ROAD PAVEMENTS - UNBOUND, HYDRAULICALLY BOUND AND OTHER MATERIALS.

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ROAD PAVEMENTS - UNBOUND, HYDRAULICALLY BOUND AND OTHER MATERIALS.

NG 800 General

1 Advice on the use of recycled materials and on design and construction of sub-bases and road bases is published in The Design Manual for Roads and Bridges (DMRB) Volume 7.

NG 801 General Requirements for Unbound, Hydraulically Bound and Other Materials

1 The permitted alternatives are Type 1 for unbound base courses and Types 1 and 2 granular material for sub-bases.

2 Compaction control is based on the relation $E_{v2}/E_{v1} < 2.2$ and may be carried out as a rule in case of soils and granular materials which don’t contain plastic fines.

3 Sub-Clause 801.12 (viii) permits combinations of different types of compacting equipment provided each type contributes its correct proportion of the total compactive effort. Thus if a machine when operated singly is required in Table 8/1 to apply X passes and that same machine actually applies K passes, then the sum of the values of K/X for each of the types of plant used in combination should equal or exceed unity.

NG 802 Use of surfaces by Traffic and Construction Plant

4 Under the Conditions of Contract the Contractor is responsible for care of the Works including the protection of the base course, sub-base and sub-grade. The choice of permitted materials is intended to allow the Contractor to make the most economical use of available materials suitable for his method of construction. The contractor shall inform the Overseeing Organization if material of lower quality than required shall be used (e.g. type 4 instead of type 2 in foundation courses) because an increase of the design thickness might be necessary.

5 As some unbound sub-bases are moisture susceptible and are unsuitable for construction traffic in wet periods, the Contractor’s choice of sub-base should be related to the time of year and his programme and method for laying the base-course and subsequent layers. Long delays could be avoided by the use of cement bound material. Traffic running on the sub-base may cause irreparable damage to the subgrade or capping (subgrade improvement). Protection of the sub-base against weather can best be achieved by laying the subsequent layers as soon as possible.

6 Some sub-base and base course materials degrade during normal laying and compacting operations. If there is any doubt about degradation of the material during laying and compacting, then sampling points should be chosen for each material which will be representative of the quality of the laid material.

7 Under wet conditions some Type 2 granular sub-base material can rapidly deteriorate if used by construction traffic and the sub grade can be damaged by rutting, which could result in permanent soft spots. Type 2 granular sub-base material is suitable for its purpose if its moisture content is kept around the optimum value. Work should preferably be programmed so that the base course is applied before the sub-base is wetted.

8 Any thickening shall be across the full width of that part of the pavement that is undergoing new construction. If temporary haul roads are laid and later removed they must be placed so that drainage of the formation and sub-base surface is not impeded.

NG 803,NG 804 Granular Material Types 1 & 2

1 Clause 803 excludes all gravels from granular sub-base material Type 1 and current design requirements exclude granular sub-base material Type 2 in heavily trafficked pavements. Where local experience indicates that these materials can be used successfully, the Overseeing Organization may require that a Substitute Clause should be written to permit their use. The inclusion of up to 12.5% natural sand in Type 1 is permitted at the discretion of the supplier to adjust the material grading.
2 The value of CBR required for materials to Clause 804 will depend upon traffic loading. For flexible roads carrying a traffic loading of more than 2 msa the sub-base strength should be at least an equivalent of CBR 30%. For traffic ranges below 2 msa the strength may be reduced to CBR 20%.

3 If more than 10% of the material is retained on a 20 mm sieve, the whole material can be assumed without test to have a CBR value of 30% or more. CBR tests should be carried out (when necessary) on specimens which are compacted at a density and moisture content which represent equilibrium conditions under the completed pavement. In most cases the moisture content and density specified in sub-Clause 804.3 will apply but where this is not so it will be necessary to specify separately the required values of density and moisture content for the CBR test. The density relating to a particular air voids content can be calculated using the formula given in BS 1377: Part 4. Compaction into the CBR mould should be carried out in such a way that the required density is obtained uniformly. The number of surcharge discs used in the CBR test should be equivalent to the weight of road construction above the sub-base.

4 The test procedure for the determination of optimum moisture content (OMC) in compliance with BS 5835 has been developed specifically for graded aggregates and gives more reproducible results than the vibrating hammer test of BS 1377: Part 4 for these materials. Whilst there is no specified moisture content for laying and compacting materials to Clause 803, in order to satisfy the requirements of sub-Clauses 801.10 and 803.3, it will be necessary to carry out these operations at optimum moisture content or thereabouts.

5 Routine water absorption tests should be made on the delivered material. If any result from these tests exceeds the declared value (d) by more than 0.5 i.e., > (d + 0.5)%, further investigation will be required.

6 Sub-Clauses 803.2 and 804.2 describe requirements for material passing the 425-micron BS sieve. If the foreign materials component of recycled coarse aggregate or recycled concrete aggregate were to be ‘clay lumps’, the material may fail these tests and hence fail to meet the Specification.

NG 806 Granular Material Type 4

General

1 Trafficking trials of Type 4 granular sub-base material carried out by TRL have produced rut-depths well within the upper recommended limit of 30 mm.

Subject to experience in use, it may be possible to increase the asphalt content specified in Clause 806.2

Transport and Laying

2 When dry, Type 4 granular sub-base material exhibits a considerable resistance to compaction due to the friction of the bitumen coating. The addition of water has a significant effect on the state of compaction by reducing the friction between the bitumen-coated particles. Type 4 granular sub-base material should therefore be compacted at moisture contents close to the optimum as determined by the BS 5835 method. The test procedure for the determination of the OMC in compliance with BS 5835 has been developed specifically for graded aggregates and gives more reproducible results than the vibrating hammer test of BS 1377: Part 4 for these materials.

Material Properties

3 The particle size distribution of asphalt arisings is best described by the term ‘lump size distribution’ because of the binding effect of bitumen. The grading envelope obtained will be dependent on the duration of shaking, the temperature at which the determination is carried out and the grading of the mineral particles within the asphalt arisings. Agglomeration of lumps can occur in stockpiled material especially in hot weather or when the material is stored for long periods. It is important that, at the time of placing, the asphalt arisings comply with the specified lump size distribution and care should be taken to ensure that material taken from a stockpile is to the required grading. It may be necessary to demonstrate that the material actually placed in-situ meets the grading specification rather than to rely on tests carried out prior to laying. Lumps, or individual particles of aggregate separated by the planning process, should be angular in appearance. Rounded particles that can be present when using arisings containing
gravel aggregates can lead to difficulties in meeting the rutting criterion.

4 Particle durability in terms of the soundness test (BS 812: Part 121) might be necessary on extracted aggregate if the aggregates have not been tested prior to the introduction of bitumen.

5 Particle hardness in terms of the ten per cent fines test (BS 812: Part 111) might be necessary on extracted aggregate if the aggregates have not been tested prior to the introduction of bitumen.

6 The performance of unbound granular sub-bases is dependent on the bearing strength of the compacted material. The measurement of bearing capacity in terms of CBR has not been specified for Type 4 granular sub-base material. The measurement of CBR on the Type 4 granular sub-base materials containing bitumen is problematic because the results are dependent upon the temperature at the time of compaction, the temperature at the time of testing and the duration of loading. However, as the grading envelope ensures that less than 10% of the material is retained on the 20 mm sieve, it can be assumed without test that the material will have an adequate CBR value.

Trafficking Trial

7 A convenient test vehicle is a 3-axle tipper lorry loaded to a gross mass of 24 tonnes (1 pass is equivalent to 3 standard axles). The selection of the test vehicle however should reflect actual site conditions and the equivalent standard axle load should be calculated using the 4th power law.

i.e.:

\[ N = \text{sum of } (W/10)^4 \text{ for each axle in turn} \]

Where: \( N \) = number of standard axles
\( W \) = axle load in tonnes