant clause(s) of MoRTH specifications.

6 Measurement of Payment

Granular sub-base shall be measured as finished work in position in cubic metres, by the level computation method. The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

7 Rate

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations described in this particular specification.

Particular specification for preparation of subgrade: (All clauses mentioned here refers to MORTH specifications)

1. Execution procedure:

When the subgrade is cut section, the natural ground shall be cut to the bottom level of subgrade and the natural ground below subgrade bottom shall be tested for lab and field density. If the percentage compaction is below 95%, the ground shall be loosened at least for 250 mm and compacted to achieve 95% compaction. Once the ground is ready, the subgrade shall be constructed in two layers, each of 250 mm thickness. Each layer shall be compacted to 98% of maximum dry density. This procedure has also been illustrated in the drawing which is attached in the tender drawings.

2. Material and properties:

All trees, stumps, etc., falling within excavation and fill lines shall be cut to such depth below ground level that in no case these fall within 500 mm of the bottom of the subgrade. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the subgrade shall be removed between fill lines to the satisfaction of the Engineer. Materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability. Maximum laboratory dry unit weight when tested as per IS:2720 (Part 8) is 17.5 kN/cu.m as per Table 300-1 of MORTH specifications.

The following types of material shall be considered unsuitable:

- a) Materials from swamps, marshes and bogs;
- b) Peat, log, stump and perishable material; any soil that classifies as OI, OI, OH or Pt in accordance with IS:1498;
- c) Materials susceptible to spontaneous combustion;
- d) Materials in a frozen condition;
- e) Clay having liquid limit exceeding 50 and plasticity index exceeding 25; and
- f) Materials with salts resulting in leaching.

Expansive clay exhibiting marked swell and shrinkage properties ("free swelling index" exceeding 50 percent when tested as per IS:2720 - Part 40) shall not be used as a subgrade material.

Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO₃) per litre when tested in accordance with BS:1377, Part 3, but using a 2:1 water-soil ratio shall not be deposited within 500 mm distance (or any other distance described in the Contract), of permanent works constructed out of concrete, cement bound materials or other cementitious material.

Materials with a total sulphate content (expressed as SO₃) exceeding 0.5 percent by mass, when tested in accordance with BS:1377, Part 3 shall not be deposited within 500 mm, or other distances described in the Contract, of metallic items forming part of the Permanent Works.

The size of the coarse material in the mixture of earth shall ordinarily not exceed 50 mm when placed in the sub-grade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the placement of fill material and its

compaction to the requirements of these Specifications. The maximum particle size in such cases, however, shall not be more than two-thirds of the compacted layer thickness.

The material to be used in subgrade shall satisfy design CBR at the specified dry density and moisture content. In case the available materials fail to meet the requirement of CBR, use of stabilization methods in accordance with Clauses 403 and 404 of MORTH or by any stabilization method approved by the Engineer shall be followed.

The Contractor shall at least 7 working days before commencement of compaction submit the following to the Engineer for approval:

- i) The values of maximum dry density and optimum moisture content obtained in accordance with IS:2720 (Part 8), appropriate for each of the fill materials he intends to use.
- ii) A graph of dry density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.

The maximum dry density and optimum moisture content approved by the Engineer shall form the basis for compaction.

3 Construction Operations

3.1 Setting Out

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

3.2 Dewatering

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

3.3 Stripping and Storing Topsoil

When so directed by the Engineer, the topsoil from all areas of cutting and from all areas to be covered by embankment foundation shall be stripped to specified depths not exceeding 150 mm and stored in stockpiles of height not exceeding 2 m for covering embankment slopes, cut slopes and other disturbed areas where re-vegetation is desired. Topsoil shall not be unnecessarily subjected to traffic either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

3.4 Compacting Ground Supporting Embankment/Sub-Grade

Where necessary, the original ground shall be levelled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling in accordance with Clauses 305.3.5 and 305.3.6 so as to achieve minimum dry density as given in Table 300-2.

In case where the difference between the sub-grade level (top of the sub-grade on which pavement rests) and ground level is less than 0.5 m and the ground does not have 97 percent relative compaction with respect to the dry density (as given in Table 300-2), the ground shall be loosened upto a level 0.5 m below the sub-grade level, watered and compacted in layers in accordance with Clauses 305.3.5 and 305.3.6 to achieve dry density not less than 97 percent relative compaction as given in Table 300-2.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation (500 mm portion just below the sub-grade) shall be removed, suitably disposed and replaced by approved materials laid in layers to the required degree of compaction.

Any foundation treatment specified for embankments especially high embankments, resting on suspect foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the Engineer. Where the ground on which an embankment is to be built has any of such material types (a) to (f) in Clause 305.2.1.1 at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.

3.5 Spreading Material in Layers and Bringing to Appropriate Moisture Content

3.5.1 The embankment and sub-grade material shall be spread in layers of uniform thickness in the entire width with a motor grader. The compacted thickness of each layer shall not be more than 250 mm when vibratory roller/vibratory soil compactor is used and not more than 200 mm when 80-100 kN static roller is used. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slope and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as in Table 300-2 and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross-section of the embankment.

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

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

Moisture content of each layer of soil shall be checked in accordance with IS:2720 (Part 2), and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of

compaction it is in the range of 1 percent above to 2 percent below the optimum moisture content determined in accordance with IS:2720 (Part 8) as the case may be. Expansive clays shall, however, be compacted at moisture content corresponding to the specified dry density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.

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

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

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

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

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

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

3.6 Compaction

Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Static three-wheeled roller, self propelled single drum vibratory roller, tandem vibratory roller, pneumatic tyre roller, pad foot roller, etc., of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

The compaction shall be done with the help of self-propelled single drum vibratory roller or pad foot vibratory roller of 80 to 100 kN static weight or heavy pneumatic tyre roller of adequate capacity capable of achieving the required compaction. The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for the site trials shall be submitted to the Engineer for approval.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.

Each layer of the material shall be thoroughly compacted to the densities specified in Table 300-2. Subsequent layers shall be placed only after the finished layer has been tested according to Clause 903.2.2

and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture/density gauge used in accordance with agreed procedure and provided the gauge is calibrated to give results identical to that obtained from tests in accordance with IS:2720 (Part 28). A record of the same shall be maintained by the Contractor.

When density measurements reveal any soft areas in the embankment/sub-grade/earthen shoulders, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted using appropriate mechanical means such as light weight vibratory roller, double drum walk behind roller, vibratory plate compactor, trench compactor or vibratory tamper to the density requirements and satisfaction of the Engineer.

3.7 Drainage

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

3.8 Repairing of Damages Caused by Rain/Spillage of Water

The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density in accordance with Clause 305.3.6. If the cut is not sufficiently wide for use of required mechanical means for compaction, the same shall be widened suitably to permit their use for proper compaction. Tests shall be carried out as directed by the Engineer to ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery/equipment for the purpose.

3.9 Finishing Operations

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

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

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

When earthwork operations have been substantially completed, the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated.

5 Plying of Traffic

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

6 Surface Finish and Quality Control of Work

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

7 Sub-grade Strength

7.1 It shall be ensured prior to actual execution that the material to be used in the sub-grade satisfies the requirements of design CBR.

7.2 Sub-grade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed sub-grade shall be determined on remoulded samples, compacted to the field density at the field moisture content and tested for soaked/unsoaked condition as specified in the Contract.

8 Measurements for Payment

8.1 Earth embankment/sub-grade construction shall be measured separately by taking cross sections at intervals given in Sub-Section 113.3 after completion of clearing and grubbing and after completion of embankment/sub-grade. The volume of earthwork shall be computed in cubic metres by the method of average end areas.

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

8.3 The embankment constructed with fly ash will be measured in cu.m, separately for the fly ash portions and for the soil cover and intervening layers of soil, unless otherwise specified in the Contract.

8.4 Construction of embankment under water shall be measured in cu.m.

8.5 Construction of high embankment with specified material and in specified manner shall be measured in cu.m.

8.6 Stripping including storing and reapplication of top soil shall be measured in cu.m.

8.7 Work involving loosening and recompacting of ground supporting embankment/sub-grade shall be measured in cu.m.

8.8 Removal of unsuitable material at embankment/sub-grade foundation and replacement with suitable material shall be measured in cu.m.

8.9 Scarifying existing granular/bituminous road surface shall be measured in square metres.

8.10 Dismantling and removal of existing cement concrete pavement shall be measured vide Clause 202.6.

9 Rates

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

- i) Cost of arrangement of land as a source of supply of material of required quantity for construction unless provided otherwise in the Contract;
- ii) Setting out;
- iii) Compacting ground supporting embankment/sub-grade except where removal and replacement of suitable material or loosening and recompact is involved;
- iv) Scarifying or cutting continuous horizontal benches 300 mm wide on side slopes of existing embankment and sub-grade as applicable;
- v) Cost of watering or drying of material in borrow areas and/or embankment and sub-grade during construction as required;
- vi) Spreading in layers, bringing to appropriate moisture and compacting to Specification requirements;
- vii) Shaping and dressing top and slopes of the embankment and sub-grade including rounding of corners;
- viii) Restricted working at sites of structures;
- ix) Working on narrow width of embankment and sub-grade;
- x) Excavation in all soils from borrow pits/designated borrow areas including clearing and grubbing and transporting the material to embankment and sub-grade site with all leads and lifts unless otherwise provided for in the Contract;
- xi) All labour, materials, tools, equipment and incidentals necessary to complete the work to the Specifications; xii) Dewatering; and
- xiii) Keeping the embankment/completed formation free of water as per Clause 311.
- xiv) Transporting unsuitable excavated material for disposal with all leads and lifts.

9.2 Clause 301.9.5 shall apply as regards Contract unit rates for items of stripping and storing top soil including reapplication of topsoil.

9.3 Clause 301.9.2 shall apply as regards Contract unit rate for the item of loosening and recompact the embankment/sub-grade foundation.

9.4 Clauses 309.1.1 and 305.8 shall apply as regards Contract rates for items of removal of unsuitable material and replacement with suitable material, respectively.

Drawings

1. Runway Profile
2. Typical details of security fencing
3. Typical Bank Protection Details
4. Typical French Drain Details.
5. Subgrade preparation cross section details
6. Overall Plan
7. Site office drawing, site lab drawing, toilet.

Supplementary Information Regarding Works to Be Procured

- Re-surfacing of runway (Length 1200 m, Width 30m).
- Extension of runway (500 m)
- RESA 90 m (one end only)
- Taxiway-overlay.
- Apron overlay and shoulder widening
- Marking to be done for Runway, Taxiways and Apron.
- Runway and Taxiway strip to be leveled.
- Gabion wall for river protection and sub-surface drainage works
- Service road from terminal building to Apron and footpath with railing.
- Security fencing
- French drain as required

Personnel Requirements

Using Form PER - 1 and PER - 2 in Section 4 (Bidding Forms), the Bidder must demonstrate that it has personnel who meet the following requirements:

No.	Position	Qualification	Nos.	<i>Experience In Similar Work [years]</i>
1.	Project Engineer	<u>B.E./ B.Tech Civil</u>	1	Minimum 5 yrs. in Bituminous work in Airport
2.	Civil Engineer	<u>B.E./B.Tech</u>	2	Minimum 2 yrs. Experience in Bituminous work in Airport/ National Highways
3.	Material Engineer	<u>Minimum Diploma</u>	1	Min. 2 yrs. experience in Bituminous Works in Airport/ National Highways
4.	Surveyor		1	Min. 5 yrs. experience in Total Station, Digital Leveling.

- Work Experience should be certified from competent authority must be submitted without which the proposed personal will not be considered for evaluation.
- Sufficient Supervisor, Operators, Lab Assistants, Survey Helpers and Labourers shall be provided for working at site and plant as directed by the Engineer-In-Charge.

Equipment Requirements

Using Form EQU in Section 4 (Bidding Forms), the Bidder must demonstrate that it has the key equipment listed below:

- **List of machineries to be deployed by the contractor (For Qualifying Criteria)**

No.	Equipment Type and Characteristics	Minimum Number Required	Remarks
1.	Computerized Bitumen Hot Weigh Batch mix plant of reputed manufacturer having a minimum 5 years of experience in manufacturing of above type of plant. (The plant manufacturer's credentials should be submitted along with bid for client's approval.)	1 No. 60/70 Ton	Qualifying criteria as per section III. Clause 1.1
2.	Electronic Operated Sensor paver of reputed manufacturer having a minimum 5 years of experience in manufacturing of above type of plant	1 Nos. (width around 5 m)	Qualifying criteria as per section III. Clause 1.1
3.	Mechanical Paver	1 No.	Qualifying criteria as per section III. Clause 1.1
4.	Vibratory Roller (8 – 10 T)	Minimum 2 Nos.	Qualifying criteria as per section III. Clause 1.1
5.	Pneumatic Roller (12-15T with tier Pressure of 0.56 MPa)	Minimum 2 Nos.	Qualifying criteria as per section III. Clause 1.1
6.	Tipper / Dumpers 16cu.m capacity	Minimum 5 Nos.	Qualifying criteria as per section III. Clause 1.1

No.	Equipment Type and Characteristics	Minimum Number Required	Remarks
7.	Truck mounted Mechanical Bitumen sprayer	1 Nos.	Qualifying criteria as per section III. Clause 1.1
8.	Front end Loader of bucket capacity of approx. 1 cum	2 Nos.	Qualifying criteria as per section III. Clause 1.1
9.	Concrete Joint cutting machine	1 Nos.	Qualifying criteria as per section III. Clause 1.1 (1 no)
10.	Excavator	2 No.	Qualifying criteria as per section III. Clause 1.1
11.	Air compressor	1 No.	Qualifying criteria as per section III. Clause 1.1
12.	Water tanker (10,000 Ltr. capacity)	1 No.	Qualifying criteria as per section III. Clause 1.1
13.	Road marking/Painting machine	1 No.	Qualifying criteria as per section III. Clause 1.1
14.	Earth compactor (not more than 5 years old)	1 No.	Qualifying criteria as per section III. Clause 1.1

• **Laboratory Equipment's** required (For Qualifying Criteria)

No.	Equipment Type and Characteristics	Minimum Number Required	Remarks
A.	General		
1.	Electric Oven, Electric hot plate, Kerosene or gas stove.	1 No. each	Qualifying criteria as per section III. Clause 1.1
B.	Apparatus for testing of Bituminous Concrete		
1.	Marshall testing equipment	1 No.	Qualifying criteria as per section III. Clause 1.1
2.	Water bath	1 No.	Qualifying criteria as per section III. Clause 1.1
3.	Binder Extraction equipment (Centrifugal extractor)	1 No.	Qualifying criteria as per section III. Clause 1.1
4.	Bitumen Core cutting equipment	1 No.	Qualifying criteria as per section III. Clause 1.1
5.	Concrete compression testing machine	1 No.	Qualifying criteria as per section III. Clause 1.1

- **List of Other Machineries** to be deployed by the contractor

No.	Equipment Type and Characteristics	Minimum Number Required
1.	Computerized concrete Weigh Batch mix plant	30 Ton / Hour
2.	Tractor mounted sweeper	2 Nos.
3.	Concrete Breaker	1 No.
4.	Milling Machine	1 No.

- **List of Laboratory** Equipment Required:

No.	Equipment Type and Characteristics	Minimum Number Required
A.	General	
1.	Electric Oven, electric hot plate, Kerosene or gas stove.	1 No. each
2.	Balance 20 kg capacity-self indicating type	1 No.
3.	Electronic Balance 5 Kg capacity 0.5 gm	2 Nos.
4.	Thermometers: Mercury-in glass thermometer range 0 to 250°C. Mercury-in steel thermometer with 30 cm stem, range up to 300°C.	2 Nos.
5.	Complete Set of IS sieves with lid and	2 Sets.
6.	200 mm diameter: 2.36mm, 2.0mm, 1.18mm, 600 micron, 425 micron, 300 micron, 150 micron and 75 micron and any other sieve required at site.	2 Sets.
7.	Water Testing Kit	1 Set
8.	First Aid Box	1 Set
B.	Apparatus for aggregates and soil	

No.	Equipment Type and Characteristics	Minimum Number Required
1.	Aggregate Impact Value Test apparatus	1 Set
2.	Flakiness and Elongation Test Gauges.	1 Set
3.	Standard measure of 30, 15 and 3 liters capacity along with standard tamping rod.	2 Set.
4.	Mold for cube test & Beam molds	12 Nos.
5.	Slump Cone	1 No.
6.	Atterberg Limits (liquid and plastic limits) determination apparatus.	1 Set
7.	Compaction Test Equipment 4.5kg hammer (Heavy compactive effort).	1 Set
8.	CBR testing machine complete set	1 No.
9.	Dry Bulk Density Test apparatus (sand pouring cylinder, tray, can etc.) complete.	1 Set
10.	Speedy Moisture Meter Complete with chemicals	1 Set
11.	Core cutter apparatus 10cm dia, 10/15 cm height, complete with dolly, rammer etc.	1 Set
12.	Straight edge with wedge	1 No.
C.	Surveying instruments	
1.	Total stations Auto-leveling Instrument with staff	1 Set
2.	Steel Tapes 30 meters, 15 meters and 5 meters	2 Nos. each

Additional conditions for Operational Area

1 General

- i) Special conditions of Contract shall be read in conjunction with General Conditions of Contract, Technical Specifications, Drawings and any other documents forming part of this contract wherever the context so requires.
- ii) Notwithstanding the sub-division of the documents into these separate sections and volume every part of each shall be deemed to be supplementary to and complementary of every other part and shall be read with and into the CONTRACT so far as it may be practicable to do so.
- iii) Where any portion of the General Condition of Contract is repugnant to or at variance with any provisions of the Special Conditions of Contract, unless a different intention appears, the provisions of the Special Conditions of Contract shall be deemed to over-ride the provisions of the General Conditions of Contract and shall to the extent of such repugnancy, or variations, prevail.

2 Completion schedule

- i) The works shall be executed strictly as per time schedule mentioned in NIT. Contractor shall have to plan his construction program and activities so as to complete the work in the stipulated period. The period of completion given includes the time required for mobilization as well as testing, rectifications, if any, re-testing and completion in all respects to the entire satisfaction of Engineer-in-Charge.
- ii) The contractor shall furnish within 7 days of letter of award, completion programme by showing the milestones for the work of *“Runway resurfacing and extension in Bumthang Domestic Airport”*. This shall follow with detailed programme which shall commensurate with the above completion milestones, giving the procurement schedule, deployment of Manpower and Machinery, Resources shall be submitted for achieving the targeted progress. The programme shall be subject to the approval of Engineer-in-Charge who may order changes in the programme. The decision of Engineer-in-Charge shall be final and binding in this regard.
- iii) Contractor is expected to mobilize and employ sufficient resources as indicated in the agreed milestones program to achieve the progress within the broad frame work of accepted methods of working and safety. In time and progress chart, deployment of machineries, equipment, apparatus and instruments are to be treated as one of the sections of the work.

- iv) No additional payment shall be made to the contractor for any multiple shift work or other incentive methods contemplated by him in his work schedule even though the time schedule is approved by the Engineer-in-Charge.
- v) During the currency of the work the contractor is expected to adhere to the time schedule on milestone and total completion and this adherence will be a part of Contractor's performance under the contract.
- vi) The Engineers-in-Charge can hold the payment till such time; the contractor does not submit CPM/Milestone Chart/Construction Equipment Program etc. The Contractor will be fully responsible to submit Milestone Chart in consultation with Engineer-in-Charge to complete the work within stipulated time.

For Monitoring of Project

- The contractor shall submit the program Network based on Critical Path Method using precedence Diagram method to complete the work with in stipulated time schedule.
- The contractor shall submit weekly details of manpower and machinery to be deployed in project along with material procurement schedule for completion of work with in stipulated period based on program Networking. The progress will be reviewed weekly with respect to the program/Net Work chart submitted by contractor. Two copies of proposed network chart showing activities completed and backlog if any, should be submitted to the Engineer-in-Charge on weekly basis. The revised BAR chart with additional manpower/machinery/ labour deployment scheduled should also be submitted in case regular backlog is observed and revised program is essential to complete the work with in stipulated period.
- The approval to the revised schedule resulting in a completion date beyond the stipulated date of completion shall not automatically amount to grant of extension of time to the Contractor.
- Contractor shall submit fortnightly progress reports (3 copies) highlighting status of various activities and physical completion of work.
- vii) The contractor shall execute the Taxiway A work at the critical zone. A separate methodology shall be submitted based on the resources and timeline.
- viii) Contractor shall give every day report on category wise labour and equipment deployed along with the progress of work done on previous day in the Pro forma prescribed by the Engineer-In-Charge.

3 Drawings and documents

- i) The drawings accompanying the tender document are of indicative nature and issued for tendering purpose with the purpose to enable the tenderer to make an offer in line with the requirements.
- ii) However, no extra claim whatsoever, shall be entertained for variation in the "approved for construction" and "tender drawings" regarding any changes. The execution of work shall be as per approved drawings and detailed specifications.

4 Bill of quantities

- i) The bill of quantities shall be read in conjunction with general conditions of contract, special conditions of contract, technical specifications, drawings and any other document forming a part of this tender. The quantities shown against the various items are only approximate and subject to variations as made in general conditions of the contract.

5 Temporary works

- i) The tenderer should see the approaches and conditions of the same. If any approach from main road is required at site or existing approach is to be made and maintained for cartage of materials etc. by the contractor, the same shall be provided, improved and maintained by the contractor at his own cost.
- ii) All temporary and ancillary works including enabling works connected with the work shall be responsibility of the contractor and the price quoted by them shall be deemed to have included the cost of such works which shall be removed by the contractor at his cost, immediately after completion of the work.
- iii) In case of transportation of mix by vehicles, Contractor has to use airport roads in Operational area, then any damage done / day-do-day cleaning of road to be made good as per direction of Engr.-in-charge by the contractor at his own cost.
- iv) All the salvageable materials received after demolitions are to be stacked properly and handed over to Engineer-in-Charge. These dismantled materials shall be the property of the DoAT.
- v) Site to the contractor shall be made available in phases and contractor shall be liable to dismantle / relocate any of the structures fouling with the proposed site as per instruction by the Engineer-in-Charge.

6 Payments

- i) The intervals as provided on or before the date fixed by the engineer-in-charge for all the works executed since previous bill in accordance with provision. The contractor shall submit all the bills on the Performa prescribed by the Engineer-in-Charge, preferably through computerized billing in triplicate.
- ii) The payment due to the contractor shall be made within 30 days of the submission of the bill by the contractor and the measurements shall be verified by the Engineer-in-Charge or his representative within 10 days of submission of the bill.
- iii) The bill shall not be entertained if the gross amount of the work done including secured advance payable is less than Nu. 2.500 million Except final Bill.

7 Water

- i) Contractor Shall Make His Own Arrangements for Water Supply For The Work And His Staff And Workmen.

8 Power Supply

- i) Contractor shall make his own arrangements for power supply for the execution of the work.

9 Construction Equipment

- i) The contractor shall without prejudice to his overall responsibility to execute and complete the work as per specifications and time schedule deploy adequate equipment and tools and tackles and augment the same as decided by the engineer-in-charge depending on the exigencies of the work so as to suit the construction schedule.

Note:

- Apart from the tools and plants quantity specified in the list of machinery, contractor is required to deploy additional machinery if required and directed by engineer – in – charge to ensure timely completion of work.
- In the interest of progress of work, if early deployment of any machinery / equipment is desired by engineer –in- charge then the contractor shall deploy the same as per the direction of engineer – in charge. For such early deployment no claim whatsoever shall be entertained.

ii) Equipment's for night working:- (if required)

Due to restricted working hours in the day in view of operational reasons, the contractor shall execute the work between 1.00 PM to next day morning 5 AM. For proper execution, the work site shall be properly illuminated and the following arrangement shall be made by the contractor at his own expenses:-

- Two Nos. of DG sets of 25 KVA capacity of each with mobile arrangement to give illumination of 16 nos. of 1000 watt halogen lamps with suitable wiring shall be installed at the work site.
- Pumps with Gensets to bail out water/mud encountered during excavation of earth i.e. dewatering wherever required.

iii) No Construction equipment shall be supplied by the DoAT

10 Site Organization

- i) Subject to the provisions in the tender document and without prejudice to contractors liabilities and responsibilities to provide adequate qualified and skilled personnel on the work. Contractor shall deploy site organization and augment the same as decided by the engineer-in-charge depending on the exigencies of work. No engineering personnel deployed at site shall be removed from the site without prior approval of the engineer-in-charge.

11 Field laboratory and list of Equipment:

- i) The contractor at his own cost shall set up a fully furnished and adequately equipped field laboratory at site within 15 days from the date of issue of work order and maintain the same by providing adequate technical and upkeep staff. The laboratory should have office space for engineers to do testing and store for storage of samples. The remaining space shall be provided for the installation of equipment, laboratory tables and cupboards, working space for carrying out tests, besides a wash basin, toilet facility. The minimum equipment shall be provided in the laboratory are specified in equipment requirement:
- ii) In addition to tools, equipment's, apparatus and instruments as described above, if any, additional tool equipment apparatus and instrument is required for laboratory and execution of work as per technical specification the same shall be provided by contractor. Nothing extra shall be payable to contractor on this account.

Recoveries:

As soon as possible after the contract is concluded the Engineer-In-Charge and the contractor shall agree upon a time and progress chart as above. In time and progress chart, deployment of machineries,

equipment's, apparatus and instrument as listed above are to be treated as one of the sections of the work. In Case of delay in deployment of plants and machineries and equipments etc. beyond the period of stipulated in the approved time and progress chart submitted as mentioned above, penalty at the rates mentioned below shall be levied.

- In the event of not providing Hot Mix Plant as per work programme approved by Engineer-In-Charge, an amount of Nu.1,20,000/- per day per Equipment shall be debited to the contractors account.
 - In the event of not providing Sensor Paver of Adequate width as per work programme approved by Engineer-In-Charge, an amount of Nu.16,000/- per day per Equipment shall be debited to the contractors account.
 - In the event of not providing Vibratory/Pneumatic Roller as per work programme approved by Engineer-In-Charge, an amount of Nu. 8,000/- per day per Equipment shall be debited to the contractors account.
 - In the event of not providing Field Laboratory Equipment's Instruments an amount of Nu. 200/- per day per Equipment / Instrument shall be debited to the contractors account.
- iii) The Engineer-in-charge may at his discretion, check the test results obtained at contractor laboratory by independent test at an approved laboratory. The cost of such material, transport, cost of testing etc. shall be borne by the contractor.
- iv) In the event of failure to setup laboratory and provide equipment's/ apparatus mentioned above or substitute/ replaced the equipment/ apparatus on account of maintenance / breakdown Nu.200.00 per day per equipment / apparatus shall be debited to the contractors account.

Note:-

- To Maintain and record of the T&P received & the dates when it has been received at site also to keep track of the receipt of the material at site, work men / staff deployed works diary shall be maintained jointly by the Engineer-in- charge and the contractor to maintain a daily record of these activities to form basis of any analysis of this kind or in case any dispute occurs at a later date.
- The works diary shall be got printed by the contractor and also pages shall be machine numbered. The Performa for the same is given below. Additional sheets should also enclose with each page so as to furnish any additional information. Work diary shall be signed by the contractor/ Engineering Representative on daily basis by presenting himself in the site office of Engineer-in-charge. Failure to do so render contractor liable to pay penalty @ Nu. 250/- per day for each day of such lapses. In case of failure to do so the details as filled up by DoAT representative shall be treated as final.
- An abstract of such information shall also be furnished by the contractor along with the progress report giving information of such deployment, date etc. Failure to submit the monthly progress report by contractor the firm is liable to pay a penalty @ Nu. 10,000/- for each occurrence.

12 Closing Day's Work

- i) Work shall be closed at 2 hrs. notice for VVIP movement and also other exigencies, if directed by the engineer-in-charge. No compensation shall be entertained on this account from the contractor.

13 Inspection of site and testing

- i) The Engineer-in-Charge or his authorized representative shall have full power to inspect any portion of the work, examine the materials and workmanship at the contractor's works or at any other place from where the material is obtained. Acceptance of any material shall in no way relieve the contractor of his responsibility for meeting the requirement of the specifications.
- ii) Routine type tests for the various items of material shall be performed at the contractor's works and test certificates furnished. The contractor shall permit the Engineer-in-Charge or his authorized representative to be present during any of or all the tests. After notification to the Engineer-in-Charge that the work has been completed, the contractor shall make under the direction and in the presence of Engineer-in-Charge such tests and inspections as have been specified or as the Engineer-in-Charge shall consider necessary to determine whether or not the full intent of requirements of the plans and specifications have been fulfilled. In case the work does not meet the full intent of the specifications it shall be rectified by the Contractor at no extra cost and the contractor shall bear all the expenses for any further tests considered necessary.
- iii) All tools, instruments, plants and labour/operating personnel for the test shall be provided by the contractor at his own cost. The contractor will establish a full-fledged laboratory at site at his own cost within 15 days from the date of issue of work order. The testing facilities should be sufficient to do various routine test of works and as approved by Engineer-in-Charge.
- iv) The Engineer-in-Charge may at his discretion, check the test results obtained at contractors laboratory by independent tests at an approved laboratory. The cost of such material, transport, cost of testing etc. shall be borne by the contractor.

14 Admission to Operational Area

- i) Work is to be executed inside the operational area of Paro Airport and entry is restricted by security. Passes as per the rules promulgated by Airport Security Authorities from time to time, the Contractor shall obtain necessary entry passes and shall bear all expenses connected to it including cost of

photographs, entry permit fees if any etc. The following is the procedure currently in force for obtaining passes from the Airport Security Authorities.

- ii) All contractors/Agencies that got award of work pertaining to operational area are required to submit the application giving the details of name and award of work, duration of work with award letter. The list containing workers name, address also be enclosed along with application while submitting to the concerned department for recommendation. The application duly recommended by the concerned department will be forwarded to the office of the security, DoAT. The on receipt of application gate number will be allotted depending upon the area of work.
- iii) The contractor while applying for passes are required to submit 2 stamp size photographs for each worker along with the application. This requirement is for maintaining record and issuance of operational area access.
- iv) PIC (Photo Identity Card) will be issued for all engaged by contractor duly recommended by the concerned department.
- v) In the Case of Loaders and Drivers who are bringing construction materials into the operational area, the Airport Security officials at the respective gate shall allow passage of both the men and material including trucks having passes issued by DoAT.
- vi) The contractor or his agent shall also be fully be liable to security for any fraudulent/unauthorized use of the PIC by the workers whether with or without his knowledge and for any theft or loss of the same.
- vii) The contractor or his agent will not be liable for any unauthorized use of the pass after the loss or theft, provided that the loss or theft has to be reported to the Airport security in writing.
- viii) The Contractor or his agent shall not use for himself nor shall be permit any of his labourers use PIC disclosed as lost or stolen even in the instance of the recovery of the same at any latter date unless duly authorized by the airport security
- ix) Any other rules imposed by the regulatory authority from time to time due to security reason will be applicable to the contractor

- x) The contractor shall provide and maintain at his cost necessary fencing, watch and ward, lights etc. as directed by the Engineer-in-charge, considering the security and operational requirements of the airport wherever required in respect of his Labour camp and plants and machineries.
- xi) Carriage of materials are to be taken carefully to avoid any spillage and to keep the area clean
- xii) The contractor shall adjust his working hours and deployment of men and material to suit the restrictions in the operational area and nothing extra shall be paid on this account
- xiii) Necessary obstruction/cross markings and obstruction lighting etc. are required to be provided on the existing runway/taxiway as per the requirement of operations department for the safety of aircraft operations. Nothing extra shall be paid on this account.
- xiv) The Contractor shall be held fully responsible for any lapse on the part of their workers/staff working and safety of the Airport. As such before deploying Engineers/Supervisions, workers and labourers on work, the Contractor must ensure that they are genuine. An undertaking to this effect shall have to be given by the contractor each request for issue of entry passes.
- xv) There are restrictions on movements in operational area imposed by the Aerodrome Authorities and the contractor shall abide by all the rules and regulations in this regard and shall acquaint himself and all his staff thoroughly with the rules and regulations.
- xvi) The Contractors staff and labourers and every transport vehicle will carry the permit, issued by the Aerodrome authorities and produce the same whenever demanded otherwise the driver of the vehicle is liable for being charged for trespassing.
- xvii) The Contractor will have to construct the necessary kutchra road for carrying materials from the entry gate to the site of construction. Nothing extra will be paid for the same.
- xviii) Whenever the vehicle crosses the taxiways, contractor has to ensure no FOD on the taxiway. If dozer or pocline has to cross the taxiway precaution shall be taken by providing the rubber pads or belts to prevent damage to the surface.
- xix) If at any time during the execution of work and for any reasons whatsoever there is some difficulty in availability of site, the contractor shall adjust his labour accordingly and no claim shall be entertained on this account.
- xx) No labour huts shall be permitted to be constructed inside the operational area of Paro Airport.

xxi) The contractor must see the proposed site for the work and study the specifications and conditions carefully before tendering. No claims of any sort shall be entertained on account of site conditions or ignorance of specifications and conditions.

xxii) The contractor shall maintain in good conditions all works executed till the completion of the entire work allocated to the contractor and its handing over to the department.

15 Stores and materials

i) No storage accommodation will be arranged by DoAT, contractor shall make all such arrangements at his own cost to the satisfaction of engineer-in-charge.

16 Stacking of materials, machines, installation of T & P and construction of temporary hutments at Site

i) The contractor shall be allowed to install plants and machineries, store and stack the material within Airport premises. However, due to operational constraint or any other reason if DoAT could not allot the land for the said purpose then contractor has to make his own arrangements for land very close to Airport for installing plant. Installing crushing plant within DoAT area will not be permitted. The contractor shall not be permitted to enter on (other than for inspection purpose) or take possession of the site until instructed to do so by the Engineer-in-Charge in writing. The portion of the site to be occupied by the contractor shall be defined and/or marked on the site plan, failing which these shall be indicated by the Engineer-in-Charge at site and the contractor shall on no account be allowed to extend his operations beyond these areas.

- No license fee will be charged for the land allotted by DoAT.
- That such use or occupation shall not confer any right of tenancy of the land to the contractor.
- That the contractor shall be liable to vacate the land on demand by the Engineer-in-Charge.
- That the contractor shall have no right to any construction over this land without the written permission of the Engineer-in-Charge. In case, he is allowed to construct any structure he shall have to demolish and clear the same before handing over the completed work unless agreed to the contrary.

All clearance if any required for installing the plant shall be obtained from the local / Government authority / Pollution Control Board by the contractor at their own cost.

ii) The contractor shall co-operate with any other agency working on the same project, compare plans, specifications and the time schedule and so arrange his work that there will be no interference the contractor shall forward to the engineer-in-charge all correspondence and drawings so exchanged

failure to check plans for conditions will render the contractor responsible for bearing the cost of any subsequent change found necessary, contractor should co-ordinate in such a way that on no account there should be any disturbance to the work.

17 Standard of workmanship

- i) To determine the acceptable standard of workmanship, the contractor shall execute portion of the item of work as sample for approval of the engineer-in-charge, before taking up the actual execution of the particular item of work.

18 Bye-laws

- i) The contractor shall comply with all bye-laws and regulations of local and statutory authorities having jurisdiction over the works and shall be responsible for payment of all fees and other charges and for giving and receiving of all necessary notices and keeping the engineer-in-charge, informed of the said compliance with the bye-laws, payments made, notices issued and received.
- ii) The contractor shall indemnify the DOAT against all claims in respect of patent rights, design, trademarks of name or other protected rights in respect of any plant, machine, work or materials used for or in connection with the work or temporary works and from and against all claims, demands proceedings, cost, charges and expenses whatsoever in respect of or in relation thereto. The contractor shall defend all actions arising from such claims and shall himself pay all royalties license fees, damages, costs and charges of all and every sort that may be legally incurred in respect thereto.

19 Site precautions

- i) When not in use, all equipment's and stockpiled materials must be so placed that after darkness the tops are below a fifty to one ratio from the ends of the basic strips of the runway and twenty to one from the sides of the usable aircraft traffic areas and must be marked with red flags by Day & Red lights by nights to indicate that they project above the general contour of the Aerodromes.
- ii) Any materials or T & P etc. found lying outside the sites approved by the Engineer-in-Charge, shall be removed by the Engineer-in-Charge at the risk and cost of the contractor.
- iii) When the contractor's equipment or personnel require to cross areas which are close to aircraft operations, the contractor shall provide competent flagmen at locations designated by the Engineer-in-Charge to relay signals from airport traffic control to personnel wishing to cross such areas.

- iv) Every transport vehicle shall carry a permit issued by the Chief Authority of Airport/Aerodrome concerned and shall be produced on demand by him or his authorized agent. All vehicles entering the Airport limits shall follow the routes prescribed by the Chief Authority of Airport for entering the areas and shall display red flags on top.
- v) No person shall drive any vehicles in the operational area of the airport or other areas as may be notified from time to time unless he has been specifically authorized by the Airport Director of the Airport after passing any test or examinations as may be considered necessary. Provided, however that the APD of the Airport may also require such a person to possess the driving license under motor vehicle acts.
- vi) With regard to construction safety measures, the contractor shall adhere to various Indian Standard Codes of Practice, requirements of Provincial Government and local Municipal Authority wherever the provisions of the latter two agencies shall be more stringent than the provisions of the former. When these codes do not exist, the contractor shall adhere to such safety measures as directed by the Engineer-in-Charge.
- vii) The contractor shall, during construction, provide barricades at his own cost as per specifications prescribed by the Engineer-in-Charge to segregate the working area to ensure safety of all concerned.
- viii) The contractor shall be responsible for any damage, resulting from his operations, either to buildings, structures, airport fixtures such as underground cable, contact lights, hard surface areas, water mains, other operational installations, Airport roads etc. The contractor shall restore, replace or repair any such damage to the complete satisfaction of the Engineer-in-Charge and in default the Engineer-in-Charge may cause the same to be made good by any other means and deduct the expenses from any sums due to contractor.
- ix) The work shall be carried out in phases in such a way that there is least obstruction to the movement of Air Traffic at the Airport. The phasing shall be decided by the Engineer-in-Charge, who will be at liberty to change the phasing to suit the requirements. The contractor shall have to abide by these instructions and nothing extra shall be paid to him on this account.
- x) The contractor shall arrange his work schedule according to the flying operations. Unavoidable adjustments in the timings may however have to be made depending upon the emergency operational requirements which may result in lesser availability of working hours or re-scheduling of working hours. Operational requirement may also not allow availability of site on certain days due to

unavoidable reasons when it will not be possible to execute any work at all on these days. Nothing extra shall be paid towards the ideal establishment labour & machinery etc on this account.

20 The contractor shall take all precautions to avoid all accidents by exhibiting necessary day & night caution boards, speed limit boards, red flags, red lights and providing barriers. He shall be responsible for all damages and accidents caused due to negligence on his part. No hindrances shall be caused to traffic during execution of work.

21 No payment will be made to the contractor for damage caused by rains or other natural calamities during the execution of the works and no such claim on this account will be entertained.

22 The contractor shall remove the labour huts, temporary barricades etc. on completion of work and leave the site in a neat and tidy state. The payment of final bill will be subject to the compliance of this condition by the contractor.

23 Materials at site

- i) Materials brought to the site by the contractor shall be stored by the contractor in a safe/dry storage space. The contractor shall be responsible for safe custody of materials at site till such time; the installation is commissioned and handed over to the Engineer-in-Charge.
- ii) Cement bags shall be stored in separate godowns to be constructed by Contractor at his own cost with weather proof roofs and walls. Each godown shall be provided with a single door with two locks, the keys of one lock shall remain with DoAT Engineer-in-Charge of work and that of the other lock with the authorized agent of the contractor at the site of work so that the cement is removed from the godown according to the daily requirement with the knowledge of both the parties and the account maintained in the prescribed Performa.

24 Work in restricted area

- i) The work is to be carried out in restricted area, whenever necessary; the work shall be carried out in the non-office period. The Contractor shall have to coordinate with the DoAT for locating T&P and stacking of materials etc. Nothing extra shall be paid to the Contractor for the entire above factor.

25 Arrangement to be made by the contractor at site

- i) Necessary registers and stationers required for entering data and test results shall be provided by the contractor at his own cost as directed by the engineer- in-charge.
- ii) The Contractor shall provide at his own cost one site office, location to be decided by Engineer-in-Charge for DoAT's staff. Site office, shall be provided with necessary electric lights, fans, Air condition, one drinking water cooler, toilet and other facilities which are generally required for a site office. Toilet should be provided with W.C. and a wash basin. The site office shall be made as per the drawing enclosed and as per the directions of Engineer-in-Charge at. The Contractor shall provide the followings furniture's at his own cost for site office as shown in table below:

S.No	Item	Nos. Required
1.	Table	3 Nos. (Three)
2.	Chair	6 Nos. (six)
3.	Racks – 5 Tier 1800mm x 900mm x 375mm	4 Nos. (four)
4.	All rooms lighting	As per site requirement to achieve desired lux level

The Contractor shall maintain the office in good condition and provide facilities for having the office cleaned every day and keep the same in hygienic conditions till the completion of the project. The Contractor has to complete the construction of office within 30 days from the date of issue of work order and handover the same to the Engineer - in – charge.

In case the site office is not provided by the contractor latest by 30 days from the date of placing of work order, the contractor shall be liable to pay penalty @ Nu. 5000/- per day for each day of delay

- In addition to the tools and plants and equipment's/apparatus and instruments required for laboratory and execution of the work as per Technical Specifications, the following additional machineries/staff are to be arranged at site by the contractor at his own cost within 15 days of stipulated date of start of work. Facilities required at Site Office as mentioned in Table below:

S.No.	Description of items	Total quantity
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	<i>For Bumthang Runway Re-surfacing office site</i>	
i)	Suitable Passenger vehicle for cylinder capacity of minimum 1400 CC or 4W drive hard top jeep, either petrol or diesel driven, not older than 2 years, (average monthly run 3000 km) including driver for taking the samples from work/plant site to laboratory and movement of the officials during progress of work for checking/controlling the quality of work. The Engineer-In-Charge of DoAT will be the controlling officer for movement of vehicles	1 No.
ii)	Office Boy	1 Nos.

After completion of work and release of final bill, all the items like complete site office, fans, electrical fixtures, drinking water cooler and all furniture provided by the contractor shall be taken away by the contractor.

Diesel/Petrol/Fuel/Lubricants etc. for smooth running of all the equipment, vehicles and machineries deployed for the work shall be provided by the contractor at his own expenses. In the event of any break down of the plant, vehicles and machineries deployed for the work, the contractor shall take prompt remedial measure to put them back in working condition and nothing extra will be paid to minimize break down period, necessary spare parts shall be kept readily available at site by the contractor at his own expense.

In the event of fail to provide vehicle or being off the road for maintenance or on account of breakdown, the contractor will provide suitable substitute vehicle immediately. If contractor fails to provide vehicle or substitute vehicle as specified above an amount of Nu. 3000/- per day shall be debited from the contractor's account.

26 Safety devices for field engineers/technicians/workers at site

The contractor is also required to provide specific uniform safety devices to the manpower deployed on site for the work in operational area as detailed below:-

- i) Trousers and reflective Jacket for male staff and Suitable dress with reflective jacket for female staff as approved by Engineer-in-charge.
- ii) An apron of reflective cloth is to be provided to each of the working labour on site.
- iii) Safety helmets and foot wears are to be provided for each of the workers
- iv) Safety belts, protective Goggles, Hand gloves etc. are to be provided as per requirement and nature of jobs.
- v) Helmets shall be provided for Contractor's and DOAT officials & Visiting / inspecting officials.

27 Employment of specialized supervisory manpower and safety devices to field engineers/ technicians/workers at site

Contractor is required to provide the required manpower within 15 days from the date of award of work to assist the DOAT officers posted on site on full time. No staff should be shifted from site or allowed on leave without prior permission of the Engineer-In-Charge.

28 Use of ready mix concrete

- i) The contractor is allowed to use Ready Mix concrete (RMC) from the batching plant as approved by the Engineer-in-charge. Also the contractor can use admixture to increase the workability of the concrete. However nothing shall be paid extra for using RMC, admixture, and lead etc. reason what so ever. The concrete shall be paid into the respective item as mentioned in the BOQ.
- ii) The contractor is allowed to use 53 grade OPC cement in case of non-availability of 43 grade OPC cement. However nothing shall be paid extra to contractor on this account.

29 Prices

The rates quoted shall be in Ngultrum only and inclusive of all taxes and duties what so ever including excise duty, VAT/Sales tax, Octroi if any, work contract tax, applicable customs duty in case of imported items, labour, tools & plants, packing freight/transportation of items from factory up to the installation site & insurance up to the site, loading, unloading and hoisting arrangement for installation, fee(s) for testing, inspection documents including the fee(s) payable for obtaining statutory license / approval etc. from concerned department but excluding service taxes.

30 Source of material

- i) Aggregate shall be procured from approved quarries subject to fulfillment of test criteria as specified in BOQ items and approval of Engineer-In-Charge.

31 Site conditions, requirements and sources of materials

- i) The contractor shall be responsible for the true and proper setting out of the work and for the correctness of the positions levels and dimensions and alignments of all parts of the works and for the provisions of all necessary applications and labour in connections therewith.

- ii) If any time during the progress of the work any error may appear or arise in the position, levels, dimension or alignments of any part of the work the contractor on being required to do so by the Engineer-in-Charge shall at his own expense rectify such errors to the satisfaction of the Engineer-in-Charge.
- iii) The checking or any setting out of any line by the Engineer-in-Charge or his representative shall not relieve in any way the contractor of responsibility for the correctness thereof and shall carefully project and preserve all bench mark site rails, pegs and other things used in the set is out of work.
- iv) All duties concerning establishment of a set of bench marks permanent theodolite stations, Centre of pillars etc. for performing all the functions of us till the physical completion of all items of the in question shall be carried out by the contractor at his own cost.
- v) He shall also keep proper record of such permanent bench marks established denoting therein their correct levels.
- vi) The work establishing all such bench marks shall be carried out only by experience staff of the contractor with the help of precision instrument suitable for this type of work. The instruments shall be checked for their accuracy and for permanent adjustment before the commencement of the work and also frequent intervals during the progress of the work.
- vii) All such bench marks established by the contractor shall be subjected to check and approval of the Engineer-in-Charge or duly representative and valuations noticed in the work as a result of improper establishment of maintenance of such bench marks shall be at the contractor's risk and expense.
- viii) The contractor has to adjust his work and progress to work in coordination with other agencies working at site.
- ix) The materials such as Good Earth, Moorum, Coarse and Fine aggregates and other materials shall be brought to site only after approval of the quarry / source by the Engineer-in-Charge.

32 Nuisance:

The Contractor shall not at any time do, cause or permit any nuisance on the Site or do anything which shall cause unnecessary disturbance or inconvenience to owners, tenants or occupiers of other properties near the Site and to the Public generally.

33 Watching and lighting

The Contractor shall provide and maintain at his own expense all lights, guards, fencing and watching when and where necessary or required by the Engineer-in-Charge for the protection of the Works or for the safety and convenience of those employed on the Works.

Duties and powers of Engineer-In-Charge's representative:

- i) The duties of the representative of the Engineer-In-Charge, is to watch and supervise the Works and to test and examine any materials to be used or workmanship employed in connection with the Works. He shall have no authority to order any work involving any extra payment by DOAT nor to make any variation in the Works.
- ii) The Engineer-in-Charge may from time to time in writing delegate to his Representative any of the powers and authorities vested in the Engineer-in- Charge and shall furnish to the Contractor a copy of all such written delegation of powers and authorities. Any written instruction or written approval given by the Representative of the Engineer-in-Charge to the Contractor within the terms of such delegations shall bind the Contractor and DOAT as though it had been given by the Engineer-in-Charge.
- iii) Failure of the Representative of the Engineer-in-Charge to disapprove any work or materials shall not prejudice the power of the Engineer-in-Charge thereafter to disapprove such work or materials and to order the pulling down, removal or breaking up thereof.
- iv) If the Contractor shall be dissatisfied with any decision of the Representative of the Engineer-in-Charge he shall be entitled to refer the matter to the Engineer-in Charge who shall thereupon confirm, reverse or vary such decision.

34 Work during night or on Sundays and holidays:

Subject to any provisions to the contrary contained in the Contract, permanent works shall be carried out during night or on Sundays or on authorized holidays with the permission of the Engineer-in-Charge.

35 Submission invoice/vouchers:

Contractor must submit the vouchers of Bitumen, Cement and Paint etc.

- i) Contractor is sole responsible for the quantity & quality of Bitumen, Cement from delivery point to work site.
- ii) All Invoices of Bitumen, Cement & Paint are to be authenticated by supplier