1.1 Excavation, Embankment and sub grade

It includes Excavation and, Embankment to reach the levels of the finished sub grade including the construction of the sub grade itself.

1.1.1. Excavation

The Excavation work includes any sort of Excavation earth or and removal of unsuitable asphalt or any layers to be replaced to reach the level of sub grade. Where existing layer does not meet the requirements for sub grade according to article 1.1.3 of these specifications, Excavation must be to the levels of the bottom of sub grade for roads designed for light and medium traffic, and to the levels of a layer 20 cm below the sub grade for roads designed for heavy traffic.

In case of rock excavation, the Contractor must excavate to the levels of the bottom of sub grade.

Structural excavation must be to the required levels according to drawings or specifications. This includes structural excavation for box culverts, for reinforced pipe culverts, for retaining walls, for PVC ducts, and for gabions.

The Contractor must dispose the excess or unsuitable material outside the site to places approved by the concerned authority.

1.1.2 Embankment

Embankment material must not be A6 or A7 according to AASHTO specifications. The Embankment is placed and compacted in layers not exceeding 20 cm after compaction. The two layers sub grade. Must be compacted not less than 95% of maximum dry density according to modified proctor. For lower layers of Embankment, compaction must not be less than 90% of maximum density according to modified proctor.

1.1.1 Sub grade

The sub grade is the layer beneath the base course layer or the sub base course layer. It must be not less than 20 cm thick after compaction. Compaction. Must be not less than 100% of maximum dry density according to modified proctor.

Sub grade material must be of soils not classified as A6 or A7 according to AASHTO specifications. This is enough for light traffic (most roads are designed for light traffic and in some villages all roads are designed for light traffic). This will be clarified in the description of roads for each village with bills of quantities.

Sub grade designed for medium and heavy traffic must also fulfill the following requirements:
• C.B.R 20% minimum
• 12 maximum
• Max. Size=3 (7.5cm)

Payments
The accepted quantities of earthworks, completed according to specifications and drawings, measured as provided above will be paid for as per the following pay items:

<table>
<thead>
<tr>
<th>NO</th>
<th>PAYITEM</th>
<th>PAY UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1.1</td>
<td>Embankment and unclassified excavation to a depth not more than 50 cm for roads designed for <em>Light traffic</em>.</td>
<td>AS Specified In Bill Of Quantities</td>
</tr>
<tr>
<td>1.1.2</td>
<td>Embankment and unclassified excavation to a depth not more than 50 cm for roads designed for <em>Medium traffic</em>.</td>
<td></td>
</tr>
<tr>
<td>1.1.3</td>
<td>Embankment and unclassified excavation to a depth not more than 50 cm for roads designed for <em>Heavy traffic</em>.</td>
<td></td>
</tr>
<tr>
<td>1.1.2</td>
<td>Embankment for depth. Exceeding 50cm.</td>
<td></td>
</tr>
<tr>
<td>1.1.2</td>
<td>Unclassified excavation for depths exceeding 50 cm.</td>
<td></td>
</tr>
</tbody>
</table>

As for heavy traffic the 20 cm layer below the sub grade layer must be of soils not classified as A6 or A7, its compaction must not be less than 95% of maximum dry density according to modified proctor.

Where the existing layer A6 or A7 for sub grade of roads designed for light traffic and layer below sub grade layer for heavy traffic, it must be replaced with material which will satisfy the following requirements:

1.2 C.B.R 20% minimum
1.3 P.I. 12 maximum
1.4 Max. Size=3 “(7.5 cm)

1.5 Backfilling

Backfilling around pipe culverts, box culverts, retaining walls and wing walls shall consist of embankment material not classified as A6 or A7 and a hall be compacted to at least 90% of modified density. One size material may be used if approved by the Engineer.

Measurements

For excavations and/or embankment not exceeding 50 cm in depth works will be measured according to B.O.Q. This work includes all excavations, embankment, ditches and sub grade according to these specifications. The specifications. For sub grade layer and below it is not the same roads designed for light traffic, for roads designed for medium traffic and for road designed for heavy traffic, so there will be three items for this work.

Excavation exceeding 50 cm in depth will be measured in cubic meters whatever it is and whether it will be used in embankment or it is excess or unsuitable material where it must be disposed out side the site to places approved by the concerned authority.

Embankment exceeding 50 cm in depth will be measured in cubic meters whether it is form excavation or borrow and it must satisfy the requirements in these specifications.

For excavations and/or embankment exceeding 50 cm excavations and/or Embankment up to 50 cm in depth will be measured in square meters. Only quantities of excavation and Embankment exceeding 50 cm in depth will be measured in cubic meters.

Structural excavations and backfilling will not be measured because they will not have separate pay items. They are included in the pay items for reinforced concrete pipes or culverts, PVC ducts, retaining walls & gabions.
SECOND: BASE COURSE & SUB-BASE COURSE

2.1 BASE COURSE

After preparing the sub grade or the sub base (if required) to the required density, finishing the surface to the required levels and approval of the Supervision Engineer, the base course will be delivered to road bed as uniform mixture after completing the required laboratory tests on contractor’s own expenses.

2.1.1

Base Course must fulfill the following specifications:

2.1.1.1

Aggregate material for base course shall consist of crushed lime stone crushed granite or crushed basalt.

2.1.1.2

Liquid limit must not exceed 25. (AASHTO-T90)

2.1.1.3

Plasticity Index must be 2-6 (AASHTO-T90-t89)

2.1.1.4

Base course must be watered and compacted to 100% density according to modified proctor. (AASHTO-T191)

2.1.1.5

Percentage of material by weight passing form sieves must be as follows (gradation A or B):

<table>
<thead>
<tr>
<th>Class</th>
<th>Sieve No</th>
<th>2”</th>
<th>1 1/2</th>
<th>3/4</th>
<th>1/2</th>
<th>3/8</th>
<th>#4</th>
<th>#10</th>
<th>#40</th>
<th>#200</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>% Passing</td>
<td>100</td>
<td>70-100</td>
<td>55-85</td>
<td>50-80</td>
<td>40-70</td>
<td>30-60</td>
<td>20-50</td>
<td>10-30</td>
<td>5-12</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.1.1.6

C.B. R> 80% for maximum dry density of modified proctor (AASHTO-T193).
2.1.1.7  
Abrasion Ratio as per Los Angelo’s test using 500 revolutions (AASHTO-96) < 40%  

2.1.1.8  
Sand equivalent must be 30% or more (AASHTO-T176)  

2.1.1.9  
Soundness must be 12% maximum tested by sodium sulphate & 18% maximum tested by magnesium sulphate (AASHTO-T 104)  

2.1.1.10  
Finished levels of base course must not be more or less than the designed levels or the levels approved by the Engineer by more than 1 cm.  

2.2 SUB-BASE COURSE  
After preparing the sub grade to the required density, finishing the surface to the required levels and approval of the Supervision Engineer, the sub base course will be delivered to roadbed as uniform mixture after completing the required laboratory tests on contractor’s own expenses.  

2.2.1  
Sub base Course must fulfill the following specifications:  

2.2.1.1  
Aggregate material for sub base course shall consist of crushed limestone, rushed granite or granite basalt, screening of wadi gravel can be used provided it satisfies specification.  

2.2.2  
Liquid limit must not exceed 30. (AASHTO-T90).  

2.2.3  
Plasticity Index must be 2-8 (AASHTO-T90-T89)  

2.2.4  
Sub base must be watered and compacted to 100% density according to modified proctor. (AASHTO-T191)  

2.2.5  
Percentage of material by weight passing from sieves must be as follows (gradation A or B):
<table>
<thead>
<tr>
<th>Class</th>
<th>Sieve No</th>
<th>2½</th>
<th>2</th>
<th>1½</th>
<th>1</th>
<th>1/2</th>
<th>#4</th>
<th>#10</th>
<th>#40</th>
<th>#200</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>% Passing</td>
<td>100</td>
<td>80-100</td>
<td>70-95</td>
<td>55-90</td>
<td>45-75</td>
<td>30-60</td>
<td>20-48</td>
<td>10-30</td>
<td>5.15</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td>100</td>
<td>80-100</td>
<td>60-95</td>
<td>47-80</td>
<td>30-60</td>
<td>22-45</td>
<td>10-30</td>
<td>5.15</td>
</tr>
</tbody>
</table>

2.2.6  C.B.R. > 40% for maximum dry density. (AASHTO-T193)

2.2.7  Abrasion Ratio as par los Angelo’s test using 500 revolutions (AASHTO-96) < 40%

2.2.8  Sand equivalent must be 25% or more (AASHTO-T176)

2.2.9  Soundness must be 12% maximum tested by sodium sulphate & 18% maximum tested by magnesium sulphate (AASHTO-T 104)

2.2.10  Finished levels of sub-base must not be more than 1cm. Than the designed levels or the levels approved by the Engineer, it can be less than that for a more thickness provided it will be compensated by increasing the depth of base course at the contractor’s expense.

Measurements
Aggregate base course and sub base course will be measured as required in place in cubic meters whether it is in the main road or in the shoulders.

Payments
The accepted quantities of aggregate base course sub base course will be paid for at the contract price, Complete in place.
Payment will be made under:
<table>
<thead>
<tr>
<th>No</th>
<th>Pay Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1</td>
<td>Base course for roads and shoulders</td>
<td>As Specified In Bill Of Quantities.</td>
</tr>
<tr>
<td>2-2</td>
<td>Sub base Course</td>
<td></td>
</tr>
</tbody>
</table>

**THIRD: ASPHALT PATCHING & LEVELLING COURSE**

3.1 Patching is carried out as follows:

3.1.1

If the potholes are deeper than the asphalt layers, base course will be repaired first according to the section of the road in that area to reach the level of the bottom of the asphalt, than prime coat is applied and asphalt is laid and compacted.

3.1.2

If the depth of the potholes is equal or less than the existing asphalt, the potholes will be required and asphalt will be laid and compacted after applying tack coats to potholes.

3.1.3

All potholes must be cleaned, trimmed and dried before asphalt patching. The tack coat must be applied to cover completely the bottom and sides of the holes.

3.2

Leveling course is carried out with different thickness to achieve the required levels and/or the required slopes.

**Measurement**

The base course and the patching asphalt will be measured according to Bill of Quantities.

**Payment**

The accepted quantities of aggregate base course and the hot asphalt patching or leveling course will be paid will be according to B.O.Q and it will inclusive asphalt or leveling and compaction of all other work in the pot holes including excavation, cleaning, and tack coat.

**For all these works the pay item is:**
FOURTH: ASPHALTIC WORK

4.1 Liquid Asphalt

Prior to application of liquid asphalt, the contractor must obtain written approval of the Engineer who will also approve the suitable application rate of liquid asphalt. The Contractor will sweep and clean the surface using air compressor and be sure that the surface is dry before application of liquid asphalt using distributor truck of the pressure type with insulated tanks. No application of liquid asphalt is allowed in rainy, windy or dusty days. No traffic of any kind shall be allowed on any surfaces where liquid asphalt is applied.

4.1.1 Prime coat

Bituminous material shall be (MC-70) and shall be applied at least twenty-four hours before placing the asphalted concrete. The rate of application will be 1-1.5% and the Engineer will approve it.

4.1.2 Tack Coat

Bituminous material shall be RC 250 or equivalent. It will be applied between two asphaltic concrete layers two hours before placing the second asphaltic Layer. The rate of application will be 0.2-0.5kg/m² and it should obtain Supervising Engineer written Approval.

4.2 Asphalt concrete

4.2.1

The asphaltic concrete shall be hot asphalt produced by central mechanical asphalt mixing plant. Percentage of bituminous material will be 4-5.5% by weight according to job mix formula. Grade 60/70-penetration bitumen will be used.

4.2.2

Asphaltic Concrete shall consist of crushed course and fine aggregates, filler and bitumen and shall conform to the following gradation requirements:
<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
<th>Gradation by weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wearing course</td>
<td>Binder Course</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>B</td>
</tr>
<tr>
<td>1</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>¾</td>
<td>100</td>
<td>70-95</td>
</tr>
<tr>
<td>½</td>
<td>74-95</td>
<td>54-82</td>
</tr>
<tr>
<td>3/8</td>
<td>60-86</td>
<td>44-74</td>
</tr>
<tr>
<td>No. 4</td>
<td>40-65</td>
<td>32-54</td>
</tr>
<tr>
<td>No. 10</td>
<td>25-45</td>
<td>-------</td>
</tr>
<tr>
<td>No. 20</td>
<td>16-30</td>
<td>14-30</td>
</tr>
<tr>
<td>No. 40</td>
<td>10-22</td>
<td>8-23</td>
</tr>
<tr>
<td>No. 80</td>
<td>6-15</td>
<td>4-15</td>
</tr>
<tr>
<td>No. 200</td>
<td>3-8</td>
<td>2-8</td>
</tr>
</tbody>
</table>

The tolerances for gradation of the mixture from the job mix formula on the basis of the Marshall Tests will be as follows:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Maximum Variation of Percentage of Material Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8 and larger</td>
<td># 5%</td>
</tr>
<tr>
<td>No.4 to no. 80</td>
<td># 4%</td>
</tr>
<tr>
<td>No. 200</td>
<td># 1%</td>
</tr>
</tbody>
</table>

Provided that gradation will continue within the limits specified in clause 4.2.2.

The aggregates used in the asphaltic concrete must fulfill the following requirements:

4.2.2.1

For the portion retained on sieve No.4, Los Angeles abrasion after 500 revolutions must not be more than 35% (AASHTO T96).

4.2.2.2

Non-plastic for material passing #40 sieve from hot bins (AASHTO-T90-T89)

4.2.2.3
Soundness according to (AASHTO-104) loss by weight after 5 cycles must not be more than 10% if sodium sulfate is used, and 12% if magnesium sulfate is used.

4.2.2.4 Flakiness index (F.I.) and Elongation index (E.I.) will be tested for according to British specifications (B.S. 512) and it must not be more than 25%.

4.2.2.5 Sand equivalent according to AASHTO T-176 and it must not be less than 50%

4.2.2.6 Clay lumps and friable particles not be more than 1 % according to AASHTO T–112

4.2.2.7 Loss of stability must be more than 25 % for the asphaltic concrete

4.2.2.8 Samples will be taken every day there is asphalting for extraction and Marshal tests to find density, % voids in mineral aggregates (VMA), % voids filled with bitumen, stability, gradation and bitumen content.

4.2.2.9 Stripping of aggregates uncoated with bitumen shall not be more than 5% according to AASHTO T- 182.

4.2.3 The asphaltic concrete shall be delivered to site at 130 C to 150 C. The asphaltic concrete will be dumped from the vehicles directly in to the paving machine and stocking is not allowed at all.

4.2.4 The asphaltic concrete will be dumped from vehicles directly in to the paving machine which must be self- propelled paving machine. Placing of asphaltic concrete will start with thickness 15-20 % more than the required compacted thickness. The contractor will take the approval of the engineer before starting paving and will coordinate with him on the paving method.

4.2.5 Steel rollers (10 tons) and pneumatic tired rollers (10 – 15 tons). Shall accomplish Rolling Minimum temperature at which break down rolling will be accomplished is 120 C. Asphalted concrete layer must bear the movement of rollers so that it will not move cracked. If rolling is delayed and the asphaltic layer is cold, it will be removed and replaced.

Compaction will be carried as follows:

4.2.5.1
First rolling shall be accomplished by a steel roller (10 tons). Required passes will follow the instruction of the Engineer.

4.2.5.2

Pneumatic tired roller to be used after that with suitable passes to reach the required density. Rolling shall begin at the low side and progress to the high side by overlapping of longitudinal trips parallel to the centerline. Also it shall begin at edge of roads towards the centerline. Prior to rolling and as often thereafter as may be necessary, each tire of the roller shall be wiped with water so that the asphalted concrete will not cling to the tires.

4.2.5.3

Density of the finished pavement shall not be less than 98% of the Marshall density obtained in the laboratory (75 blows).

4.2.5.4

95% compaction of Marshal density by using smaller rollers may be allowed if the area is narrow which makes it difficult for heavy rollers to reach. This should be subjected to the approval of supervising the Engineer.

4.2.6

Before an asphaltic concrete is placed after a stoppage for any reason, the old asphaltic layer be trimmed to a vertical face by cutting the edge of asphalt and tack coat to it horizontally and vertically. The surface in the area of the joint shall not have difference more than 6mm using 6 meters straight edge.

4.2.7.1

If stability decreases below the specified value.

4.2.7.2

If average specific gravity of aggregates is beyond + 0.1% of the design.

4.2.7.3

If bulk specific density of mixture is beyond + 0.1% that of the design.

4.2.8

The job mix formula according to Marshall Method must satisfy the following:

4.2.8.1 Stability 75 kegs min.

4.2.8.2 Voids in total mix

i) For binder course 3-6%

ii) For wearing course 3-5%

4.2.8.3 Flow 2-4 mm

4.2.8.4 Stiffness 450 Kg/mm min

4.2.8.5 Voids filled with bitumen

i) For binder course 60-70%

ii) For wearing course 65-75%
4.2.8.6 V.M.A.
i) For binder course 12% min.
ii) For wearing course 13% min.

4.2.9 Tolerances
4.2.9.1 Bitumen content
4.2.9.2 Level of surface
4.2.9.3 Thickness of asphaltic layer

4.3 Seal coat
Seal coat will be applied to a base course surface with prime coat applied to it.

4.3.1
Aggregate for seal coat cover shall consist of crushed lime, granite or basalt stone.

4.3.2
Gradation of Aggregate for the first and the second application (the two-application or the first application can be used as per bill of quantities) as follows:

<table>
<thead>
<tr>
<th>Sieve No.</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>First Application</td>
<td>100</td>
</tr>
<tr>
<td>Second Application</td>
<td>100</td>
</tr>
</tbody>
</table>
4.3.3 Application Rates of aggregate
- 12.5-20 kg/m² (for first application)
- 10-15 kg/m² (for second application)
- And the Engineer should approve it.

4.3.4
RC 250 will be used with application of rate 1-2 kg/m² and to be approved by the Engineer.

4.2.5
A self-propelled continuous feed chip spreader and distributor truck must be used for spreading the cover material and applying the bituminous material. In very steep locations, the work can be carried out manually using simple tools after taking the approval of the Engineer.

4.3.6
No work on seal coat is allowed in rainy, windy or dusty days.

4.3.7
Abrasion for aggregates=35% maximum. (AASHTO-T96)

Measurement
All asphaltic works are measured in square meters.

Payment
The accepted quantities of asphaltic concrete, prime coat, tack coat and seal coat will be paid at the contract unit price for the asphaltic work complete in place, no payment will be made for extra width.

Payment will be made under:

<table>
<thead>
<tr>
<th>No.</th>
<th>PAYITEM</th>
<th>PAY UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1.1</td>
<td>Prime coat (MC70)</td>
<td></td>
</tr>
<tr>
<td>1.1.2</td>
<td>Tack coat (RC 250)</td>
<td></td>
</tr>
<tr>
<td>4.2.1</td>
<td>Asphalitic concrete, 70 mm thick binder course.</td>
<td>As Specified In Bill Of Quantities.</td>
</tr>
<tr>
<td>4.2.2.</td>
<td>Asphalitic concrete 50 mm thick wearing course.</td>
<td></td>
</tr>
<tr>
<td>4.3.1</td>
<td>Seal coat – tow application</td>
<td></td>
</tr>
<tr>
<td>4.3.2</td>
<td>Seal coat – one application</td>
<td></td>
</tr>
</tbody>
</table>