

### **SECTION 3: SUB BASE AND BASE COURSES**

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## **SECTION 3.01 MATERIALS FOR SUB-BASE AND BASE COURSES**

### **3.01.01 SCOPE**

**A.** This section covers the requirements for the characteristics, source, supply and storage of sub base and base course pavement materials

**B.** Materials specified for use in the construction of sub-base and base courses for flexible and rigid pavements include the following:

- Screened or partially crushed granular material consisting of well graded gravel, crushed stone or crushed gravel for sub-base course construction.
- Crushed stone for base course construction.
- Stabilizing materials including Portland cement, bitumen and lime to be used where specified in sub-base and base courses and in subgrades.

### **3.01.02 GENERAL**

#### **A. Sources and Production**

**A.1** All material sources and the quality of materials proposed for use in the Works shall be approved by the Engineer prior to procuring or processing material from such sources. Inspection, sampling, testing and retesting shall be at the Contractor's expense in accordance with Part 1- Section 4.6: Samples and Approvals and as specified hereunder for specific materials.

**A.2** Location of sources and manufacturers of materials in accordance with the requirements of the Specification is the responsibility of the Contractor, who shall produce the required granular materials and aggregates at the rates and in the quantities necessary to complete the Works on time.

**A.3** The Contractor shall have satisfied himself as to the location, suitability and quantity of materials available, the extent of work necessary to obtain the material available, the work required to open the quarry, crush, screen and wash the materials and the length of haul to the Site.

**A.4** Prior to starting quarrying or borrow pit operations the Contractor shall obtain written permission from the relevant authorities and owners.

**A.5** All screening or crushing and screening plant shall be approved by the Engineer prior to being put into operation. If any plant fails to perform as intended the Contractor shall either rectify the defects in the existing plant to the satisfaction of the Engineer or provide suitable alternatives.

**A.6** Approval of the crushing and screening plants and other equipment shall not relieve the Contractor of his responsibilities in respect of producing granular materials and aggregates which conform to the Specification and in the quantities required for the completion of the Works on time.

## **B. Stockpiling**

**B.1** Storage and handling of all materials shall conform to the relevant requirements of Part 1 of the Specification, Section 4-6 Samples and Approvals. Materials shall be stored on hard, clean, well drained surfaces as approved or as directed by the Engineer.

**B.2** All topsoil in stockpile areas shall be stripped and stored in berms or bunds less than 1.2m in height prior to stockpiling of materials. The prepared stockpile areas shall be surveyed prior to stockpiling to establish control points and to obtain a record of existing cross sections for future use in determining stockpile quantities. The areas shall be adequately drained at all times.

**B.3** Stockpiling procedures shall not result in noticeable degradation or segregation of the stockpiled material, the introduction of foreign materials into the stockpile or coning. Heights of granular material and aggregate stockpiles shall not exceed 3 m.

**B.4** Granular material that, in the opinion of the Engineer, has been adversely affected by stockpiling or handling procedures shall not be incorporated in the Works, regardless of previous approval of such material until the deficiencies have been rectified in an acceptable manner.

**B.5** Stockpile areas shall be reinstated, including the spreading of stored topsoil, to the satisfaction of the Engineer on completion of stockpiling activities

## **C. Sampling and Testing**

**C.1** Sampling and testing procedures shall conform to the relevant requirements of Part 1- Section 4-6: Samples and Approvals of the Specification and with the following requirements.

**C.2** The Contractor shall submit to the Engineer, at least 10 days prior to the scheduled beginning of crushing and screening operations, a statement of origin and composition of all stone and/or gravel aggregates and granular materials proposed for use in the Works.

**C.3** In order to ascertain the properties of granular and aggregate materials, the Contractor shall submit for testing and approval representative samples of all materials intended for incorporation in the Works, prior to starting quarry or borrow pit operations. The representative samples shall be taken by the Contractor in the presence of the Engineer.

**C.4** Tests performed by the Contractor shall be used for assessing the locations, extent of deposits and quantities of materials that will conform to the Specification when properly processed but shall not obviate the need for further testing if required by the Engineer. Approval of specific sources of materials shall not be construed as final approval and acceptance of materials from such sources.

**C.5** The Contractor shall conduct necessary tests on materials in field laboratories in the presence of the Engineer and the Contractor's Materials Engineer.

**C.6** Processed materials shall be tested and approved before being stockpiled on Site or incorporated in the Works and shall be inspected and tested at any time during preparation, storage and use. Materials awaiting testing and approval shall not be unloaded and mixed with materials previously approved. If the grading or quality of any materials delivered to the Site does not conform to requirements of the Specification, the Engineer shall reject these materials.

**C.7** Materials shall be tested in accordance with Table 3.1.1 after mixing with water at the mixing plant.

**C.8** Samples shall satisfy all specified test requirements. The Contractor shall permit the Engineer to inspect any and all materials used or to be used, at any time during or after their preparation or while being used during progress of the Works. Materials not complying with the Specification, whether in place or not, shall be removed promptly from the Site. The Contractor shall furnish all necessary labour, transport, tools and equipment required by the Engineer for such inspections.

**Table 3.1.1: Required Tests and Minimum Repetition for Sub Base and Base Course Materials**

<b>Source of Materials</b>	
<b>Required Tests</b>	<b>Repetition Required for all Tests</b>
1. Gradation of Materials 2. Plasticity Index	<ul style="list-style-type: none"><li>• Test for each source and every 2000 m<sup>3</sup></li></ul>
1. Abrasion 2. C.B.R. 3. Soundness 4. Percentage of fractured Grains (Base course) 5. Clay content 6. Sand equivalent	<ul style="list-style-type: none"><li>• When material source or process changes and when otherwise instructed by the Engineer</li></ul>

**3.01.03 GRANULAR MATERIAL FOR SUB-BASE**

**A.** Granular material for use in sub-base courses shall be a naturally occurring gravel, blended as necessary with fine or coarse material and screened to produce the specified gradation. Crushing of natural granular material shall not normally be required, unless for meeting the grading requirements, producing a higher quality sub-base with improved mechanical stability or when shown on the Drawings.

**B.** Gravel shall consist of hard, durable and sound rock fragments, free from dirt, organic matter, shale and other deleterious substances.

C. Granular materials for sub-base shall meet the requirement of class A or B as shown in table 3.1.2, when tested in accordance with AASHTO T-27 after dry mixing and just before spreading and compacting. The class of granular material to be used shall be as shown on the Drawings or as selected by the Engineer. The actual gradation shall be continuous and smooth within the specified limits for each Class.

**Table 3.1.2: Gradings of Granular Material by Class**

<b>Sieve Designation (Square Openings)</b>	<b>Percent by Weight Passing</b>	
	<b>Class A</b>	<b>Class B</b>
50 mm (2 in.)	100	100
25 mm (1 in.)	-	75 - 95
9.5 mm (3/8 in.)	30 – 65	40 - 75
4.75 mm (No. 4)	25 – 55	30 - 60
2.00 mm (No. 10)	15 – 40	20 - 45
0.425 mm (No. 40)	8 – 20	15 - 30
0.075 mm (No . 200)	2 – 8	5 - 20

D. The material shall contain a maximum 5% clay content at any stage of construction when tested in the Hydrometer Test in accordance with AASHTO T88.

E. The loss in weight of granular material shall not exceed 50% after 500 revolutions, when tested in accordance with AASHTO T 96 (Los Angeles Abrasion Test).

F. The granular material shall have a 4-day soaked CBR of not less than 30 when compacted at 100% of modified proctor AASHTO (T 180-D) and tested in accordance with AASHTO T 193.

G. When tested for soundness in accordance with AASHTO T 104, the material shall not show signs of disintegration and the percentage loss in weight after 5 cycles shall not exceed 12 % in the case of the sodium sulphate test and 18% in the case of the magnesium sulphate test.

H. The portion of granular material, including any blended material, passing the 0.425 mm (No. 40) mesh sieve shall have a liquid limit (L.L.) of not more than 25 and a plasticity index (P.I.) not greater than 6 when tested in accordance with AASHTO T 89 and T 90.

I. If additional fine material is required to correct the gradation the granular material, or for adjusting the L.L. or P.I. of the fraction passing 0.425 mm (No 40) sieve, it shall be uniformly blended and mixed with the granular material. Additional fine material for these purposes shall be obtained from the crushing of stone, gravel, or slag, if naturally occurring fine material is not available.

#### **3.01.04 AGGREGATES FOR BASE COURSES**

A. Aggregates for use in base course construction shall be either crushed stone or crushed gravel. The fine aggregate shall consist of screenings obtained from crushed stone,

gravel or sand. Aggregate shall be washed if necessary to remove excessive quantities of clay, silty clay or salts.

**B.** Crushed stone shall consist of hard, durable particles or fragments of stone, free from dirt or other objectionable matter and shall contain not more than 8% of flat, elongated, soft or disintegrated pieces.

**C.** Crushed gravel shall consist of hard durable stones, rocks and boulders crushed to specified sizes and shall be free from excess flat, elongated, soft or disintegrated pieces, dirt or other objectionable matter

**D.** The method used in the production of crushed gravel shall provide a uniform material quality. The crushing of the gravel shall result in a product having at least 90% by weight of particles with at least one fractured face. All stones, rocks, and boulders of inferior quality occurring in the pit shall be discarded.

**E.** Any material passing the 4.75 mm (No. 4) sieve and produced in the crushing process may be incorporated in the base material up to the grading limits required for the base course aggregate.

**F.** Crushed aggregate for base course shall meet the requirements of Class A or Class B gradings as shown in Table 3.1.3 when tested in accordance with AASHTO T 27 after mixing with water, just before spreading and prior to compacting. The class of aggregate to be used shall be as shown on the Drawings or as selected by the Engineer. The actual grading shall be continuous and smooth within the specified limits for each Class. Gap graded aggregate shall not be accepted. If gradings are tested after compaction a tolerance of 3% shall be allowed in the upper limit for the percentage of material passing the 200 sieve.

**Table 3.1.3: Grading of Base Course Aggregate by Class**

<b>Sieve Designation (Square Openings)</b>	<b>Percent by Weight Passing</b>	
	<b>Class A</b>	<b>Class B</b>
50 mm (2 in.)	100	-
25 mm (1 in.)	75 - 95	100
9.5 mm (3/8 in.)	40 - 75	50 - 85
4.75 mm (No. 4)	30 - 60	35 - 65
2.00 mm (No. 10)	20 - 45	25 - 50
0.425 mm (No. 40)	15 - 30	15 - 30
0.075 mm (No. 200)	5 - 20	5 - 15

**G.** The amount of the fraction of material passing the No 200 mesh sieve shall not exceed one half of the fraction passing the No. 40 mesh sieve.

**H.** The loss in weight shall be in the range of 45% after 500 revolutions, when tested in accordance with AASHTO T 96 (Los Angeles Abrasion Test) and the sand equivalent shall be a minimum of 43% when tested in accordance with AASHTO T176.

**I.** The crushed aggregate base course material shall have a 4-day soaked CBR of not less than 80 when compacted at 100% of modified proctor AASHTO (T180-D) and tested in accordance with AASHTO T 193.

**J.** When tested for soundness in accordance with AASHTO T 104, the material shall not show signs of disintegration and the loss by weight shall not exceed 12% in the case of the sodium sulphate test and 18% for the magnesium sulphate test.

**K.** The portion of aggregate, including any blended material, passing the 0.425 mm (No. 40) mesh sieve shall have a Liquid Limit (L.L.) of not more than 25 and Plasticity Index (P.I.) of not more than 6 when tested in accordance with AASHTO T 89 and T 90.

**L.** If additional fine material is required to correct the aggregate grading or for adjusting the L.L. or P.I. of the fraction passing the 0.425 mm (No. 40) sieve, it shall be uniformly blended and mixed with the aggregate material at the crushing plant or by a method approved by the Engineer. Reworking of the material in situ to obtain the specified gradation shall not be permitted. Additional fine material shall only be obtained from the crushing of stone, gravel or natural material.

### **3.01.05 STABILIZING AGENTS**

#### **A. Cement as Stabilizing Agent**

Cement shall be Portland cement conforming to AASHTO M 85 Type II, or sulphate resistant Portland cement conforming to AASHTO M 85, Type V.

#### **B. Bitumen as Stabilizing Agent**

**B.1** Bitumen may include straight run (penetration grade) bitumen; RC cutback bitumen, MC cutback bitumen, or cationic emulsified bitumen. Penetration grade, cutback bitumen and emulsified bitumen shall conform to all relevant requirements herein.

**B.2** The selection of a suitable bitumen will depend on the properties of the material to be stabilized and shall be subject to laboratory and field trials by the Contractor, under the supervision of the Engineer.

**B.3** When the material moisture content is high and material must be dried, penetration grade bitumen or viscous cutback bitumen shall be used and materials mixed using appropriate plant.

**B.4** When the natural moisture content of the material is low, cutback bituminous or emulsified bitumen shall be used.

#### **C. Lime as Stabilizing Agent**

**C.1** Hydrated lime (calcium hydroxide) and quicklime (calcium oxide) shall conform to AASHTO M 216 Mixing of different brands of lime or use of lime from different mills shall not be permitted.



**C.2** Lime slurry shall be a homogeneous pumpable mixture of lime and water. Slurry shall be a premixed material in which the lime solids content shall be not less than 30 % by weight.

**3.01.06 MEASUREMENT**

Granular aggregate materials for Sub-Base and Base Course shall be measured as prescribed in the appropriate Sections of these Specifications.

## **SECTION 3.02      GRANULAR SUB-BASE COURSE**

### **3.02.01              SCOPE**

The work covered in this Section consists of furnishing granular sub-base material of the required class, mixing, spreading on prepared subgrade, compacting and finishing, all as and where shown on the Drawings

### **3.02.02              MATERIALS**

All materials shall conform to the relevant requirements of Section 3.01 - Materials for Sub-Base and Base Courses, in respect of granular material for sub-base construction and the particular requirements for sub-base courses detailed on the Drawings.

### **3.02.03              SUBGRADE SURFACE PREPARATION**

A. The subgrade shall have previously been constructed in accordance with the requirements of Section 2.07: Subgrade Construction, properly maintained and kept well drained.

B. The minimum thickness of sub-base shall be as shown on the Drawings. At transition points, such as specified changes of sub-base thickness, areas adjacent to structures and at tie-ins to existing pavements the subgrade shall be adjusted to a depth sufficient to permit construction of the sub-base course to the specified finished levels and thicknesses. Transitions shall be of sufficient lengths to avoid abrupt changes of grade that compromise drainage paths in the sub-base and shall be within plus or minus 3 % of the final design grade unless otherwise directed by the Engineer. Surplus material shall be removed and disposed of.

C. The subgrade shall be inspected and approved immediately prior to commencement of sub-base construction. Any soft, yielding material shall be removed and replaced by topping material approved by the Engineer. Holes, depressions and other irregularities shall be made good as directed by the Engineer and the subgrade recompact and finished to receive the sub-base course.

### **3.02.04              EQUIPMENT**

Equipment used to handle, place, spread, water, compact and finish sub-base shall conform to the requirements of Part 1 of the Specification - Section 4-4: Contractor's Plant and Equipment and with the Contractor's approved Work Programme.

**3.02.05**

**CONSTRUCTION OF TRIAL SECTIONS**

**A.** If directed by the Engineer, before commencement of sub-base construction, the Contractor shall lay and compact trial sections of varying thickness of sub-base. Each trial section shall be 2 lanes wide by 50 metres long at approved locations on or close to the Site. Each trial section shall be laid using the same materials, mix proportions, mixing, spreading and compaction equipment and construction procedures proposed for use in the Works.

**B.** The objectives of these trials shall be to determine the adequacy of the Contractor's equipment, the loose depth measurements that will result in the specified compacted layer depths, the field moisture content and the relationship between the number of compaction passes and the resulting density of the sub-base material.

**3.02.06**

**CONSTRUCTION**

**A. Stockpiling of Granular Material**

Stockpiling procedures shall conform to the relevant requirements of Section 3.01 - Materials for Sub-Base and Base Courses.

**B. Mixing and Spreading**

**B.1** All components of sub-base course material shall be mixed thoroughly and uniformly with water in situ. The amount of water added shall be sufficient to maintain the material within the specified moisture content range at the time of compaction. Water shall only be added as necessary during placing and compaction of sub-base material. Watering of granular material in stockpiles or in trucks before or during delivery to the Site shall not take place.

**B.2** The sub-base material shall be placed on the subgrade in a uniform layer or layers not exceeding 200 mm thickness (after compaction).

**B.3** The Engineer shall permit compaction of sub-base in layers of up to 300mm if heavy duty vibratory compaction equipment is used and compaction tests with appropriate testing equipment indicate that the specified compaction standard will be attained and uniform throughout the thickness of the layer.

**B.4** Sub-base material shall be placed to the required width using a self-propelled spreader or a motor grader equipped with blade extensions. Water shall be applied by approved spraying equipment and thoroughly mixed with the sub-base material.

**B.5** The material shall not be handled in such a way as to cause segregation. If the spreading equipment causes segregation in the material or leaves ridges or other objectionable marks on the surface which cannot be readily eliminated or prevented by adjustment of the equipment, the use of such equipment shall forthwith be discontinued and replaced by a spreader or grader capable of spreading the material in a satisfactory manner.

**B.6** All segregated material shall be removed and replaced with well-graded material. Skin patching shall not be permitted. Only minor surface manipulation and

watering to achieve the required surface tolerances shall be permitted during the compaction process.

**B.7** Neither hauling nor placement of material shall be permitted when, in the judgment of the Engineer, the weather or surface conditions are such that hauling operations will cause cutting or rutting of the subgrade or cause contamination of the sub-base material.

## **C. Compaction**

**C.1** The Contractor shall plan the sequence of operations so that the least amount of water will be lost by evaporation from uncompleted surfaces. If the Contractor delays placing of succeeding layers of material to the extent that additional water is required to prevent ravelling or excessive drying the application of such water shall be carried out as directed by the Engineer and at the Contractor's expense.

**C.2** The sub-base material shall be compacted by progressing gradually from the outside towards the centre, with each succeeding pass uniformly overlapping the previous pass.

**C.3** Rolling shall continue until the entire thickness of each sub-base layer is thoroughly and uniformly compacted to 100 % AASHTO T 180 (Method D) maximum density. Final rolling of the completed course shall be completed by a self-propelled roller. Rolling shall be accompanied by sufficient blading, to ensure a smooth surface, free from ruts or ridges and having the proper shape. When additional water is required, it shall be applied by a method approved by the Engineer.

**C.4** Any areas inaccessible to normal compaction equipment shall be compacted by portable mechanical tampers until the required standard of compaction is achieved.

**C.5** Each layer shall be completely compacted and approved prior to delivery of materials for the subsequent layer.

**C.6** Prior to placing a subsequent layer, the existing surface shall be made sufficiently moist as directed, to ensure a proper bond between layers.

**C.7** The edges and edge slopes of the sub-base course shall be bladed or otherwise dressed to conform to the lines and dimensions shown on the Drawings and to present straight, neat lines and slopes free of loose material.

**C.8** Material which has dried out prior to final compaction or which has dried and de-compacted subsequent to final compaction shall be watered and recompacted using equipment and procedures approved by the Engineer. If the Contractor is unable to return the material to its original or specified condition with respect to compaction, thickness and surface tolerances, the Contractor shall remove the material and reconstruct the sub-base course on a re-approved subgrade.

**D. Tolerances**

**D.1** The fully compacted and completed sub-base course shall conform to the lines, grades and cross sections as shown on the Drawings.

**D.2** The levels of the finished sub-course shall be checked by the Contractor in the presence of the Engineer at maximum intervals of 10 m and at intermediate points as directed.

**D.3** The tolerances on levels of the finished surface shall be plus 10 mm to minus 20 mm. A minus tolerance shall be compensated by the addition of material in the proceeding layer.

**D.4** When the finished surface is tested with a 3 m long straightedge, placed parallel to, or at right angles to the centreline, the maximum deviation of the surface from the testing edge between any two contact points shall not exceed 10 mm.

**D.5** All areas which exceed the specified tolerances shall be corrected by removing the defective sections of sub-base and reconstructing them or, if approved by the Engineer, by the addition of new material, mixing, re-compacting and finishing to the specified standard.

**E. Maintenance of Completed Sub-Base**

Following completion and acceptance of the sub-base course, it shall be maintained by the Contractor at his own expense. The sub-base shall be bladed, broomed and otherwise maintained, keeping it free from ravelling and other defects until such time as the base course is placed. Water shall be applied at such times and in such quantities as directed by the Engineer.

**3.02.07 TESTING**

**A.** Materials at source or at the stockpile area shall be tested in accordance with Section 3.01 Materials for Sub- Base and Base Course. Materials laid and compacted shall be tested in accordance with Table 3.2.1 below and, if found satisfactory, shall be approved by the Engineer. This approval shall not be deemed to constitute acceptance of the sub-base course for full payment purposes.

**B.** Sampling and testing shall conform to the relevant requirements of part 1 of the Specification, Section 4-6 Samples and Approvals.

**C.** Compaction shall be tested in accordance with AASHTO T 191 or AASHTO T 205. If there is a delay between the construction of any layer and the following layer, if necessary and required by the Engineer the compaction of the lower layer shall be retested to ensure that it has not loosened due to traffic, passage of construction equipment, adverse weather conditions or otherwise.

**Table 3.2.1: Required Tests and Minimum Repetition for Sub-Base Course Material**

<b>Control on Site after Laying and Compaction</b>	
<b>Required Tests</b>	<b>Frequency</b>
1. Proctor 2. Gradation of Materials 3. Plasticity Index 4. C.B.R 5. Abrasion 6. Sand equivalent 7. Clay lumps & friable particles 8. Field Density	<ul style="list-style-type: none"><li>• Test for every 500 m for each layer and lane width, when material source or process changes and when otherwise instructed by the Engineer,</li></ul>
9. Thickness	<ul style="list-style-type: none"><li>• Test for every 1000 m<sup>2</sup> and for every layer</li></ul>

### **3.02.08 MEASUREMENT**

**A.** Granular Sub-Base Course shall be measured by the cubic metre of granular material furnished, screened, crushed if necessary, mixed with water, placed, spread, compacted and finished, completed, and accepted. Measurements shall be of the volumes computed from the cross sections shown on the Drawings and of the field measurements of area and compacted depth of each Trial Section.

**B.** Rates for Granular Sub-Base Course in Temporary Diversions shall also include for removal and disposal of the sub-base material and reinstatement of the area of the temporary diversion, to the satisfaction of the Engineer, on completion of use.

**C.** No measurement shall be made for direct payment of over-depth or over-wide construction, regardless of the Engineer's permission for it to remain in place.

## **SECTION 3.03      AGGREGATE BASE COURSE**

### **3.03.01                  SCOPE**

The work covered in this Section consists of furnishing crushed aggregate base course material of the required class, mixing, spreading on a prepared sub-base course, compacting and finishing, as and where shown on the Drawings.

### **3.03.02                  MATERIALS**

All materials shall conform to the relevant requirements of Section 3.01 - Materials for Sub-Base and Base Courses, in respect of crushed aggregate for base course construction and the particular requirements for base courses detailed on the Drawings.

### **3.03.02                  SURFACE PREPARATION**

A.      Where a sub-base course is present, it shall have previously been constructed in accordance with the requirements of Section 3.02: Granular Sub-Base Course and properly maintained and kept well drained thereafter.

B.      The sub-base surface shall be inspected and approved prior to commencement of base construction. Holes, depressions and other irregularities shall be made good as directed by the Engineer and the sub-base recompacted as necessary and finished ready to receive the base course.

C.      Where a sub-base course has been omitted in the Drawings and the aggregate base course is placed directly on completed sub-grade, preparation of the sub-grade surface shall be as specified in Section 3.02 - Granular Sub-Base Course.

### **3.03.03                  EQUIPMENT**

Equipment used to handle, place, spread, water, compact and finish base course shall conform to the requirements of Part 1 - Section 4-4: Contractor's Plant and Equipment of the Specification and with the Contractor's approved work programme.

### **3.03.04                  CONSTRUCTION OF TRIAL SECTIONS**

A.      If the Engineer deems it necessary the Contractor shall lay and compact trial sections of varying thickness of base. Each trial section shall be 2 lanes wide by 50 m long, at locations agreed by the Engineer on or close to the Site. Each trial section shall be laid using the same materials, mix proportions, mixing, spreading and compaction equipment, and construction procedures, proposed for use in the Works.

B.      The objectives of these trials shall be to determine the adequacy of the Contractor's equipment, the loose depth measurements that will result in the specified compacted layer depths, the field moisture content for compaction and the relationship between the number of compaction passes and the resulting density of the base course material.

### **3.03.05 CONSTRUCTION**

#### **A. Stockpiling of Aggregate Materials**

Stockpiling procedures shall conform to the relevant requirements of Section 3.01 - Materials for Sub-base and Base Courses.

#### **B. Mixing and Spreading**

**B.1** All components of base course material may be premixed with water, in a pugmill mixing plant or on site. The amount of water added, as determined, shall be such that the material will be uniform and within the specified moisture content range at the time of compaction. The Engineer shall consider other methods of mixing provided such method(s) do not reduce the standard of work. The Contractor shall demonstrate, in the presence of the Engineer, his ability to attain the requirement given in this Specification.

**B.2** The premixed material shall be placed on the sub-base in a uniform layer or layers not exceeding 250 mm in thickness before compaction. Where the required uncompacted thickness is greater than 250 mm but less than 500 mm, the material shall be placed in layers of equal thickness.

**B.3** Compaction of sub-base in layers of up to 350 mm after compaction shall be permitted if heavy duty vibratory compaction equipment is used and compaction tests with appropriate testing equipment indicate that the specified compaction standard will be attained and uniform throughout the thickness of the layer.

**B.4** The base course material shall be placed to the required width using a self-propelled spreader or motor grader and shall be delivered such that it is ready for compaction without further shaping.

**B.5** The material shall not be handled in such a way as to cause segregation. If the spreader causes segregation in the material or leaves ridges or other objectionable marks on the surface which cannot be readily eliminated or prevented by adjustment of the spreader operation, the use of such a spreader shall forthwith be discontinued and it shall be replaced by a spreader capable of carrying out this work in a satisfactory manner.

**B.6** All segregated material shall be removed and replaced with well-graded material. Skin patching shall not be permitted. Only minor surface manipulation and watering to achieve the required surface tolerances shall be permitted during the compaction process.

**B.7** Hauling or placement of material shall not be permitted when, in the judgment of the Engineer, the weather or surface conditions are such that hauling operations will cause cutting or rutting of the sub-base or sub-grade or cause contamination of the base material.



### **C.     Compaction**

**C.1**       The Contractor shall plan the sequence of operations so that the least amount of water will be lost by evaporation from uncompleted surfaces. If the Contractor delays placing of succeeding layers of material to the extent that additional water is required to prevent ravelling or excessive drying, the application of such water shall be carried out using a method approved by the Engineer and at the Contractor's expense.

**C.2**       The base course material shall be compacted by means of suitable compaction equipment, progressing gradually from the outside towards the centre, with each succeeding pass uniformly overlapping the previous pass.

**C.3**       Rolling shall continue until the entire thickness of each base layer is thoroughly and uniformly compacted to 100% AASHTO T 180 (Method D) maximum density. Final rolling of the completed course shall be by means of an approved self-propelled roller. Rolling shall be accompanied by sufficient blading to ensure a smooth surface, free from ruts or ridges and having the proper shape. When additional water is required, it shall be applied by a method approved by the Engineer.

**C.4**       Any areas inaccessible to normal compaction equipment shall be compacted by use of portable mechanical tampers until the required standard of compaction is achieved.

**C.5**       Each layer shall be completely compacted and approved prior to delivery of materials for the following layer.

**C.6**       Prior to placing a following layer, the surface shall be made sufficiently moist, to the satisfaction of the Engineer, to ensure an effective bond between the layers.

**C.7**       The edges and edge slopes of the base course shall be bladed or otherwise dressed to conform to the lines and dimensions shown on the Drawings and to present straight, neat lines and slopes as free of loose material as practicable.

**C.8**       Material which has dried out prior to final compaction or which has dried and de-compacted subsequent to final compaction shall be watered and recompactd using approved equipment and procedures. If the Contractor is unable to return the material to its original or specified condition with respect to compaction, thickness and surface tolerances, the Contractor shall scarify the material in the upper layer and reconstruct the base course on a re-approved sub-base surface to the satisfaction of the Engineer.

### **D.     Tolerances**

**D.1**       The fully compacted and completed base course shall conform to the lines, grades and cross sections as shown on the Drawings.

**D.2**       The elevations of the finished base course shall be checked by the Contractor in the presence of the Engineer at intervals of 20 metres on straight lines and of 10 metres on curves and at intermediate points as directed.

**D.3** The tolerances on elevations of the finished surface shall not exceed + 10 mm or -15 mm.

**D.4** When the finished surface is tested with a 4 metre long straightedge, placed parallel to or at right angles to the centreline, the maximum deviation of the surface from the testing edge between any two contact points shall not exceed 12 mm.

**D.5** All areas which exceed the specified tolerances shall be corrected by removing defective sections of base course and reconstructing them or by scarifying and adding new material and re-compacting and finishing to the specified standard.

**E. Maintenance of Completed Base**

Following completion and acceptance of the base course it shall be maintained by the Contractor at his own expense. The surface shall be broomed rolled and otherwise maintained, keeping it free from ravelling and other defects until the following course is placed. Water shall be applied at such times and in such quantities as directed by the Engineer.

**3.03.06 TESTING**

**A.** Base course material shall be tested in accordance with Table 3.3.1 after in-situ compaction and if satisfactory shall be approved for use by the Engineer. This approval shall not be deemed to constitute acceptance of the base course for full payment purposes.

**B.** Sampling and testing shall conform to the relevant requirements of specifications Part 1 - Section 4-6 Samples and Approvals.

**C.** Compaction shall be tested in accordance with AASHTO T 191, AASHTO T 205 as specified on the Drawings or as agreed by the Engineer. If there is a significant delay between the construction of any layer and the following layer, the Engineer may require the compaction of the lower layer to be retested to ensure that it has not loosened due to traffic, passage of construction equipment, adverse weather conditions or otherwise.

**Table 3.3.1: Required Tests and Minimum Repetition for As- Laid Base Course Material**

<b>Control on Site after Laying and Compaction</b>	
<b>Required Tests</b>	<b>Frequency</b>
1. Proctor 2. Gradation of Materials 3. Plasticity Index 4. C.B.R 5. Abrasion 6. Sand equivalent 7. Clay lumps & friable particles 8. Field Density	<ul style="list-style-type: none"><li>• Test for every 500 m for each layer and lane width and when material source or properties changed</li></ul>
9. Thickness	<ul style="list-style-type: none"><li>• Test for every 1000 m<sup>2</sup> and for every layer</li></ul>

**3.03.07 MEASUREMENT**

**A.** Aggregate Base Course shall be measured by the cubic metre of aggregate materials furnished, crushed, screened, mixed with water, placed, spread, compacted and finished, completed, and accepted. Measurements shall be of volumes computed from the cross sections shown on the Drawings and of the field measurements of the area and compacted depth for each Trial Section.

**B.** Rates for Aggregate Base Course in Temporary Diversions shall also include for removal and disposal of the sub-base material and reinstatement of the area of the temporary diversion, to the satisfaction of the Engineer, on completion of use.

**C.** No measurement shall be made for direct payment of overdepth construction, regardless of the Engineer's permission for it to remain in place.