SERIES 800 (05/01)
ROAD PAVEMENTS - UNBOUND, HYDRAULICALLY BOUND AND OTHER MATERIALS

Contents

NATIONAL ALTERATIONS OF THE OVERSEEING ORGANISATIONS OF SCOTLAND, WALES AND NORTHERN IRELAND

Contents

# denotes a Clause or Sample Appendix which has a substitute National Clause or Sample Appendix for one or more of the Overseeing Organisations of Scotland, Wales or Northern Ireland.

Note
The Overseeing Organisation is issuing separate interim advice with respect to the introduction of European standards for aggregates. (11/03)

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ROAD PAVEMENTS - UNBOUND, HYDRAULICALLY BOUND AND OTHER MATERIALS

#801 (05/01) General Requirements for Unbound, Hydraulically Bound and Other Materials

1 Sub-bases and roadbases shall be made and constructed using materials described in the following Clauses. The permitted alternatives for each part of the Works shall be as described in Appendix 7/1.

2 Blastfurnace slag for use in sub-bases shall comply with BS 1047 : 1983. Steel slag may be used provided it has been weathered and conforms with the requirements of BS 4987 : Part 1. Materials other than slag when placed within 500 mm of cement-bound materials, concrete pavements, concrete structures or concrete products shall have a water soluble sulfate content not exceeding 1.9 g of sulfate (expressed as SO_3) per litre when tested in accordance with BS 812 : Part 118, Clause 5.

3 Where recycled coarse aggregate or recycled concrete aggregate is used in accordance with this Series, it shall have been tested in accordance with Clause 710.

Transporting

4 Plant-mixed material shall, when mixed, be removed at once from the mixer, transported to the point where it is to be laid and protected from weather both during transit from the mixer to the laying site and whilst awaiting tipping.

Laying

5 Materials in a frozen condition shall not be incorporated in the Works but may be used, if acceptable, when thawed. Materials shall not be laid on any surface which is frozen or covered with ice.

6 All material shall be placed and spread evenly. Spreading shall be undertaken either concurrently with placing or without delay. Unbound and hydraulically bound roadbase material shall be spread using a paving machine or a suitable spreader box and operated with a mechanism which levels off the material to an even depth.

7 Except where otherwise stated in Appendix 7/1, material up to 225 mm compacted thickness shall be spread in one layer so that after compaction the total thickness is as specified. Material of compacted thickness greater than 225 mm shall be laid in two or more layers and the minimum compacted thickness of any such layer shall be 110 mm. Where the layers of unbound material are of unequal thickness the lowest layer shall be the thickest layer.

Compaction

8 Compaction shall be completed as soon as possible after the material has been spread and in accordance with the requirements for the individual materials.

9 Full compaction shall be obtained over the full area including in the vicinity of both longitudinal and transverse joints.

10 Compaction of unbound materials shall be carried out by a method specified in Table 8/1, unless the Contractor demonstrates at site trials that a state of compaction achieved by an alternative method is equivalent to or better than that using the specified method.

11 The surface of any layer of material shall on completion of compaction and immediately before overlaying, be well closed, free from movement under construction plant and from ridges, cracks, loose material, pot holes, ruts or other defects. All loose, segregated or otherwise defective areas shall be removed to the full thickness of the layer, and new material laid and compacted.

12 For the purposes of Table 8/1 the following shall apply:

(i) The number of passes is the number of times that each point on the surface of the layer being compacted shall be traversed by the item of compaction plant in its operating mode (or struck, in the case of power rammers).

(ii) The compaction plant in Table 8/1 is categorised in terms of static mass. The mass per metre width of roll is the total mass on the roll divided by the total roll width. Where a smooth-wheeled roller has more than one axle, the category of the machine shall be determined on the basis of the axle giving the highest value of mass per metre width.

(iii) For pneumatic-tyred rollers the mass per wheel is the total mass of the roller divided by the number of wheels. In assessing the

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number of passes of pneumatic-tyred rollers the effective width shall be the sum of the widths of the individual wheel tracks together with the sum of the spacings between the wheel tracks provided that each spacing does not exceed 230 mm. Where the spacings exceed 230 mm the effective width shall be the sum of the widths of the individual wheel tracks only.

(iv) Vibratory rollers are self-propelled or towed smooth-wheeled rollers having means of applying mechanical vibration to one or more rolls:

(a) The requirements for vibratory rollers are based on the use of the lowest gear on a self-propelled machine with mechanical transmission and a speed of 1.5-2.5 km/h for a towed machine or a self-propelled machine with hydrostatic transmission. If higher gears or speeds are used an increased number of passes shall be provided in proportion to the increase in speed of travel.

(b) Where the mechanical vibration is applied to two rolls in tandem, the minimum number of passes shall be half the number given in Table 8/1 for the appropriate mass per metre width of one vibrating roll but if one roll differs in mass per metre width from the other, the number of passes shall be calculated as for the roll with the smaller value. Alternatively the minimum number of passes may be determined by treating the machine as having a single vibrating roll with a mass per metre width equal to that of the roll with the higher value.

(c) Vibratory rollers operating without vibration shall be classified as smooth-wheeled rollers.

(d) Vibratory rollers shall be operated with their vibratory mechanism operating at the frequency of vibration recommended by the manufacturer. All such rollers shall be equipped, or provided with devices indicating the frequency at which the mechanism is operating and the speed of travel. Both devices shall be capable of being read by an inspector alongside the machine.

(v) Vibrating-plate compactors are machines having a base-plate to which is attached a source of vibration consisting of one or two eccentrically-weighted shafts:

(a) The mass per square metre of base-plate of a vibrating-plate compactor is calculated by dividing the total mass of the machine in its working condition by its area in contact with compacted material.

(b) Vibrating-plate compactors shall be operated at the frequency of vibration recommended by the manufacturer. They shall normally be operated at travelling speeds of less than 1 km/h but if higher speeds are necessary, the number of passes shall be increased in proportion to the increase in speed of travel.

(vi) Vibro-tampers are machines in which an engine driven reciprocating mechanism acts on a spring system, through which oscillations are set up in a base-plate.

(vii) Power rammers are machines which are actuated by explosions in an internal combustion cylinder; each explosion being controlled manually by the operator. One pass of a power rammer shall be considered to have been made when the compacting shoe has made one strike on the area in question.

(viii) Combinations of different types of plant or different categories of the same plant will be permitted; in which case the number of passes for each shall be such proportion of the appropriate number in Table 8/1 as will together produce the same total compactive effort as any one operated singly, in accordance with Table 8/1.

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TABLE 8/1: Compaction Requirements for Granular Sub-base Material Types 1, 2 and 3

Type of compaction plant	Category	Number of passes for layers not exceeding the following compacted thicknesses: 110 mm	150 mm	225 mm
Smooth-wheeled roller (or vibratory roller operating without vibration)	Mass per metre width of roll:			
	over 2700 kg up to 5400 kg	16	unsuitable	unsuitable
	over 5400 kg	8	16	unsuitable
Pneumatic-tyred roller	Mass per wheel:			
	over 4000 kg up to 6000 kg	12	unsuitable	unsuitable
	over 6000 kg up to 8000 kg	12	unsuitable	unsuitable
	over 8000 kg up to 12000 kg	10	16	unsuitable
	over 12000 kg	8	12	unsuitable
Vibratory roller	Mass per metre width of vibrating roll:			
	over 700 kg up to 1300 kg	16	unsuitable	unsuitable
	over 1300 kg up to 1800 kg	6	16	unsuitable
	over 1800 kg up to 2300 kg	4	6	10
	over 2300 kg up to 2900 kg	3	5	9
	over 2900 kg up to 3600 kg	3	5	8
	over 3600 kg up to 4300 kg	2	4	7
	over 4300 kg up to 5000 kg	2	4	6
	over 5000 kg	2	3	5
Vibrating-plate compactor	Mass per square metre of base plate:			
	over 1400 kg/m^2 up to 1800 kg/m^2	8	unsuitable	unsuitable
	over 1800 kg/m^2 up to 2100 kg/m^2	5	8	unsuitable
	over 2100 kg/m^2	3	6	10
Vibro-tamper	Mass:			
	over 50 kg up to 65 kg	4	8	unsuitable
	over 65 kg up to 75 kg	3	6	10
	over 75 kg	2	4	8
Power rammer	Mass:			
	100 kg-500 kg	5	8	unsuitable
	over 500 kg	5	8	12

Induced Cracks

13 Hydraulically bound materials that have a strength of CBM3 or above (i.e. with an average minimum 7 day cube compressive strength of 10.0 N/mm^2 or greater) shall have cracks induced during construction as described in Clause 1047 and in Appendix 7/20.

Use of Surfaces by Traffic and Construction Plant

14 Construction plant and traffic used on pavements under construction shall be suitable in relation to the material, condition and thickness of the courses it traverses so that damage is not caused to the subgrade or the pavement courses already constructed. The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.

15 Where the Contractor proposes to use the sub-base or roadbase layers for construction plant he shall improve the sub-base or roadbase layers where necessary, to accommodate the method of construction and the type of plant and vehicles which he proposes to use, in order to avoid damage to the roadbase, sub-base, any capping and the subgrade. Any permanent thickening shall be across the whole width of the pavement. Temporary thickening shall not impede drainage of the sub-base or the subgrade.

Frost Heave

16 Subject to the tolerances given in Table 7/1 and unless otherwise stated in Appendix 7/1, material shall not be frost susceptible if it is used within 450 mm of the designed final surface of a road or paved central reserve, or 350 mm if the Mean Annual Frost Index (MAFI) of the site is less than 50.

17 (05/01) Material shall be classified as non-frost-susceptible if the mean heave is 15 mm or less, when tested in accordance with BS 812 : Part 124 : 1989, amended as follows:

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3 Principle. Line 3. After '(SRU)' add 'and compared with reference specimens'.

5 Delete the NOTE and insert a new NOTE:

NOTE: The tolerances on the dimensions given in Figures 1 and 2, subject to the compatibility of parts, shall be:

Dimensions in excess of 100 mm	± 10 mm
Dimensions in excess of 25 mm	± 5 mm
Other dimensions	± 1 mm

The dimensions of the support frame and push rods are nominal, and can be altered to suit the equipment.

5 Add additional items:

5.3.4.10 Filter paper - (Whatman No. 40 is suitable)

5.16 Standard sand for reference specimens shall be clean silica sand from the Leighton Buzzard district and shall comply with the grading requirements of Fraction C of BS 4550 : Part 5. The sand shall not have been used previously for any other test.

5.17 (11/03) Standard filler for reference specimens shall be a limestone filler from the designated source (see NOTE).

NOTE: The standard filler shall be obtained from Babtie Laboratory, St Michaels Close, Aylesford, Kent, ME20 7BU (Tel 01622 605872) and in Scotland, Heriot Watt University Research Park, Avenue South, Riccarton, Edinburgh, EH14 4AP (Tel 0131 449 3377). Sources of sand are given in BS 4550 : Part 5.

6.1 Add "use a spirit level in the base of the specimen cradle when properly seated, to level the apparatus".

6.6 Add a Note after (j):

NOTE: The functioning of the CLD may be tested at the stage when the correct levels have been achieved, with the reservoir connected, but before specimens are put in place. This may be done as follows:

(i) Using a 100 ml bulb pipette and suction bulb, withdraw water from the cabinet until a bubble separates from the constant head capillary. Measure the volume withdrawn by discharging the pipette into a 100 ml measuring cylinder.

(ii) Allow the levels to come to equilibrium again (bubbling ceases) and repeat the measurement.

(iii) Typical results are 62 ml, 56 ml, 52 ml, Mean 57 ml. This demonstrates that a drop in water bath level of 0.23 mm is corrected by the CLD arrangement and represents an outside estimate of the differential over which the device works.

9 Add a new section 9.4:

9.4 **Preparation of Reference Test Specimens**

9.4.1 Take representative samples of the sand and filler. Oven-dry them separately to constant mass of 105°C - 110°C so that a mass of at least 7.5 kg of sand and 1.3 kg of filler is obtained. After drying, store the sand and filler separately in sealed containers and allow to cool to room temperature.

9.4.2 Weigh out to the nearest 1 g representative portions of 2338 g of sand and 412 g of filler and place both together in a suitable container (eg. a plastic bag). Shake the contents of the container in the dry state for half a minute to ensure that the sand and filler are thoroughly mixed.

9.4.3 Place the sand filler mixture into the mixer (see 5.6). Add 250 ml of distilled or demineralised water. Mix the sand, filler and water for five minutes. Store the mixed material in a sealed container for a minimum period of 16 hours before proceeding with the tests.

9.4.4 Weigh out to the nearest 1 g, 2562 g of the mixed material and prepare a frost-heave specimen as described in Clauses 9.3.1.2 - 9.3.3.1. Repeat to prepare two further reference specimens.

10.1.1 Add: "If fine grained material or soils are to be tested, place a filter paper on the porous disc".

Delete 10.1.2 and 10.1.3 and insert:

10.1.2 Locate thermocouples between the bottom of the porous disc and the copper carrier in each of the specimen positions 1, 3, 5, 7, 9 as in Figure 2. Ensure that the tip of the thermocouple is not in contact with the copper carrier and is 5 to 10 mm into the water bath when the carrier is loaded with specimens, and as central as possible in each specimen position. Also fix a thermocouple under the Tufnol disc in position 5, so that the junction is exposed at the centre of the disc and in contact with the upper surface of the test specimen.

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10.1.3 Place the three reference specimens into positions 3, 5 and 7. Fill the other six positions with specimens which shall be a minimum of three for each material to be tested.

10.1.4 Delete the NOTE and insert a new NOTE:

NOTE: Support the dowels either by drilling holes of the correct diameter or by flexible tubing placed on the dowel ends which are then pushed onto preset studs on the floor of the cradle. Care should be taken to ensure that particles of sand do not get under the dowels thus raising the thermocouples.

11 Delete 11.2(a), (b) and (c) and 11.3

Insert revised 11.2(a) and (b) and 11.3:

11.2 (a) The mean heave of the three reference sand and filler specimens shall be in the range 13.6 ± 4.0 mm.

(b) The range (i.e. highest - lowest) of results of each of the three sets of specimens in the test run shall not exceed 6 mm.

11.3 If either of the conditions given in 11.2 (a) or 11.2 (b) is not satisfied the results of the whole test run shall be rejected. The operating procedure and equipment shall then be examined and adjusted as necessary to ensure that the requirements for the range and mean of the standard sand and filler specimens are satisfied.

11.4 Data obtained on the reference specimens shall be tabulated and plotted on forms and charts issued by the supplier of the filler. Completed forms shall be sent to the supplier of the filler once a year. (Ref. Clause 5.17 NOTE).

12.1 Line 1. After 'determined' add: "without reference specimens".

12 Add new Clauses 12.5 and 12.6.

12.5 A further precision experiment included tests on Type 1 sub-base materials (crushed limestones) and on sand filler mixes. The reproducibility value (R_2) of the frost-heave of the crushed limestones was 11.3 mm. The use of reference sand filler mixes to exclude tests where the frost-heave of the sand filler mix deviated by more than 4.0 mm from the target value for the mix, reduced the value of R_2 to 7.1mm. This is the justification for the rule given in 11.2(a).

12.6 The target value of 13.6 mm for the standard sand and filler mix specified in Clause 9.4 was established by a trial carried out in 1990 involving 13 test cabinets.

13 Delete and insert revised Clause 13:

13 **Test Report**

The test report shall affirm that the frost-heave was determined in accordance with Part 124 of BS 812 : 1989 as amended by Clause 801 of the SHW and whether or not a copy of a certificate of sampling is available. If available, a copy of the certificate of sampling shall be provided. The test report shall contain the following information:

For the standard sand and filler mixture

(a) The maximum heave observed in 96 hours of each individual specimen to the nearest 0.5 mm.

(b) The mean result reported under (a) above calculated to the nearest 0.1 mm.

For each of the other aggregates

(a) Sample identification

(b) The dry density at which the specimens were prepared.

(c) The moisture content used to prepare the specimens.

(d) The particle size distribution of the test portion (8.1).

(e) The particle-size distribution of the stable test specimen (8.2.2.7).

(f) The maximum heave observed in 96 hours of each individual specimen to the nearest 0.5 mm.

(g) The mean results reported under (f) above calculated to the nearest 0.1 mm.

802 (05/01) Not used

803 Granular Sub-base Material Type 1

1 (05/01) Type 1 granular material shall be crushed rock, crushed slag, crushed concrete, recycled aggregates or well burnt non-plastic shale and may contain up to 12.5% by mass of natural sand which passes the 5 mm BS sieve. The material shall lie within the grading envelope of Table 8/2, and not be gap graded. The other materials content of recycled coarse aggregate and recycled concrete aggregate shall be

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determined in accordance with Clause 710 and shall comply with the requirements in Table 8/4.

2 The material passing the 425 micron BS sieve shall be non-plastic as defined by BS 1377: Part 2 and tested in compliance therewith.

3 The material shall be transported, laid and compacted without drying out or segregation.

4 The material shall have a ten per cent fines value of 50 kN or more when tested in compliance with BS 812 : Part 111. The test sample shall be in a soaked condition at the time of test.

5 The aggregate will be considered suitable if:

(i) aggregate from the source, when tested in accordance with BS 812 : Part 121, has a soundness value greater than 65;

or

(ii) evidence can be provided to the Overseeing Organisation of satisfactory use of aggregate from the source.

The water absorption of the coarse aggregate from the source determined in accordance with BS 812 : Part 2 shall also be declared.

TABLE 8/2: Sub-base Type 1 Range of Grading

BS sieve size	Percentage by mass passing
75 mm	100
37.5 mm	85-100
20 mm	60-100
10 mm	40-70
5 mm	25-45
600 micron	8-22
75 micron	0-10
The particle size shall be determined by the washing and sieving method of BS 812 : Part 103	

804 Granular Sub-base Material Type 2

1 (05/01) Type 2 granular material shall be natural sands, gravels, crushed rock, crushed slag, crushed concrete, recycled aggregates or well burnt non-plastic shale. The material shall lie within the grading envelope of Table 8/3 and not be gap graded. The other materials content of recycled coarse aggregate and recycled concrete aggregate shall be determined in accordance with Clause 710 and shall comply with the requirements in Table 8/4.

2 The material passing the 425 micron BS sieve when tested in compliance with BS 1377 : Part 2 shall have a plasticity index of less than 6.

3 The material shall satisfy the minimum CBR requirement in Appendix 7/1 when tested in accordance with BS 1377 : Part 4, with surcharge discs. The material shall be tested at the density and moisture content likely to develop in equilibrium pavement conditions, which shall be taken as being the density relating to a uniform air voids content of 5% and the optimum moisture content determined in compliance with BS 5835.

4 The material shall be transported, laid and compacted at a moisture content within the range 1% above to 2% below the optimum moisture content determined in compliance with BS 5835 and without drying out or segregation.

5 The material shall have a ten per cent fines value of 50 kN or more when tested in compliance with BS 812 : Part 111. The test sample shall be in a soaked condition at the time of test.

6 The aggregate will be considered suitable if:

(i) aggregate from the source, when tested in accordance with BS 812 : Part 121, has a soundness value greater than 65;

or

(ii) evidence can be provided to the Overseeing Organisation of satisfactory use of aggregate from the source.

The water absorption of the coarse aggregate from the source determined in accordance with BS 812 : Part 2 shall also be declared.

TABLE 8/3: Sub-base Type 2 Range of Grading

BS sieve size	Percentage by mass passing
75 mm	100
37.5 mm	85-100
20 mm	60-100
10 mm	40-100
5 mm	25-85
600 micron	8-45
75 micron	0-10
The particle size shall be determined by the washing and sieving method of BS 812 : Part 103	

TABLE 8/4: (05/01) **Maximum Other Materials Content of Recycled Aggregates**

Other Materials	Maximum Permitted Content (% by mass)
Asphalt	50
Foreign materials including wood, plastic and metal.	1

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805 (05/01) Slag Bound Material

General

1 Slag bound material (SBM) is a granular aggregate bound by granulated blastfurnace slag (GBS). The SBM produced shall be of SBM type B2 for road pavements or SBM type B3 for footways, and shall comply with draft EN 227189 with the exception of the following sub-Clauses, and shall be classified by compressive strength in compliance with Table 2 of draft EN 227189. The SBM shall contain aggregate with usually between 10% and 25% by mass of GBS and an activator to increase the rate of curing.

2 Slag bound material shall be made and constructed as described in the following sub-Clauses. The permitted alternatives for each part of the works shall be as described in Appendix 7/1.

Constituent materials

3 The proportion of activator shall be within ±10% of the target values of the approved mixture.

Water

4 Water from a water company supply may be used without testing. Water from other sources may be used if it conforms with BS 3148.

Aggregate

5 Aggregates for SBM shall be rock or crushed gravel complying with BS 882 or crushed concrete which when crushed complies with the quality and grading requirements of BS 882. Alternatively, coarse aggregate may be crushed air-cooled blastfurnace slag complying with the concrete aggregate requirements of BS 1047. The aggregate will be considered suitable if:

(i) aggregate from the source, when tested in accordance with BS 812 : Part 121, has a soundness value greater than 75;

or

(ii) evidence can be provided to the Overseeing Organisation of satisfactory use of aggregate from the source.

6 The water absorption of the coarse aggregate from the source determined in accordance with BS 812 : Part 2 shall also be declared.

7 The grading of the mixture shall be in accordance with draft EN 227189, zone 1 of Figure 5 or Figure 6.

Granulated Blastfurnace Slag

8 The source of granulated blastfurnace slag and the hydraulic activity of the granulated blastfurnace slag as defined in draft EN 227189, shall be as for the proposed mixture.

Activator

9 The activator shall usually be lime, as specified in Clause 615, but may be changed given evidence of satisfactory performance of a suitable alternative, with authorisation of the Overseeing Organisation. The source and chemical characteristics of the activator shall be as for the proposed mixture.

Batching and Mixing

10 SBM shall be batched by mass and mixed in plant. The materials shall be batched and mixed in compliance with BS 5328 : Part 3. Where continuous mixers are used, the continuous mixers shall comply with Table 5 of BS 1305 : 1974 when tested in accordance with BS 3963.

Laying

11 Laying of SBM shall be carried out only during the months of March to September inclusive, within the maximum time after mixing specified by the supplier.

12 All SBM shall be placed and spread evenly in such a manner as to prevent segregation and drying. Spreading shall be undertaken either concurrently with placing or without delay.

13 SBM shall be laid and compacted in layers which enable the specified thickness, surface level, regularity requirements and compaction to be achieved.

14 At longitudinal and transverse construction joints, the edge of compacted SBM shall be cut back to as vertical a face as is practical, and to where the correct thickness of properly compacted SBM has been obtained.

15 Longitudinal construction joints shall not be more than 150 mm from the centre of traffic lanes, or at the lane line markings, with individual bay widths not exceeding 4.75 m. At tapers and other changes in section the construction joint layout shall be as detailed on the Drawings.

Compaction

16 Compaction shall be carried out immediately after the slag bound material has been spread and in such a manner as to prevent segregation.

17 Compaction shall be completed within 6 hours of the addition of the GBS and activator. The 6-hour period may be varied if the preliminary trial described in sub-Clause 29 of this Clause indicates that this is necessary and appropriate.

Curing

18 The SBM shall be either overlaid as soon as practical or one of the following curing methods applied until the material is overlaid:

(i) Covering with impermeable sheeting with joints overlapping at least 300mm and set to prohibit egress of moisture. The sheeting shall be removed at the end of the curing period.

(ii) Bituminous spraying in accordance with Clause 920.

Whichever method is used, immediately prior to overlaying with any bituminous layer a cationic bituminous tack coat shall be applied in accordance with Clause 920 at a rate between 0.35 l/m² to 0.55 l/m².

Testing of Slag Bound Materials

19 Samples shall be provided in accordance with BS 1924 : Part 1 : 1990, Clause 5, from the laid SBM before compaction. One group of five samples shall be provided from five locations equally spaced along a diagonal that bisects each 800 m² or part thereof laid each day.

20 One compressive strength specimen shall be made from each sample taken under sub-Clause 19 of this Clause. The specimens shall be either cubes or cylinders of slenderness ratio 1. The specimens shall be made in accordance with BS 1924 : Part 2 : 1990, Clause 4.2.5, with the exception that cylinders shall be made in cylindrical moulds with the use of a circular tamper. Specimens shall be compacted directly following the compaction of the material on site.

21 The specimens shall be cured and classified in accordance with draft EN 227189 and tested in accordance with prEN 13286-41. The age of specimens at testing and the curing temperature shall be chosen based on the evidence given in sub-Clause 28.

22 To determine the wet density of the specimen the mould shall be weighed prior to making the specimen and the mass recorded. Immediately after completion of compaction, the specimen and mould shall be weighed and the mass recorded. These masses together with the known volume of the mould shall be used to derive the wet density of the specimen.

23 The in situ wet density of the SBM, measured by Nuclear Density Gauge, shall be taken as the average of the wet densities at five locations equally spaced along a diagonal that bisects each 800 m² or part thereof laid each day. The wet density at each location shall be the average of two readings obtained in accordance with the following sub-Clauses. Two readings shall be taken at 180° to each other using the same source rod hole. The source rod shall be lowered to within 25 mm of the bottom surface of the layer. Readings shall be taken within 2 hours after final compaction.

Standardisation of Nuclear Density Gauges

24 The operation, warming-up period, if any, and standardisation of the gauge shall be carried out in compliance with the manufacturer's recommendations. The gauge shall be calibrated in accordance with BS 1924 : Part 2.

25 The gauge shall be used in the direct transmission mode of operation. Use of nuclear density gauges shall comply with Clause 124.

26 The determination of bulk density by direct transmission shall be in accordance with BS 1924 : Part 2.

Acceptance of Proposed Mixture and Construction Techniques

27 Prior to commencing the Works the Contractor shall supply evidence of satisfactory strength and compliance of the proposed SBM mixture with the required classification at an age of 1 year, in accordance with draft EN 227189. The documentation shall include all information required under Clause 9 of draft EN 227189.

28 The Contractor shall supply evidence of the characteristics of the same proposed mixture at 28 and 90 days at 20°C and 40°C. From this evidence, the Overseeing Organisation shall choose a suitable test age and curing temperature for the compliance testing of specimens and set the limits for compliance.

Preliminary Trial

29 At least 10 days before the start of the main SBM works a trial area of at least 400 m² shall be laid to assess the suitability of the proposed materials, mix proportions, mixing, laying, compaction plant and construction procedures. The location and area of the trial shall be subject to the approval of the Overseeing Organisation. The rate of testing shall not be less than that required by sub-Clause 19. The trial area will only be accepted for main construction in the Permanent Works if it complies with this Clause. The main construction in the Permanent Works shall not start until the trial has been approved by the Overseeing Organisation. On the trial area satisfying the Specification with respect to material composition, in situ density and surface finish the proposed material will be accepted for use within the Permanent Works.

30 The materials and mix proportions shall not be changed without the agreement of the Overseeing Organisation and satisfying sub-Clauses 1, 3, 8, 9 and

10 for the new mixture. The laying, compaction plant and construction procedures shall not be changed unless the Contractor lays a further trial area or agrees the changes with the Overseeing Organisation.

806 (05/01) Granular Sub-base Material Type 4

1 Type 4 granular sub-base material shall be derived from asphalt arisings. The asphalt arisings shall be either asphalt road planings or granulated asphalt, but excluding materials containing tar or tar-bitumen binders.

Asphalt planings are defined as materials derived from the asphalt layers of the pavement using a mobile machine fitted with milling cutters.

Granulated asphalt is defined as asphalt bound material recycled from roads under reconstruction or surplus asphalt material destined for bound pavement layers, but unused, which has been granulated.

2 Type 4 granular sub-base material shall have an upper limit on recovered bitumen content of 10% when tested in accordance with BS 598 : Part 102.

3 Type 4 granular sub-base material shall, at the time of placing, lie within the lump size grading envelope of Table 8/5 and not be gap graded.

TABLE 8/5: Type 4 Granular Sub-base Material Range o1f Lump-size Grading

BS sieve size	Percentage by mass passing
75 mm	100
37.5 mm	85-100
20 mm	60-90
10 mm	30-70
5 mm	15-45
600 micron	0-22
75 micron	0-10
The lump size distribution shall be determined either by the washing and sieving method or by the dry sieving method of BS 812 : Part 103 :1985 (see Note 1) Note 1: The planings should be oven dried (prior to sieving) at a temperature of 45 to 50°C. Sieving shall be carried out at 20 ± 5°C to reduce the tendency of the bitumen to soften and particles to adhere to each other	

4 The material shall be transported, laid and compacted at a moisture content within the range optimum moisture content to 2% below the optimum moisture content determined in compliance with BS 5835 and without drying out or segregation.

Measurement of moisture content both for control purposes and for optimum moisture content determination shall be according to BS 812 : Part 109 using a conventional oven on a reduced temperature setting of 45 to 50°C.

5 When required by Appendix 7/1, the Contractor shall undertake a Trafficking Trial incorporating the Type 4 granular sub-base material proposed for use in the Works. A trial area shall be constructed, trafficked and assessed in accordance with the procedure described in sub-Clauses 6 to 11 of this Clause. The mean vertical deformation after 1000 equivalent standard axles shall be less than 30 mm when measured in accordance with the procedure stated in sub-clause 10 of this clause.

Proposals for sub-base trials shall be submitted to the Overseeing Organisation 5 days in advance of construction.

Trial Procedure

6 The trial area shall be located on a formation prepared in accordance with the Specification. The trial area may be located so that it can be incorporated within the Permanent Works if the resistance to wheel track rutting is demonstrated to comply with sub-Clause 5 of this Clause.

7 The trial area shall be at least 60 m long, and of sufficient width that when trafficked, the wheel paths of the test vehicle shall be at least 1 m from either edge of the top of the sub-base layer. The sub-base shall be compacted to the thickness specified in Appendix 7/1. The formation shall extend for a further 1 m either side of the sub-base layer.

8 A sufficient run off/run on area shall be constructed at each end of the trial area, the same width, and compacted to the same level, as the trial area, to ensure correct tracking by the test vehicle and minimise dynamic effects of the vehicle bouncing on its springs. Suitable guidance shall be given to assist the driver in maintaining the same track on each pass and to achieve channelled trafficking. Examples of suitable guides would be a string or painted line.

Materials

9 The sub-base used in the trial shall be transported, laid and compacted using the equipment proposed for use in the Works.

10 Maximum vertical deformation shall be measured in both wheel tracks using optical or laser levels at pre-determined monitoring points on five transverse lines spaced equally along the length of the trial bay. The transverse lines at the ends of the trial area shall be at least 5 m from the run off/run on areas. The average vertical deformation of the two wheel tracks after 1000

standard axles shall be recorded.

Reporting

11 The Contractor shall provide the Overseeing Organisation with a report on the Trafficking Trial. For Type 4 sub-base to be approved for use in the Works the report shall set out the results of the trial, stating how they validate the use of the material.

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NATIONAL ALTERATIONS OF THE OVERSEEING ORGANISATION OF SCOTLAND

850SE (05/01) Crushed Gravel Sub-base Material Type 1

Material Properties

1 For the purposes of this Clause gravel is defined as aggregate derived from a natural, unconsolidated, coarse-grained sedimentary deposit consisting of water-worn rock fragments.

2 (05/01) Crushed gravel granular sub-base material Type 1 shall be derived from natural cobble-sized material (60 mm - 200 mm), or larger, crushed and screened to be well-graded and lie within the grading envelope of Table 8/50SE below.

TABLE 8/50SE: (05/01)**Sub-base Type 1 Range of Grading**

BS sieve size	Percentage by mass passing
75 mm	100
37.5 mm	85-100
10 mm	40-70
5 mm	25-50
600 micron	8-22
75 micron	0-10
The particle size shall be determined by the washing and sieving method of BS 812 : Part 103	

3 The material passing the 425 micron BS sieve shall be non-plastic as defined in BS 1377 : Part 2 and tested in compliance therewith.

4 The degree of crushing of individual particles in the mixed material shall meet the following requirements:

(i) not less than 90% by mass of the particles passing BS 50 mm and retained on BS 6.3 mm sieve shall exhibit at least 3 freshly broken faces;

and

(ii) not less than 80% by mass of the particles in each BS 63 specified size fraction within the size range stated at (i) above shall exhibit at least three freshly broken faces.

5 The material shall satisfy the minimum CBR requirement of Appendix 7/1 when tested in accordance with Clause 7 of BS 1377 : Part 4. The material shall be tested at the density and moisture content likely to develop in equilibrium field conditions which shall be taken as being the density relating to the uniform air voids content of 5% and the optimum moisture content determined in compliance with BS 5835. The specimens shall be tested in a soaked condition.

6 The material shall have a ten per cent fines value of 50 kN or more when tested in compliance with BS 812 : Part 111 except that the samples shall be tested in a saturated and surface-dried condition. Prior to testing, the selected test portions shall be soaked in water at room temperature for 24 hours without previously having been oven-dried.

7 The aggregate will be considered suitable if:

(i) aggregate from the source, when tested in accordance with BS 812 : Part 121, has a soundness value greater than 65;

or

(ii) evidence can be provided to the Overseeing Organisation of satisfactory use of aggregate from the source as Type 1 sub-base material.

The water absorption of the coarse aggregate from the source determined in accordance with BS 812 : Part 2 shall also be declared.

Transportation and Compaction

8 (05/01) The material shall be transported, laid and compacted to the requirements of Clause 801 at a moisture content within the range 1% above to 2% below the optimum moisture content determined in compliance with BS 5835 and without drying out or segregation.

Trafficking Trial

9 When required by Appendix 7/1, the Contractor shall construct a trial area incorporating the crushed gravel sub-base material proposed for use in the Works. The trial area shall be constructed, trafficked and assessed in accordance with the procedure described in Appendix 7/1. The mean vertical deformation after 1000 standard axles shall be less than 30 mm when measured in accordance with the stated procedure.

Performance of Crushed Gravel Sub-base

10 A brief performance report on the behaviour of the crushed gravel sub-base is required.

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NATIONAL ALTERATIONS OF THE OVERSEEING ORGANISATION OF NORTHERN IRELAND

801NI (05/01) General Requirements for Unbound, Hydraulically Bound and Other Materials

1 Sub-bases and roadbases shall be made and constructed using materials described in the following Clauses. The permitted alternatives for each part of the Works shall be as described in Appendix 7/1.

2 Blastfurnace slag for use in sub-base and roadbase materials shall comply with BS 1047 : 1983. Steel slag may be used provided it has been weathered and conforms with the requirements of BS 4987 : Part 1. Materials other than slag when placed within 500 mm of cement-bound materials, concrete pavements, concrete structures or concrete products shall have a water soluble sulfate content not exceeding 1.9 g of sulfate (expressed as SO_3) per litre when tested in accordance with BS 812 : Part 118, Clause 5.

3 Where recycled coarse aggregate or recycled concrete aggregate is used in accordance with this Series, it shall have been tested in accordance with Clause 710.

Transporting

4 Plant-mixed material shall, when mixed, be removed at once from the mixer, transported directly to the point where it is to be laid and protected from weather both during transit from the mixer to the laying site and whilst awaiting tipping.

Laying

5 Materials in a frozen condition shall not be incorporated in the Works but may be used, if acceptable, when thawed. Materials shall not be laid on any surface which is frozen or covered with ice.

6 All material shall be placed and spread evenly. Spreading shall be undertaken either concurrently with placing or without delay. Unbound and hydraulically bound roadbase material shall be spread using a paving machine or a suitable spreader box and operated with a mechanism which levels off the material to an even depth.

7 Except where otherwise stated in Appendix 7/1, material up to 225 mm compacted thickness shall be spread in one layer so that after compaction the total thickness is as specified. Material of compacted thickness greater than 225 mm shall be laid in two or more layers and the minimum compacted thickness of any such layer shall be 110 mm. Where the layers of unbound material are of unequal thickness the lowest layer shall be the thickest layer.

Compaction

8 Compaction shall be completed as soon as possible after the material has been spread and in accordance with the requirements for the individual materials.

9 Full compaction shall be obtained over the full area including in the vicinity of both longitudinal and transverse joints.

10 Compaction of unbound materials shall be carried out by a method specified in Table 8/1NI, unless the Contractor demonstrates at site trials that a state of compaction achieved by an alternative method is equivalent to or better than that using the specified method.

11 The surface of any layer of material shall on completion of compaction and immediately before overlaying, be well closed, free from movement under construction plant and from ridges, cracks, loose material, pot holes, ruts or other defects. All loose, segregated or otherwise defective areas shall be removed to the full thickness of the layer, and new material laid and compacted.

12 For the purposes of Table 8/1NI the following shall apply:

(i) The number of passes is the number of times that each point on the surface of the layer being compacted shall be traversed by the item of compaction plant in its operating mode (or struck, in the case of power rammers).

(ii) The compaction plant in Table 8/1NI is categorised in terms of static mass. The mass per metre width of roll is the total mass on the roll divided by the total roll width. Where a smooth-wheeled roller has more than one axle, the category of the machine shall be determined on the basis of the axle giving the highest value of mass per metre width.

(iii) For pneumatic-tyred rollers the mass per wheel is the total mass of the roller divided by the number of wheels. In assessing the

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number of passes of pneumatic-tyred rollers the effective width shall be the sum of the widths of the individual wheel tracks together with the sum of the spacings between the wheel tracks provided that each spacing does not exceed 230 mm. Where the spacings exceed 230 mm the effective width shall be the sum of the widths of the individual wheel tracks only.

(iv) Vibratory rollers are self-propelled or towed smooth-wheeled rollers having means of applying mechanical vibration to one or more rolls:

(a) The requirements for vibratory rollers are based on the use of the lowest gear on a self-propelled machine with mechanical transmission and a speed of 1.5-2.5 km/h for a towed machine or a self-propelled machine with hydrostatic transmission. If higher gears or speeds are used an increased number of passes shall be provided in proportion to the increase in speed of travel.

(b) Where the mechanical vibration is applied to two rolls in tandem, the minimum number of passes shall be half the number given in Table 8/1NI for the appropriate mass per metre width of one vibrating roll but if one roll differs in mass per metre width from the other, the number of passes shall be calculated as for the roll with the smaller value. Alternatively the minimum number of passes may be determined by treating the machine as having a single vibrating roll with a mass per metre width equal to that of the roll with the higher value.

(c) Vibratory rollers operating without vibration shall be classified as smooth-wheeled rollers.

(d) Vibratory rollers shall be operated with their vibratory mechanism operating at the frequency of vibration recommended by the manufacturer. All such rollers shall be equipped, or provided with devices indicating the frequency at which the mechanism is operating and the speed of travel. Both devices shall be capable of being read by an inspector alongside the machine.

(v) Vibrating-plate compactors are machines having a base-plate to which is attached a source of vibration consisting of one or two eccentrically-weighted shafts:

(a) The mass per square metre of base-plate of a vibrating-plate compactor is calculated by dividing the total mass of the machine in its working condition by its area in contact with compacted material.

(b) Vibrating-plate compactors shall be operated at the frequency of vibration recommended by the manufacturer. They shall normally be operated at travelling speeds of less than 1 km/h but if higher speeds are necessary, the number of passes shall be increased in proportion to the increase in speed of travel.

(vi) Vibro-tampers are machines in which an engine driven reciprocating mechanism acts on a spring system, through which oscillations are set up in a base-plate.

(vii) Power rammers are machines which are actuated by explosions in an internal combustion cylinder; each explosion being controlled manually by the operator. One pass of a power rammer shall be considered to have been made when the compacting shoe has made one strike on the area in question.

(viii) Combinations of different types of plant or different categories of the same plant will be permitted; in which case the number of passes for each shall be such proportion of the appropriate number in Table 8/1NI as will together produce the same total compactive effort as any one operated singly, in accordance with Table 8/1NI.

TABLE 8/1NI: Compaction Requirements for Granular Sub-base Material Types 1, 2 and 3

Type of compaction plant	Category	Number of passes for layers not exceeding the following compacted thicknesses: 110 mm	150 mm	225 mm
Smooth-wheeled roller (or vibratory roller operating without vibration)	Mass per metre width of roll:			
	over 2700 kg up to 5400 kg	16	unsuitable	unsuitable
	over 5400 kg	8	16	unsuitable
Pneumatic-tyred roller	Mass per wheel:			
	over 4000 kg up to 6000 kg	12	unsuitable	unsuitable
	over 6000 kg up to 8000 kg	12	unsuitable	unsuitable
	over 8000 kg up to 12000 kg	10	16	unsuitable
	over 12000 kg	8	12	unsuitable
Vibratory roller	Mass per metre width of vibrating roll:			
	over 700 kg up to 1300 kg	16	unsuitable	unsuitable
	over 1300 kg up to 1800 kg	6	16	unsuitable
	over 1800 kg up to 2300 kg	4	6	10
	over 2300 kg up to 2900 kg	3	5	9
	over 2900 kg up to 3600 kg	3	5	8
	over 3600 kg up to 4300 kg	2	4	7
	over 4300 kg up to 5000 kg	2	4	6
	over 5000 kg	2	3	5
Vibrating-plate compactor	Mass per square metre of base plate:			
	over 1400 kg/m^2 up to 1800 kg/m^2	8	unsuitable	unsuitable
	over 1800 kg/m^2 up to 2100 kg/m^2	5	8	unsuitable
	over 2100 kg/m^2	3	6	10
Vibro-tamper	Mass:			
	over 50 kg up to 65 kg	4	8	unsuitable
	over 65 kg up to 75 kg	3	6	10
	over 75 kg	2	4	8
Power rammer	Mass:			
	100 kg-500 kg	5	8	unsuitable
	over 500 kg	5	8	12

Induced Cracks

13 Hydraulically bound materials that have a strength of CBM3 or above (i.e. with an average minimum 7 day cube compressive strength of 10.0 N/mm^2 or greater) shall have cracks induced during construction as described in Clause 1047 and in Appendix 7/20.

Use of Surfaces by Traffic and Construction Plant

14 Construction plant and traffic used on pavements under construction shall be suitable in relation to the material, condition and thickness of the courses it traverses so that damage is not caused to the subgrade or the pavement courses already constructed. The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.

15 Where the Contractor proposes to use the sub-base or roadbase layers for construction plant he shall improve the sub-base or roadbase layers where necessary, to accommodate the method of construction and the type of plant and vehicles which he proposes to use, in order to avoid damage to the roadbase, sub-base, any capping and the subgrade. Any permanent thickening shall be across the whole width of the pavement. Temporary thickening shall not impede drainage of the sub-base or the subgrade.

Frost Heave

16 Subject to the tolerances given in Table 7/1 and unless otherwise stated in Appendix 7/1, material shall not be frost susceptible if it is used within 450 mm of the designed final surface of a road or paved central reserve, or 350 mm if the Mean Annual Frost Index (MAFI) of the site is less than 50.

17 (05/01) Material shall be classified as non-frost-susceptible if the mean heave is 15 mm or less, when tested in accordance with BS 812 : Part 124 : 1989, amended as follows:

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3 Principle. Line 3. After '(SRU)' add 'and compared with reference specimens'.

5 Delete the NOTE and insert a new NOTE:

NOTE: The tolerances on the dimensions given in Figures 1 and 2, subject to the compatibility of parts, shall be:

Dimensions in excess of 100 mm	± 10 mm
Dimensions in excess of 25 mm	± 5 mm
Other dimensions	± 1 mm

The dimensions of the support frame and push rods are nominal, and can be altered to suit the equipment.

5 Add additional items:

5.3.4.10 Filter paper - (Whatman No. 40 is suitable)

5.16 Standard sand for reference specimens shall be clean silica sand from the Leighton Buzzard district and shall comply with the grading requirements of Fraction C of BS 4550 : Part 5. The sand shall not have been used previously for any other test.

5.17 (11/03) Standard filler for reference specimens shall be a limestone filler from the designated source (see NOTE).

NOTE: The standard filler shall be obtained from Babtie Laboratory, St Michaels Close, Aylesford, Kent, ME20 7BU (Tel 01622 605872) and in Scotland, Heriot Watt University Research Park, Avenue South, Riccarton, Edinburgh, EH14 4AP (Tel 0131 449 3377). Sources of sand are given in BS 4550 : Part 5.

6.1 Add "use a spirit level in the base of the specimen cradle when properly seated, to level the apparatus".

6.6 Add a Note after (j):

NOTE: The functioning of the CLD may be tested at the stage when the correct levels have been achieved, with the reservoir connected, but before specimens are put in place. This may be done as follows:

(i) Using a 100 ml bulb pipette and suction bulb, withdraw water from the cabinet until a bubble separates from the constant head capillary. Measure the volume withdrawn by discharging the pipette into a 100 ml measuring cylinder.

(ii) Allow the levels to come to equilibrium again (bubbling ceases) and repeat the measurement.

(iii) Typical results are 62 ml, 56 ml, 52 ml, Mean 57 ml. This demonstrates that a drop in water bath level of 0.23 mm is corrected by the CLD arrangement and represents an outside estimate of the differential over which the device works.

9 Add a new section 9.4:

9.4 **Preparation of Reference Test Specimens**

9.4.1 Take representative samples of the sand and filler. Oven-dry them separately to constant mass of 105°C - 110°C so that a mass of at least 7.5 kg of sand and 1.3 kg of filler is obtained. After drying, store the sand and filler separately in sealed containers and allow to cool to room temperature.

9.4.2 Weigh out to the nearest 1 g representative portions of 2338 g of sand and 412 g of filler and place both together in a suitable container (eg. a plastic bag). Shake the contents of the container in the dry state for half a minute to ensure that the sand and filler are thoroughly mixed.

9.4.3 Place the sand filler mixture into the mixer (see 5.6). Add 250 ml of distilled or demineralised water. Mix the sand, filler and water for five minutes. Store the mixed material in a sealed container for a minimum period of 16 hours before proceeding with the tests.

9.4.4 Weigh out to the nearest 1 g, 2562 g of the mixed material and prepare a frost-heave specimen as described in Clauses 9.3.1.2 - 9.3.3.1. Repeat to prepare two further reference specimens.

10.1.1 Add: "If fine grained material or soils are to be tested, place a filter paper on the porous disc".

Delete 10.1.2 and 10.1.3 and insert:

10.1.2 Locate thermocouples between the bottom of the porous disc and the copper carrier in each of the specimen positions 1, 3, 5, 7, 9 as in Figure 2. Ensure that the tip of the thermocouple is not in contact with the copper carrier and is 5 to 10 mm into the water bath when the carrier is loaded with specimens, and as central as possible in each specimen position. Also fix a thermocouple under the Tufnol disc in position 5, so that the junction is exposed at the centre of the disc and in contact with the upper surface of the test specimen.

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10.1.3 Place the three reference specimens into positions 3, 5 and 7. Fill the other six positions with specimens which shall be a minimum of three for each material to be tested.

10.1.4 Delete the NOTE and insert a new NOTE:

NOTE: Support the dowels either by drilling holes of the correct diameter or by flexible tubing placed on the dowel ends which are then pushed onto preset studs on the floor of the cradle. Care should be taken to ensure that particles of sand do not get under the dowels thus raising the thermocouples.

11 Delete 11.2(a), (b) and (c) and 11.3

Insert revised 11.2(a) and (b) and 11.3:

11.2 (a) The mean heave of the three reference sand and filler specimens shall be in the range 13.6 ± 4.0 mm.

(b) The range (i.e. highest - lowest) of results of each of the three sets of specimens in the test run shall not exceed 6 mm.

11.3 If either of the conditions given in 11.2 (a) or 11.2 (b) is not satisfied the results of the whole test run shall be rejected. The operating procedure and equipment shall then be examined and adjusted as necessary to ensure that the requirements for the range and mean of the standard sand and filler specimens are satisfied.

11.4 Data obtained on the reference specimens shall be tabulated and plotted on forms and charts issued by the supplier of the filler. Completed forms shall be sent to the supplier of the filler once a year. (Ref. Clause 5.17 NOTE).

12.1 Line 1. After 'determined' add: "without reference specimens".

12 Add new Clauses 12.5 and 12.6.

12.5 A further precision experiment included tests on Type 1 sub-base materials (crushed limestones) and on sand filler mixes. The reproducibility value (R_2) of the frost-heave of the crushed limestones was 11.3 mm. The use of reference sand filler mixes to exclude tests where the frost-heave of the sand filler mix deviated by more than 4.0 mm from the target value for the mix, reduced the value of R_2 to 7.1mm. This is the justification for the rule given in 11.2(a).

12.6 The target value of 13.6 mm for the standard sand and filler mix specified in Clause 9.4 was established by a trial carried out in 1990 involving 13 test cabinets.

12 Delete and insert revised Clause 13:

13 **Test Report**

The test report shall affirm that the frost-heave was determined in accordance with Part 124 of BS 812 : 1989 as amended by Clause 801NI of the SHW and whether or not a copy of a certificate of sampling is available. If available, a copy of the certificate of sampling shall be provided. The test report shall contain the following information:

For the standard sand and filler mixture

(a) The maximum heave observed in 96 hours of each individual specimen to the nearest 0.5 mm.

(b) The mean result reported under (a) above calculated to the nearest 0.1 mm.

For each of the other aggregates

(a) Sample identification

(b) The dry density at which the specimens were prepared.

(c) The moisture content used to prepare the specimens.

(d) The particle size distribution of the test portion (8.1).

(e) The particle-size distribution of the stable test specimen (8.2.2.7).

(f) The maximum heave observed in 96 hours of each individual specimen to the nearest 0.5 mm.

(g) The mean results reported under (f) above calculated to the nearest 0.1 mm.

850NI Granular Sub-base Material Type 3

1 Type 3 granular material shall be sound clean crushed rock. The material shall not contain any weathered or vesicular basalt, nor any shaley gritstone. The materials shall be well graded and lie within the grading envelope of Table 8/50NI.

2 The material passing the 425 micron BS sieve shall be non plastic as defined by BS 1377 : Part 2 and tested in compliance therewith.

3 The material shall have a ten per cent fines value of 160 kN or more when tested in compliance with

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BS 812 : Part 111 except that samples be tested in a saturated and surface dried condition. Prior to testing the selected test portion shall be soaked in water at room temperature for 24 hours without previously having been oven dried.

4 The material shall be transported, laid and compacted without drying out or segregation.

TABLE 8/50NI: Sub-base Type 3 Range of Grading

BS sieve size	Percentage by mass passing
75 mm	100
37.5 mm	65-95
20 mm	48-77
10 mm	30-55
5 mm	20-35
600 micron	4-15
75 micron	0-5
The particle size shall be determined by the washing and sieving method of BS 812 : Part 103	

5 (05/01) The aggregate will be considered suitable if:

(i) aggregate from the source, when tested in accordance with BS 812 : Part 121, has a soundness value greater than 65,

or

(ii) evidence can be provided to the Overseeing Organisation of satisfactory use of aggregate from the source.

The water absorption of the coarse aggregate from the source determined in accordance with BS 812 : Part 2 shall also be declared.

851NI Filter Layers

1 Crushed rock or sand filter layers shall be well graded and lie within the grading limits of Table 8/51NI. The material passing the 425 micron BS Sieve when tested in accordance with BS 1377 : Part 2, shall be non plastic.

2 (05/01) Filter layers shall be protected from damage by traffic and construction plant in accordance with Clause 801NI. The Contractor shall so organise work that only the traffic directly engaged in depositing, spreading and compacting the filter layer shall be permitted access to the surface of this layer. At no time shall the Contractor permit the leading edge of the filter layer to extend more than 100 metres beyond the leading edge of the succeeding layer of sub-base.

TABLE 8/51NI: Crushed Rock and Sand Filter Layer Range of Grading

BS sieve size	Percentage by mass passing
75 mm	100
2.36 mm	75-100
600 micron	35-100
212 micron	15-60
75 micron	0-18
The particle size shall be determined by the washing and sieving method of BS 812 : Part 103	

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