SERIES 700
ROAD PAVEMENTS - GENERAL

Contents

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

# 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.

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ROAD PAVEMENTS - GENERAL

701 (05/02) Pavement Construction

1 Road pavements shall be constructed from one of the permitted options described in Appendix 7/1 and in compliance with this Series and the appropriate Clauses of Series 800, 900 and 1000.

2 (05/04) The Contractor shall, in his choice of permitted materials for subbases and bases, have regard to the nature of those materials and of the subgrade or any capping and the need to protect them from deterioration due to the ingress of water, the adverse effects of weather and the use of constructional plant. The Contractor shall programme the laying and compaction of the subbase and the subsequent pavement courses and take such other steps as may be considered necessary, to afford protection to the base, subbase and subgrade.

#702 Horizontal Alignments, Surface Levels and Surface Regularity of Pavement Courses

Horizontal Alignments

1 (05/04) Horizontal alignments shall be determined from one edge of the pavement surface as described in Appendix 1/12. The edge of the pavement as constructed and all other parallel alignments shall be correct within a tolerance of 25 mm therefrom, except for kerbs and channel blocks which shall be laid with a smooth alignment within a tolerance of ±13 mm. Longitudinal road markings lateral tolerance shall be in accordance with sub-Clause 1212.20.

Surface Levels of Pavement Courses

2 The design levels of pavement courses shall be calculated from the vertical profile, crossfalls and the pavement course thicknesses described in Appendix 7/1. The level of any point on the constructed surface of the pavement courses shall be the design level subject to the appropriate tolerances stated in Table 7/1.

TABLE 7/1: (11/04) **Tolerances in Surface Levels of Pavement Courses**

Road surfaces - general - adjacent to a surface water channel*	 ± 6 mm + 10 - 0 mm
Binder course *	± 6 mm
Base *	± 15 mm
Subbase under concrete pavement surface slabs laid full thickness in one operation by machines with surface compaction	± 10 mm
Subbases other than above	+ 10 - 30 mm

* Where a surface water channel is laid before the adjacent road pavement layer the top of that layer, measured from the top of the adjacent edge of the surface water channel, shall be to the tolerances given in Table 7/1.

3 (05/04) Notwithstanding the tolerances permitted in surface levels of pavement courses, the cumulative tolerance shall not result in a reduction in thickness of the pavement, excluding the subbase, by more than 15 mm from the specified thickness nor a reduction in the thickness of the bituminous surface course by more than 5 mm from that specified.

4 For checking compliance with sub-Clause 2 of this Clause, measurements of the surface levels of all courses will be taken on a grid of points located as described in Appendix 7/1. In any length of pavement, compliance shall be deemed to be met for all surfaces, other than the final road surface, when not more than one of ten consecutive measurements taken longitudinally or one in any transverse line, exceeds the tolerances permitted in Table 7/1, provided that this one measurement shall not exceed by more than 5 mm the tolerance for the course concerned. For the final road surface the tolerance given in Table 7/1 shall apply to any point on that surface.

Surface Regularity

5 (11/06) The longitudinal regularity of the surfaces of surface courses, binder courses and concrete slabs shall be such that the number of surface irregularities is within the relevant limits stated in Table 7/2.

An irregularity is a variation of not less than 4 mm or not less 7 mm of the profile of the road surface as measured by the rolling straight-edge set at 4 mm or 7 mm as appropriate, or equivalent apparatus capable of measuring irregularities within the same magnitudes over a 3 m length. No irregularity exceeding 10 mm shall be permitted.

6 (11/02) Prior to checking any final road surface, binder course or top surface of base in pavements without binder course for level, regularity or macrotexture depth, it shall be cleaned of loose or extraneous materials. These operations shall be carried out without damaging the surface of the pavement, as soon as possible and within 3 days of construction of the pavement.

7 Compliance with Table 7/2 shall be checked by the rolling straight - edge along any line or lines parallel to the edge of pavement on sections of 300 m at regular intervals as stated in Appendix 7/1, whether or not it is constructed in shorter lengths. Sections shorter than 300 m forming part of a longer pavement shall be assessed using the number of irregularities for a 300 m length pro-rata to the nearest whole number.

Where the total length of pavement is less than 300 m, the measurements shall be taken on 75 m lengths.

8 (11/04) Pavements shall be measured transversely for irregularities at regular intervals as stated in Appendix 7/1, by a 3 m long straight-edge in accordance with BS 8420 placed at right angles to the centre line of the road. The maximum allowable difference between the pavement surface and the straight-edge shall be 3 mm.

9 A straight-edge 3 metres long, shall be used to check longitudinal surface regularity in the following cases:

(i) (11/04) for lengths of less than 75 m of surface course, binder course and concrete slabs;

(ii) where use of the rolling straight-edge or equivalent apparatus is impracticable;

(iii) (05/04) for all lengths of subbase under concrete pavement slabs laid full thickness in one operation by machine with surface compaction.

The maximum allowable difference between the surface and the underside of the straight-edge, when placed parallel with, or at right angles to, the centre line of the road shall be:

for pavement surfaces	3 mm
(05/02) for binder courses	6 mm
(05/04) for subbases under concrete pavements (as in (iii) above)	10 mm

TABLE 7/2: (11/06) **Maximum Permitted Number of Surface Irregularities**

	Surfaces of each lane of carriageway, each hard strip and each hard shoulder for each irregularity limit				**Surfaces of each lane of bituminous binder courses for carriageway, hard strip and hard shoulder for each irregularity limit**				**Surfaces of lay-bys, service areas, and associated bituminous binder courses for each irregularity limit**			
Irregularity Limits	4 mm		7 mm		4 mm		7 mm		4 mm		7 mm	
Length (m)	300	75	300	75	300	75	300	75	300	75	300	75
Category A* Roads	20	9	2	1	40	18	4	2	40	18	4	2
Category B* Roads	40	18	4	2	60	27	6	3	60	27	6	3

* The Category of each section of road is described in Appendix 7/1.

Rectification

10 (11/02) Where any pavement area does not comply with the Specification for regularity, surface tolerance, thickness, macrotexture depth, material properties or compaction, the full extent of the area which does not comply with the Specification shall be made good and the surface of the pavement course shall be rectified in the manner described below:

(i) Unbound and hydraulically bound materials

The top 75 mm shall be scarified, reshaped with material added or removed as necessary, and re-compacted. The area treated shall be not less than 20 m long and 2 m wide. For hydraulically bound materials, all rectification shall be completed within 48 hours of the binder being added to the material.

(ii) (08/08) Cement bound subbases and bases

The method of correction will depend on the period which has elapsed between detection of the error and the time of mixing of the material. If this is less than 4 hours, the surface shall be scarified to a depth of not less than 50 mm, surplus material removed or freshly mixed material added as necessary, and re-compacted in accordance with the Specification. If the period is 4 hours or more the full depth of the layer shall be removed from the pavement and replaced with material in accordance with the Specification. In either case the area treated shall be at least 5 m long and the full width of the paving laid in one operation. If the Contractor proposes rectification within 7 days of laying he shall comply with sub-Clause 1048.4. Alternatively, for subbases under concrete pavements the Contractor may make up low areas to a level within the tolerances of this Clause with a 1:4 cement and sand mortar or with an AC4 fine surface course complying with Clause 914.

(iii) (11/04) Bituminous bases

With coated macadam or asphalt bases, the full depth of the top layer as laid shall be removed and be replaced with fresh material laid and compacted in accordance with the Specification. Any area so treated shall be at least 5 m long and the full width of the paving laid in one operation. Alternatively for low areas in bituminous bases, the Contractor may make up the level with additional binder course material.

(iv) (11/04) Surface courses and binder courses

These shall have the full depth of the course removed and replaced with fresh material laid and compacted in accordance with the Specification.

The area rectified shall be the full width of the paving laid in one operation, and at least 5 m long if binder course, or 15 m if surface course.

Where the number of surface irregularities exceeds the limits in Table 7/2, the area to be rectified shall be 300 m or 75 m long as appropriate and the full width of the lanes affected, or such lesser length as necessary to make the number of surface irregularities conform with the limits and shall be the full width of the lanes affected.

Checking of the surface course for compliance with this Clause shall be carried out as soon as possible after completion of the surfacing and remedial works completed before the road is opened to traffic.

Where the macrotexture depth requirement is not met for:

(a) a section 1000 m in lane length; or

(b) the full lane length of a section less than 1000 m long as the balance of a complete scheme; or

(c) the full lane length of a scheme less than 1000 m long;

then sufficient 50 m lengths shall be replaced, starting with that length having the least macrotexture depth, until the average requirement for the section length is complied with.

A minimum length of 50 m and the full lane width shall be removed and replaced either:

(a) (05/02) to the full depth of the surface course; or

(b) to a depth of 20 mm when replaced by the repave method process in compliance with Clause 926.

Areas to be removed shall be delineated both longitudinally and transversely by saw cutting prior to the material being removed. Joints shall be formed either by coating the exposed sawn face with hot bitumen or heating by a suitable heater. The heater shall raise the temperature of the full depth of the course immediately before laying the new material to a figure within the range of minimum rolling temperature and maximum temperature at any stage specified for the material and for a width of not less than 75 mm.

(v) Concrete slabs

Concrete slabs shall be rectified by planing, grinding or bump cutting. Large depressions, which cannot be dealt with in this way, shall be rectified by cutting out the surface and replacing by a thin bonded surface repair complying with Clause 1032.

Retexturing of hardened concrete shall be carried out by sawing grooves in accordance with the Specification. Texturing of replaced surfaces shall be by brushing in accordance with the Specification. Where the slab cannot be rectified as above, the full depth of

slab shall be removed and replaced with a slab constructed in compliance with Clause 1033 to the extent required to obtain compliance with the Specification. Remedial works involving the placing of fresh concrete shall be completed in sufficient time for the concrete strength to have developed as required in Clause 1048, before that section of pavement is opened to traffic.

703 (05/01) Not used

704 (05/01) Not used

705 (05/01) Not used

#706 (05/01) Excavation, Trimming and Reinstatement of Existing Surfaces

General

1 The Contractor shall not excavate pits, trenches or other openings in paved areas which have been constructed as part of the Permanent Works in order to construct other parts of the Works, including Statutory Undertakers and other service works, except with the prior approval of the Overseeing Organisation.

2 Where excavation and trimming of existing paved areas and highways not constructed as part of the Permanent Works are required in Appendix 7/2, they shall be carried out and reinstated in compliance with this Clause and with any additional requirements described in Appendix 7/2. Excavations shall be carried out to the dimensions described in Appendix 7/2, or, if not so described, to the minimum dimensions, subject to sub-Clause 3 of this Clause, necessary to carry out the work.

Excavations

3 (05/04) Excavations in existing pavements and other paved areas, except those described in sub-Clause 4 of this Clause, including surfacing, base and subbase, shall be cut to neat lines to dimensions at least 75 mm greater on each side than the dimensions of any further excavation below formation level. Excavations in capping shall be taken at least 75 mm outside the dimensions of any excavation below. Road surfacing of bituminous material shall be cut back by sawing or planing to a further 75 mm on each side. Planing shall be carried out in accordance with Clause 709. Concrete surfacing and concrete bases, except CBM, shall be cut back by sawing by at least 300 mm on each side to the level of any reinforcement in reinforced slabs and to the full depth of the slab in unreinforced slabs.

If excavations are required to inspect the condition of lower layers, each layer shall be excavated separately and cleaned of debris to permit inspection.

4 Concrete blocks, clay pavers and precast concrete flags, kerbs and channels shall be lifted without cutting, to the nearest joint satisfying sub-Clause 3 of this Clause and carefully stored for re-use or dealt with as described in Appendix 2/3. In situ kerbs and channels shall be broken out to at least 150 mm beyond the excavation.

Reinstatement of Paved Areas

5 (05/02) For roads designed to carry traffic loading of 120 msa or less, reinstatements of openings in highways shall comply with the 'Specification for the Reinstatement of Openings in Highways' issued by the Highway Authorities and Utilities Committee.

The same requirements shall apply for roads designed to carry traffic loading of more than 120 msa except where otherwise stated in the appropriate Clauses of the Specification for Highway Works including the requirements of Appendix 7/2.

6 Where foamed concrete is used for the reinstatement of openings in roads carrying more than 30 msa, the requirements of the foamed concrete shall comply with Clause 1043.

7 Immediately before bituminous layers are reinstated, the edges of the existing material shall be cleaned of all loose material and be coated with an appropriate hot bituminous binder, or equivalent treatment. Where joints in concrete slabs are affected by the excavation they shall be reinstated by cutting back to at least 0.5 m on each side of a transverse joint and forming an expansion joint on one side of the excavation and a contraction joint on the other and provide longitudinal joints where necessary in the same line before reinstatement in compliance with Series 1000 to match the existing construction.

Reinstatement of Other Areas

8 Where the excavation affects grassed areas, unpaved footpaths, footways, verges and bridleways they shall be reinstated to match the existing surface, after backfilling with acceptable material described in Appendix 7/2 to a depth of not less than 150 mm below the finished surface.

Junctions Between New Pavement Construction and Existing Pavement or Other Paved Areas

9 Where new pavement construction abuts an existing bituminous pavement which has to be reduced

in level or overlaid to match alignment and levels, the existing surface shall be trimmed by the minimum amount of cold-milling (planing) to a depth which will allow the specified thickness of new construction to be laid, the edge being trimmed and treated in compliance with this Clause. Where the difference in level makes it necessary, a regulating course as described in Appendix 7/1 and specified in Clause 907 shall be provided. The locations of areas to be trimmed are given in Appendix 7/2.

10 (05/01) Junctions between concrete pavements and between concrete and bituminous pavements shall be constructed as described in Appendix 7/2. Junctions in porous asphalt surfacing shall comply also with Clause 938. Junctions between porous asphalt surfacing and other pavement surfaces shall be constructed as described in Appendix 7/2.

(05/01) **Compressed Air**

11 When compressed air is used to clean dust, dirt and debris from prepared faces of existing concrete or bituminous pavements which are otherwise ready for reinstatement, only oil-free compressed air shall be used and this shall be at a pressure of not less than 0.5 N/mm2.

707 Breaking Up or Perforation of Redundant Pavement

1 Where redundant pavement construction is to be perforated or broken up, the pavement shall be treated as described in Appendix 7/6.

708 (05/01) Not used

709 (05/01) Cold-milling (Planing) of Bituminous Bound Flexible Pavement

1 Where cold-milling of bituminous bound flexible pavement is required, the area of carriageway to be milled shall be removed by a suitable milling machine to the requirements specified in Appendix 7/9. The process shall be carried out so as not to produce excessive quantities of dust, which shall be minimised by damping with water sprays.

2 The cut edges shall be left neat, vertical and in straight lines. The Contractor shall brush and sweep the milled surface by mechanical means to produce a clean and regular running surface with a groove depth not greater than 10 mm, and with a uniform texture.

3 Carriageways shall be milled to the tolerance of ± 6 mm. If the tolerances in this Clause are exceeded, the full extent of the area which does not comply shall be rectified by further milling or by regulating with materials in accordance with Clause 907.

4 Existing ironwork shall not be disturbed by the milling action. Where necessary, surfacing in the vicinity of ironwork and in small or irregular areas shall be cut out by pneumatic tools or other suitable methods and removed.

5 Where milling is carried out on a carriageway open to traffic, temporary ramping to ensure the safe passage of vehicles shall be provided in accordance with the requirements of Appendix 1/17.

6 If the milled surface profile varies by more than 10 mm, when measured transversely or longitudinally by a 3 metre straight edge, adjustments or replacements shall be made to the cutting teeth on the milling drum before work continues. Any discontinuity between adjacent milling passes exceeding 10 mm, when measured transversely by a 3 metre straight edge, shall be rectified by further milling or regulating before placing bituminous materials.

7 Where milling is required over extensive areas, the Contractor shall programme the work to allow removal of full lane widths unless this is impracticable. The Contractor shall notify his proposed programme of milling to the Overseeing Organisation prior to commencement of the work.

8 Immediately after milling, surplus materials shall be removed by a machine of suitable and efficient design and the milled surface swept to remove all dust and loose debris.

9 The material removed from the carriageway shall be removed from site, unless otherwise described in Appendix 2/3. No stockpiling shall be allowed on Site unless the material is to be used in the Works.

10 Carriageways which are closed to traffic to permit milling shall be resurfaced after milling prior to reopening the carriageway to traffic unless otherwise agreed by the Overseeing Organisation.

11 When specified in Appendix 7/9, 48 hours prior to cold-milling the Contractor shall carry out a sweep of the area(s) to locate any buried metalwork within the layer to be cold-milled. The sweep shall be carried out with electronic detection equipment suitable for the purpose. The surface shall be clearly marked above all objects to show their detected extent. The objects shall be referenced and their location and depth reported to the Overseeing Organisation within 6 hours of discovery. Surfacing in the vicinity of such objects shall be excavated using pneumatic tools or other suitable methods.

710 (11/04) Testing for Constituent Materials in Recycled Aggregate and Recycled Concrete Aggregate

Scope

1 (11/04) This Clause specifies the basic procedure and test methods for the examination of recycled aggregate and recycled concrete aggregate for the purpose of identifying and quantifying constituent materials.

Quality Control Procedure

2 (05/09) The quality control procedure shall be in accordance with the 'Quality Protocol for the production of aggregates from inert waste' and the 'Producers' compliance checklist' published by Waste and Resources Action Programme (WRAP). The results of all quality control checks carried out by the Contractor shall be compiled in accordance with the procedure set down in the above document and with those in this Clause. These shall be delivered promptly to the Overseeing Organisation on request.

Test Principle

3 (11/04) The method requires the visual recognition and quantification of the constituents of a sample of a recycled aggregate. This work shall be carried out by a suitably trained laboratory technician who has demonstrated his competence to classify the constituents in the sample in accordance with this Clause. This shall be achieved by hand-sorting particles from a test sample of aggregate and visually assessing into the following component parts:

(i) (05/04) asphalt (Class A);

(ii) (05/04) masonry (brick & block, other than lightweight block masonry) (Class B);

(iii) (05/04) concrete and concrete products (Class C);

(iv) (11/06) glass (Class G);

(v) (11/07) lightweight block masonry and other particles with a particle density less than 1000 kg/m3 (Class L);

(vi) (11/07) normal weight unbound aggregates (Class U);

(vii) (11/07) other materials such as metal, clay lumps, plastics, wood etc (Class X).

The mass of each of these groups shall be determined in accordance with sub-Clause 6 of this Clause. It shall then be expressed as a percentage of the total mass of the test portion as specified in sub-Clause 7.

Apparatus

4 The following apparatus shall be used:

(i) Oven, thermostatically controlled to maintain a temperature of 40°C within a tolerance of ± 5°C;

(ii) (11/04) Balance, of adequate capacity readable and accurate to ± 0.1% of the total mass to be weighed;

(iii) (05/04) Test sieves, 63 mm and 8 mm size with apertures as specified in BS EN 933-2.

Sampling

5 (11/03) The sample shall be taken in accordance with the procedures described in BS EN 932-1. The sample shall be reduced in accordance with the procedures specified in BS EN 932-2.

To assist the visual examination of particles, it may be beneficial to wash the sample before drying.

The sample shall be dried at a temperature of 40°C within a tolerance of ± 5°C until it has constant mass. The entire sample shall then be thoroughly sieved on the 63 mm sieve specified in sub-Clause 4 of this Clause in order to remove oversize fractions. All particles retained on the 63 mm sieve shall be discarded.

The sample shall then be further reduced in accordance with BS EN 932-2 to produce duplicate test portions. Both test portions shall then be thoroughly sieved on the 8 mm sieve in order to remove undersize fractions. All particles passing the 8 mm sieve shall be discarded. The mass of each seived test portion (8/63 mm size) shall be recorded as M_{total}.

Both remaining duplicate portions are to be tested. Each of these portions shall consist of not less than 500 particles. The mass required to provide 500 particles is dependent on the particle size distribution and the particle density of the aggregate. Table 7/3 provides guidance on the mass that is likely to be required to give 500 particles.

TABLE 7/3: (11/03) **Minimum Mass of Each Test Portion**

Upper aggregate size D mm	Test portion mass (minima) (kg)
63	50
40	15
31.5	8
20	2
16	2
14	1

Test Procedure

6 (11/06) The particles of the test portion shall be spread onto a flat surface and separated by hand into the following groups:

- asphalt (Class A);
- masonry (Class B);
- concrete and concrete products (Class C);
- glass (Class G)
- lightweight particles (Class L);
- unbound aggregate (Class U);
- other particles (Class X).

Each group shall be weighed and the respective masses recorded as:

- M_A (Class A)
- M_B (Class B)
- M_C (Class C)
- M_G (Class G)
- M_L (Class L)
- M_U (Class U)
- M_X (Class X)

If the sum of the masses in each class differs by more than 1% from the total mass of the sieved test portion, Mtotal, the test shall be repeated.

Repeat the procedure using the duplicate test portion.

Calculation and Expression of Results

7 (05/04) The percentage by mass P of particles in each group shall be calculated from the following equation:

$$P_{subscript} = M_{subscript} \times 100/M_{total}$$

Report the results as the mean of the values obtained from the two test portions. Record the values to the nearest 0.1% for other particles (Class X) and to the nearest whole number for all other classes.

Test Report

8 (05/04) The test report shall include the following information:

(i) reference to this test method;

(ii) identification of the sample;

(iii) identification of the laboratory;

(iv) sample reception date;

(v) (11/03) a statement classifying the aggregate type, and identifying the sample as either conforming to or not conforming to the requirements of Table 2 of BS 8500-2;

(vi) additional observations, comments and other sample data.

A work sheet based on the proforma in Appendix 7/10 shall be used to record the test results and the calculations made from them.

711 (05/01) Overband and Inlaid Crack Sealing Systems

1 Overbanding and inlaid crack sealing systems shall have current British Board of Agrément HAPAS (BBA/HAPAS) Roads and Bridges Certificates. If no BBA/HAPAS certificates have been issued, then in the interim, only overbanding and inlaid crack sealing systems approved by the Overseeing Organisation shall be used.

2 A crack sealing system with a current BBA/HAPAS certificate shall only be installed by a contractor approved by the Certificate Holder as an Approved Installer for that system.

Overbanding Crack Sealing Systems

3 The installed width and nominal thickness of overbanding sealants applied on the road surface shall not exceed 40 mm and 3 mm respectively.

Inlaid Crack Sealing Systems

4 The inlaid crack sealing system BBA/HAPAS Grade Classification required for each location shall be as specified in Appendix 7/11.

Chippings

5 (11/03) The minimum polished stone value of the source aggregate for chippings applied to the surface of overbanding and inlaid crack sealing systems, determined in accordance with BS EN 1097-8, shall be as specified in Appendix 7/11.

Installation and Quality Control Procedures

6 The installation and quality control procedures for overbanding and inlaid crack sealing systems shall be in accordance with the BBA/HAPAS Certificate for each system and the current Method Statement agreed by the BBA. The results of all quality control checks carried out on site by the Contractor and quality assurance information compiled in accordance with the requirements of the BBA/HAPAS Certificate, including results from BBA surveillance visits, shall be made available to the Overseeing Organisation on request.

Initial Skid Resistance

7 (11/04) The minimum wet Skid Resistance value of overbanding and inlaid crack sealing systems when newly installed shall not be less than 60 when determined using the portable skid resistance tester (pendulum) in accordance with BS EN 13036-4, except that for sealant widths less than 75 mm, the narrow slider shall be used over the full 126 mm sliding length utilising the normal slider scale C.

712 (05/01) Maintenance of Arrester Beds

1 The locations and maintenance requirements of arrester beds are given in Appendix 7/12. Generally the arrester beds comprise an area of ground excavated and replaced with a granular material and having a paved approach.

2 The Contractor shall provide advance signing indicating that an arrester bed is closed, and shall temporarily cover the permanent signing while this work is carried out.

3 The maintenance work shall comprise:

(i) clearance of debris, litter and weed growth from granular material and removal off Site;

(ii) sweeping of loose granular material from channel or paved approach, replacement on bed and raking over and levelling the granular material on bed.

4 Where there is a series of arrester beds, the Contractor shall restrict access to only one bed at a time.

713 (05/01) Saw-cut and Seal Bituminous Overlays on Existing Jointed Concrete Pavements

General

1 Where shown on the Drawings listed in Appendix 7/13, a bituminous overlay or inlay, as specified in Appendix 7/1, shall be laid over the existing concrete pavement which has been either treated or prepared as specified in Clause 714. The overlay or inlay shall then be saw-cut and sealed above existing transverse joints.

2 (05/02) Prior to the commencement of any preparatory work under sub-Clause 3 of this Clause, any and all existing bituminous binder course, surfacing and the like shall be removed from the area to be treated as defined in sub-Clause 1 of this Clause. This requirement shall not apply to work to this Clause to correct reflection cracking to existing bituminous surfacing exceeding 40 mm thickness in rigid composite pavements where so specified in Appendix 7/13.

3 Preparatory work to the existing concrete pavement including joints shall comply with Clause 714.

4 Before any tack or bond coating commences, the Contractor shall ensure that there are adequate stable accurate reference marks delineating all existing transverse pavement joints or saw-cuts and that they have been clearly marked and agreed with the Overseeing Organisation for purposes of accurately locating the positions of saw-cuts after overlaying to sub-Clause 5 of this Clause. The marking procedure and the nature and location of offsets and the means of their establishment shall be agreed in advance with the Overseeing Organisation in a method statement. The accuracy of such markings shall be compatible with the specified accuracy of subsequent saw-cutting operations to this Clause.

Bituminous Overlay Including Tack Coat and Bond Coat

5 (05/02) Bituminous overlay shall comply with Appendix 7/1 and the relevant Clauses of Series 900. For the purposes of this Clause, bituminous overlay shall include all specified regulating course, base, binder course and surfacing. Tack or bond coating shall be as specified in Appendix 7/4.

Saw-cutting of Grooves, Cleaning and Sealing

6 Saw-cutting of grooves, cleaning, application of bond-breaker tape and sealing of grooves shall be carried out in one continuous operation and shall be completed in its entirety before the surface is opened to site traffic. This trafficking restriction shall not apply to Contractor's vehicles and plant necessary to complete the bituminous overlay.

Saw-cutting of Grooves

7 As soon as practicable following the completion of the bituminous overlay in a given area, transverse saw-

cutting of grooves shall be carried out at each of the pre-marked locations defined in sub-Clause 4 of this Clause. The positions and dimensions of all such saw-cut grooves shall be to the tolerance specified in Appendix 7/13. The cross-section of saw-cut grooves shall comply with Figure 7/1. The saw-cut groove shall comprise both the sealant slot and the crack-initiation slot. The centre line of the crack-initiation slot in the overlay shall be aligned with each existing joint in the underlying concrete pavement to within the tolerance specified in Appendix 7/13.

Sealing

8 The area at saw-cut grooves in the bituminous overlay at which the sealing material is to be laid shall have been thoroughly cleaned, and shall be dry and free from dust, detritus or other debris. The ambient temperature and the temperature of the adjacent bituminous material shall be neither less than 5ºC nor greater than 50ºC. Suitable measures shall be taken to prevent the sealant from entering the crack-initiation slot.

9 Sealing at saw-cut grooves shall not commence until the line, direction and dimensions of each saw-cut groove has been verified by the Overseeing Organisation and the Contractor has received written agreement that sealing may commence.

The saw-cut grooves shall be sealed to the requirements of Clause 1016 with a hot-applied material to Clause 1017. A sample of the proposed sealant together with the manufacturer's certificate and recommendations for its use shall be supplied to the Overseeing Organisation before any saw-cutting commences. The sealant shall fill the sealant slot to the surface level within the tolerance stated in Figure 7/1. The sealant level and tolerance will be verified within 24 hours of the application of the sealant.

10 The sealing processes shall be completed after the surfacing course has been completed and before the surface is opened to traffic.

714 (05/01) Preparation of Jointed Concrete Pavements Prior to Overlaying and Saw-cut and Seal of the Bituminous Overlays

General

1 Where specified in Appendix 7/14 and shown on the Drawings, the existing jointed un-reinforced or reinforced cementitious pavement shall be prepared in accordance with this Clause before receiving a bituminous overlay which will then be saw-cut and sealed in accordance with Clause 713.

Acceptance of the Main Work

2 Once the preparation work to this Clause has been accepted by the Overseeing Organisation for a specified portion of the total area, the bituminous overlay, including any tack or bond coating, may proceed. Then the saw-cutting and sealing shall be carried out and accepted solely in accordance with the requirements of Clause 713.

Checking and Repair of Joints

3 All joints, arrises and temporary repairs shall be checked and repaired in accordance with Appendix 7/14.

Removal of Debris, Brushing and Cleaning before Overlay

4 Before work to this Clause commences, the area shall be cleared of all debris and detritus and then be thoroughly brushed clean. Similar cleaning shall be carried out on completion of work to this Clause and prior to tack or bond coating in preparation for overlaying with the specified bituminous material.

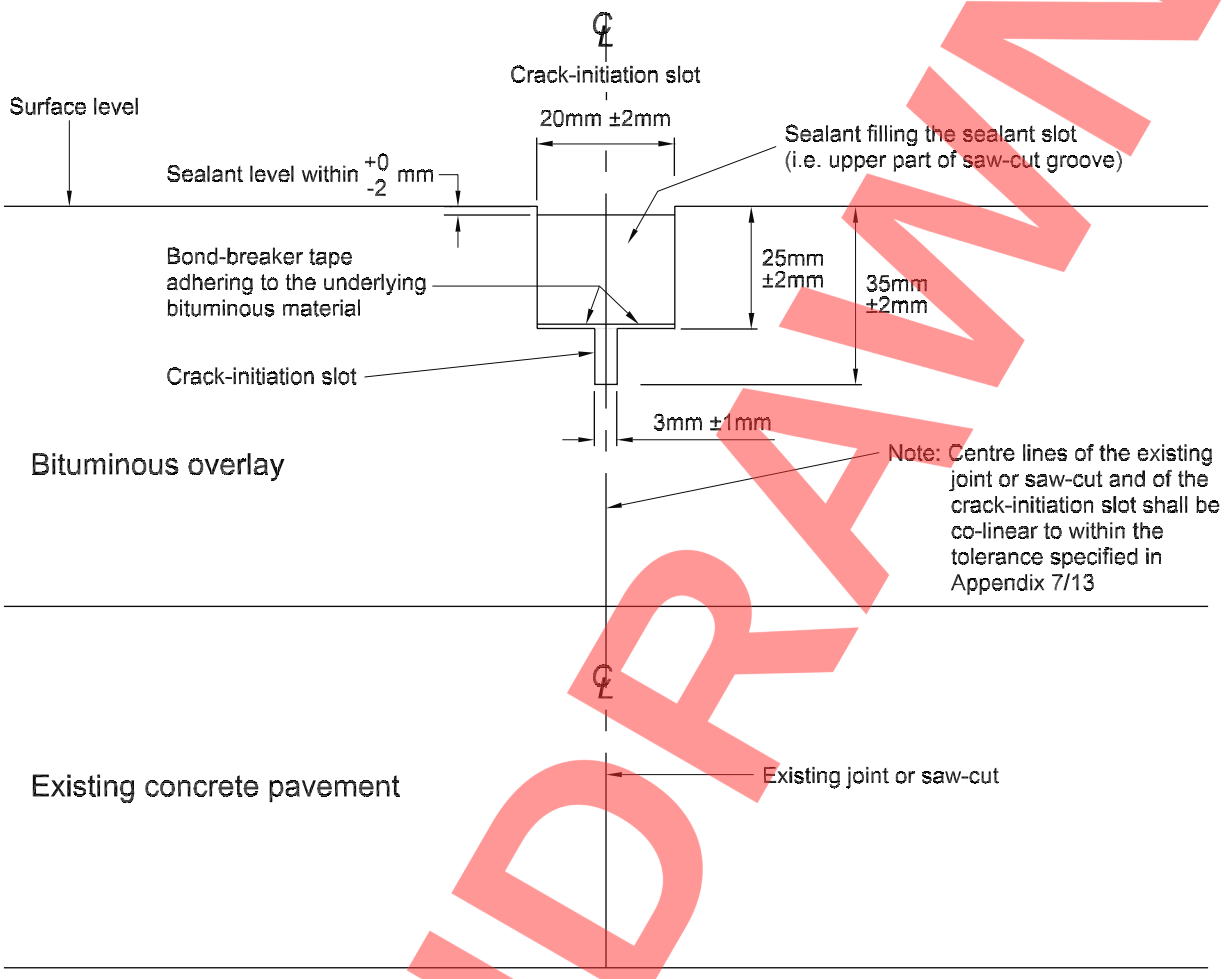
715 (05/01) Saw-cut, Crack and Seat Existing Jointed Reinforced Concrete Pavements

General

1 (11/07) Where shown on the drawings listed in Appendix 7/15, the existing reinforced concrete pavement layers shall be saw-cut and cracked and seated with plant and equipment to which the Overseeing Organisation's consent has been given, and shall comply with this Clause. The treated surface shall then be prepared in accordance with Clause 920 and tack or bond coated in accordance with Appendix 7/4 prior to overlaying in the locations specified in Appendix 7/1.

2 (11/07) Prior to the commencement of any saw-cutting operations, any existing asphalt overlay and surfacing shall be removed from the area to be treated under this Clause to the full width of each lane up to the adjoining longitudinal joint(s) unless directed otherwise by the Overseeing Organisation. Removal of any overlay shall be completed ahead of the works at a distance of not less than 50 m from the saw-cutting operation. The Contractor shall also ensure that adequate reference location marks based on the Overseeing Organisation's chainage have been clearly marked and agreed with the Overseeing Organisation for purposes of accurately recording progress and the locations of changes to equipment settings.

FIGURE 7/1: (05/01) **Detail of Saw-cut and Seal Groove with Sealant in Bituminous Overlay**



3 (11/07) Before any of the main saw-cut and crack and seat work is commenced, a main trial shall be carried out as specified in sub-Clause 21 of this Clause. After the main trial, the Contractor shall locate all bay joints, repair joints and any existing transverse cracks and shall pre-plan and mark the positions of the intended transverse saw-cuts using the transverse saw-cut spacing determined from the main trial. If the Contractor foresees any difficulty in complying with this sub-Clause, he shall immediately inform the Overseeing Organisation and shall not proceed with saw-cutting in such areas until he has received appropriate instructions from the Overseeing Organisation.

4 (11/07) Unless directed otherwise by the Overseeing Organisation, cracking and seating operations shall not take place unless there is adequate side restraint in place from the adjacent verge(s) and central reserve assisted by any Temporary Works which may be necessary.

5 (11/07) Compliance with this Clause shall be assessed by (i) examining the concrete surface for spalling, (ii) examining the depth and severity of cracking and the depth of saw-cuts by means of core extraction, (iii) measuring the spacing of saw-cuts, and (iv) recording the number of passes of the seating roller. Where required in Appendix 7/15, the effective stiffness modulus and/or joint efficiency of the cracked concrete layer or layers will be calculated from Falling Weight Deflectometer (FWD) measurements. The Overseeing Organisation may then instruct any variation required in the spacing of saw-cuts and/or method and pattern of cracking and/or subsequently confirm or otherwise the thickness of overlay required.

6 (11/07) The sequence of operations shall be: (i) pre-planning and marking of the positions of intended transverse saw-cuts, (ii) saw-cutting of the concrete pavement at the spacing and depths specified in Appendix 7/15, (iii) verification of saw-cut depths, (iv) inducing transverse cracks, (v) extracting cores, and (vi) seating. The observation of the surface crack pattern and examination of the cores shall be carried out in daylight or under sufficient artificial light provided by the Contractor to the satisfaction of the Overseeing Organisation. Where FWD measurements are specified in Appendix 7/15, these will follow the seating operation and shall be made by the Contractor in accordance with Clause 718 unless stated otherwise in Appendix 7/15. Processing and analysis of the FWD results shall be performed by the Contractor in accordance with Clause 719 unless stated otherwise in Appendix 7/15. The road shall be neither overlaid nor re-opened to highway traffic without the Overseeing Organisation's written confirmation that his interpretation of the FWD measurements is complete and that the condition of the treated pavement is in accordance with the design requirements.

7 (11/07) If, for reasons other than those in sub-Clauses 27 and 28 of this Clause, it either (i) becomes necessary for the Contractor to change any plant, equipment and/or method or (ii) the Contractor makes unplanned use of different or additional plant, he shall carry out a Special Trial which shall be so named but otherwise shall be in accordance with sub-Clauses 33 to 35 of this Clause.

Saw-cutting of Concrete Pavement

8 (11/07) Transverse saw-cutting of the concrete pavement shall be carried out to comply with this Clause including the particular requirements in Appendix 7/15.

9 (11/07) The position of all saw-cuts shall be clearly marked by the Contractor on the surface of the concrete prior to cutting. The spacing of saw-cuts to be used for the main trial in sub-Clauses 21 to 24 of this Clause shall be as specified in Appendix 7/15. No saw-cuts shall be made within the distance stated in Appendix 7/15 from an existing transverse joint or crack. The saw-cuts shall be made at the marked positions and shall be transverse to the longitudinal axis of the carriageway and within the tolerances specified in Appendix 7/15.

10 (11/07) The depth of all saw-cuts shall be measured from the top surface of the concrete pavement slab. The minimum depth of saw-cuts shall be just sufficient to cut completely through the longitudinal steel reinforcement but this depth shall in no circumstances exceed 50% of the nominal depth of the concrete pavement layer. When such a saw-cut fails to fully cut through the reinforcing steel, the cracking operation shall not proceed within 5 m of the incompletely cut bar. This fact shall be recorded by the Contractor who shall report it to the Overseeing Organisation as soon as practicable. This report shall be confirmed within 18 hours. Saw-cutting shall also cease immediately and not re-commence on the same slab until so instructed by the Overseeing Organisation. If there has been any over-cutting, this shall be remedied in accordance with sub-Clause 31 of this Clause.

11 (11/07) Each saw-cut, and the carriageway surface adjacent to it, shall be thoroughly cleaned of the slurry produced by sawing and any other detritus prior to cracking.

Cracking

12 (11/07) Induced cracking of existing pavement layer or layers shall be carried out to comply with this Clause including the particular requirements in Appendix 7/15.

13 (11/07) Transverse cracks at the positions of the saw-cuts shall be induced by suitable plant with a guillotine action capable of delivering controlled variable pre-set impact loads to the concrete surface. The plant used to crack the concrete pavement layer or layers shall be self-propelled and have all wheels fitted with rubber tyres. The compressive strength of the existing concrete shall be provided by the Overseeing Organisation in Appendix 7/15. The Contractor shall keep records of (i) the settings to his plant and equipment, (ii) the chainage and (iii) the time at which each and every adjustment is made to the plant and equipment. Such records shall be in accordance with the pro forma in Appendix 7/17 for the 'Cracking Plant and Equipment Progress Record' and shall be available on demand for inspection by the Overseeing Organisation. Cracks shall be induced in the concrete underlying the saw-cut by one strike of the impacting head of such plant. The Contractor shall take suitable measures to ensure that the plant and impact head are of sufficient mass and geared to prevent both head bounce and any associated surface damage arising therefrom. The impact force shall be adjustable to achieve the cracking specified and the minimum force consistent with no damage to either the saw-cut or to the adjoining concrete surface. Excessive impact forces which cause multiple cracking or shattering of the underside of the concrete slab, or to the underlying or adjacent layers, shall not be permitted. If such damage does occur, the Contractor shall carry out remedial measures in accordance with sub-Clause 31 of this Clause.

14 (11/07) The induced cracks shall extend from the bottom of the concrete slab to the base of the saw-cut and shall be predominantly vertical. They shall extend the full width of each concrete bay. The generation of longitudinal cracks is undesirable and those produced within the highway traffic wheel track zones of length greater than the longitudinal spacing of the saw-cuts specified in Appendix 7/15 or derived from a Main Trial shall constitute a failure under sub-Clause 31 of this Clause.

15 (11/07) Where the full width of any existing pavement layer cannot be cracked transversely with one pass of the crack inducing plant further parallel passes shall be made as necessary so that all subsequent transverse cracks are aligned with those from the preceding pass within the tolerances specified in Appendix 7/15.

16 (11/07) The Contractor shall adjust his equipment and methods so that (i) full depth fine vertical cracks in the concrete layer or layers are obtained, (ii) shattering of the concrete at the surface and/or at the bottom of the slab is avoided, and (iii) treated areas are rendered suitable for overlaying, to the satisfaction of the Overseeing Organisation. The cracking operation shall not proceed more than 100 metres beyond the last accepted core in the assessment under sub-Clause 29 of this Clause. Cracking shall not commence on a given saw-cut until it has been cut over its entire width to the appropriate depth in accordance with this Clause.

Coring

17 (11/07) The Contractor shall take cores in accordance with sub-Clauses 22, 29, 30 and 32 of this Clause and with Appendix 7/15 at locations selected by the Overseeing Organisation. All holes from which core samples have been extracted shall be filled with new hydraulically bound material equivalent to that in the surrounding pavement and adequately compacted in layers each not exceeding 50 mm thickness.

Seating

18 (11/07) Following cracking, all the cracked pavement layer shall be seated with a multi-wheeled pneumatic-tyred roller with a weight of not less than 20 tonnes compliant with Appendix 7/15 and with the number of passes specified in Appendix 7/15. The load including any ballast shall be distributed uniformly over all the wheels. The drive gear shall provide a progressive, variable speed, forward and reversing capability. Such compaction plant shall have articulating wheels on both front and rear axles. The wheel arrangement shall provide an overlap of not less than 40 mm with the adjacent wheels. The internal pressure of the tyres shall be adjustable to provide variable ground contact pressure (GCP). The Contractor shall certify in an agreed form on a daily basis the exact extent of work completed under this sub-Clause and shall deliver each such certificate to the Overseeing Organisation before noon the next day.

19 (11/07) Where voids under the pavement permit rocking at the ends of the slab(s) that is not remedied by the seating operation under sub-Clause 18 of this Clause, this shall be deemed to be unstable seating. This shall require additional parallel saw-cuts followed by cracking at suitable positions sufficient to enable stable seating to be achieved to the satisfaction of the Overseeing Organisation.

20 (11/07) Once saw-cutting and cracking and seating and any remedial work under sub-Clause 31 of this Clause have been completed, the pavement shall be prepared to Clause 920 before overlay.

Main Trial Area

21 (11/07) The Contractor shall demonstrate that the plant, equipment and method that he proposes for the saw-cut and cracking and seating of the existing concrete layer or layers are capable of producing the

required depth of saw-cut and required type of cracks. This shall be demonstrated by first executing a main trial over an area neither less than 250 m2 nor greater than 420 m2 of existing pavement. The location and area of the trial shall be as directed by the Overseeing Organisation, and shall include a length of the most heavily trafficked lane. The Contractor shall demonstrate that the saw-cutting and cracking operation can achieve consistent compliance with this sub-Clause and with sub-Clauses 8, 9, 10, 12, 13 and 22 of this Clause and with Appendix 7/15. If the road pavement to be treated contains known areas where there are significant differences in the concrete thickness or the concrete strength or in the conditions of the reinforcement or foundations, then a main trial shall be conducted in each such area. The locations of pre-existing transverse cracks within the Main Trial shall be recorded by the Contractor. The work on the main trial length shall proceed as follows:

(i) Saw-cutting and cracking shall proceed in stages as directed by the Overseeing Organisation. Each Stage that is cracked and seated shall be assessed in accordance with sub-Clause 22 of this Clause.

(ii) Stage 1 of the main trial shall be on 1 no. slab. The Contractor shall set up his plant and equipment and demonstrate that he can produce the required pattern and quality of saw-cuts and transverse cracks in accordance with this Clause including Appendix 7/15. This shall be assessed in accordance with sub-Clause 22 of this Clause.

(iii) In Stage 2 and any subsequent Stage of the main trial, a length encompassed by 6 no. saw-cuts shall be cracked starting from one end to produce transverse cracks at the saw-cut spacing stated in Appendix 7/15. For each Stage, the settings of the cracking plant and equipment shall be recorded in accordance with the pro forma in Appendix 7/17. The cracked pavement shall then be seated in accordance with the method in sub-Clauses 18 and 22(v) of this Clause.

(iv) Seating: After cracking, the pavement shall be seated with the number of passes of the roller specified in Appendix 7/15 as described in sub-Clause 18 of this Clause.

Assessment of Main Trial

22 (11/07) Compliance with the saw-cutting and the cracking and seating requirements for the main trial shall be assessed as follows:

(i) The depths of the saw-cutting shall be checked by the Contractor before cracking.

(ii) The spacing of transverse saw-cuts will be checked by the Contractor before cracking.

(iii) The surface cracking patterns shall be checked by the Overseeing Organisation either before or after seating by the Contractor.

(iv) The depth of the saw-cut and the depth and vertical direction of cracking shall be determined by coring through the full depth of the concrete pavement layer or layers symmetrically at any transverse position along the length of the saw-cut. Core diameter shall be in accordance with Appendix 7/15. In Stage 1 the Contractor may select the number and position of cores to be taken. In Stage 2 and in subsequent Stages of the main trial, the number of cores shall be in accordance with Table 7/4, with not less than one core taken from alternate saw-cuts. These shall be at locations selected by the Overseeing Organisation. If the depth of saw-cut exceeds the specified depth, or if any shattering or multiple cracking is present in the extracted core then it is deemed to require remedial work in accordance with sub-Clause 31 of this Clause.

(v) The Contractor's seating certificates required under sub-Clause 18 of this Clause will be checked by the Overseeing Organisation. If the number of roller passes required for seating is not in accordance with sub-Clause 18 of this Clause, the Contractor shall roll the entire area again in accordance with sub-Clause 18 of this Clause with not less than the number of passes of the roller specified in Appendix 7/15.

23 (11/07) Where required in Appendix 7/15, FWD testing of effective stiffness modulus shall be performed before saw-cutting and after seating in Stage 2 and any subsequent Stages of the main trial. The FWD testing shall be performed by the Contractor in accordance with Clause 718, unless stated otherwise in Appendix 7/15, both (i) before cracking and (ii) after seating in accordance with this Clause. Unless stated otherwise in Appendix 7/15, the Contractor shall perform the processing and analysis of the FWD measurements in accordance with Clause 719 and will present the results to the Overseeing Organisation for interpretation and instruction. The Contractor shall remove all debris from the cracked pavement in the main trial lengths before FWD measurements are made. Saw-cutting of Stage 2 or subsequent Stages of the

Main Trial shall not commence until the Overseeing Organisation has interpreted the analysed FWD measurements undertaken before cracking and has confirmed or otherwise the suitability of the area selected for the Main Trial.

Consent to the Method and Acceptance of the Main Trial

24 (11/07) The Contractor shall not proceed with the main work until the Overseeing Organisation has given its consent that the plant, equipment and methods used in the main trial length comply with the requirements in Table 7/4. Consent to use the plant equipment and methods of saw-cutting and cracking and seating will be given by the Overseeing Organisation following a successful demonstration in the main trial that the saw-cutting and the cracking and seating complies with the requirements of this Clause and that the effective stiffness modulus of the cracked and seated pavement and/or underlying foundation derived from FWD testing meets the design criteria. When consent by the Overseeing Organisation to the method has been given, the plant, equipment and methods shall not be changed thereafter without the prior consent of the Overseeing Organisation except for normal adjustment and maintenance of plant. Should it be necessary for the Contractor to otherwise change any plant, equipment and/or method the Contractor may be required to carry out a further main trial Stage.

Main Production Work

25 (11/07) The saw-cutting and cracking operation for the main production work shall proceed using the parameters as determined from the Main Trial or from any relevant subsequent Saw-cutting and Cracking Re-Assessment Trial. The seating operation shall be completed by rolling the pavement with the number of passes specified in Appendix 7/15. The main work shall be assessed in accordance with sub-Clause 29 of this Clause. As required in Appendix 7/15, the Contractor shall make allowance in his programme for FWD measurements of effective stiffness modulus which will be made by the Contractor according to Clause 718 after seating in accordance with this Clause, unless stated otherwise in Appendix 7/15. The Contractor will perform the processing and analysis of the FWD measurements in accordance with Clause 719, unless stated otherwise in Appendix 7/15, and will present the results to the Overseeing Organisation for interpretation and instruction. The Contractor shall remove all debris from the cracked pavement before FWD measurements are made.

26 (11/07) The Contractor shall be responsible for the continuous observation of the operation. The location of pre-existing transverse cracks shall be recorded by the Contractor. Should the results vary from those to which consent was given in the main trial, or from any relevant subsequent Saw-cutting and Cracking Re-Assessment Trail, with the consent of the Overseeing Organisation the Contractor shall adjust the plant and equipment and/or saw-cut depth in order to produce the agreed results. The new settings of the plant and equipment shall be recorded by the Contractor, together with the location at which it was changed. These particulars shall be delivered to the Overseeing Organisation within 24 hours of the changes being completed. If the agreed surface crack pattern is not restored within 25 m production cracking shall cease in accordance with sub-Clause 6 of this Clause. A Saw-cutting and Cracking Re-Assessment Trial shall then be carried out in accordance with sub-Clauses 33 to 35 of this Clause before any further production saw-cutting and cracking and seating work is executed.

27 (11/07) The depth of saw-cutting shall be measured before cracking. If the depth is not within the depth as specified in Appendix 7/15 the saw-cutting shall cease. If the saw-cut is too shallow it shall be re-cut until it is within tolerance. If the saw-cut is too deep it shall be deemed non-compliant under sub-Clause 22(iv) of this Clause. The saw-cut depth shall be brought within tolerance for subsequent cuts.

28 (11/07) The depth of the saw-cutting and the depth and quality of the induced cracks shall be monitored by inspection of extracted cores. If there has been any non-compliance with sub-Clause 22(iv) of this Clause, production saw-cutting and cracking shall cease immediately. The extent of the area affected shall be determined as specified in sub-Clause 32 of this Clause.

Assessment of the Main Production Work

29 (11/07) Compliance with the saw-cutting and the cracking and seating requirements shall be assessed during the main work in accordance with the following criteria:

(i) The spacing and depths of transverse saw-cuts will be monitored by the Overseeing Organisation.

(ii) The surface pattern of cracking of all areas that have been cracked and seated shall be checked by the Contractor and will be monitored by the Overseeing Organisation.

(iii) The depth of saw-cut and the depth and the vertical direction of cracking through the full depth of the concrete pavement layer or layers shall be determined symmetrically at the saw-cut position. Core diameter shall be in accordance with Appendix 7/15. The minimum frequency for coring of saw-cut

and cracked and seated concrete is specified in Appendix 7/15.

(iv) The seating shall be assessed in accordance with sub-Clause 22(v) of this Clause.

Acceptance of the Main Production Work

30 (11/07) The main work under this Clause shall be accepted when it complies fully with the requirements of this clause and Table 7/4.

Failure to Comply and Remedial Work

31 (08/08) The results of the saw-cut and crack and seat operations of any 5 m length of jointed reinforced concrete shall be rejected if they fail to comply with any of the criteria in sub-Clause 28 of this Clause. If:

(i) shattering or multiple cracking of concrete material occurs within the extracted core; or

(ii) excessive spall damage is caused to be arrises of the saw-cuts; or

(iii) the length of any longitudinal cracks in the highway traffic wheel tracks are in excess of the spacing of the induced transverse cracks; or

(iv) the spacing of the transverse saw-cuts is outside the tolerance specified in Appendix 7/15; or

(v) the depth of the transverse saw-cuts is greater than the depth specified in Appendix 7/15;

or any combination of these, then the following remedial measures shall be taken. The size of the affected area shall be determined and the rejected section(s) shall be broken out, excavated to full depth and reinstated with equivalent material, unless otherwise instructed by the Overseeing Organisation. The positions of the highway traffic wheel tracks to which reference is made in this Clause shall be as defined in sub-Clause 903.21.

If the number of roller passes required for seating is less than the number of passes specified in Appendix 7/15 at each and every point on the pavement, then the Contractor shall roll the entire area again with not less than the number of passes of the roller specified in Appendix 7/15, unless otherwise instructed by the Overseeing Organisation.

32 (11/07) The extent of shattering or multiple cracking or the extent to which the depth of the saw-cut is outside the specified tolerance shall be determined by extracting and inspecting cores. Such cores shall be taken through a saw-cut within the area between the position of the crack-inducing plant and the last core in which the saw-cutting and cracking complied with the requirements of sub-Clause 29 of this Clause. The extent of longitudinal cracking in the highway traffic wheel tracks shall be determined by visual inspection.

Saw-cutting and Cracking Re-assessment Trial

33 (11/07) When in the opinion of the Overseeing Organisation the conditions so require, a saw-cut and cracking re-assessment trial shall take place. The re-assessment trial described in this sub-Clause and in sub-Clauses 7, 26, 34 and 35 of this Clause shall require the Contractor to demonstrate that the plant, equipment and method to which consent was given by the Overseeing Organisation for use in the main production work are capable of producing the required effective stiffness modulus in the existing concrete layer or layers by executing this trial over an area of neither less than 75 m^2 nor greater than 120 m^2 of existing pavement. The location of the trial shall be as directed by the Overseeing Organisation. The saw-cut spacing(s) shall be as directed by the Overseeing Organisation within the tolerances specified in Appendix 7/15. The Contractor shall demonstrate that the saw-cutting and the cracking operations can achieve consistent compliance with sub-Clause 29 of this Clause. The saw-cutting and cracking re-assessment trial length shall be seated with the number of roller passes specified in Appendix 7/15.

Where FWD measurements are required by Appendix 7/15 the Contractor shall make programme allowance for these which shall be made by the Contractor according to Clause 718 before sawing and after cracking in accordance with this Clause, unless stated otherwise in Appendix 7/15. Unless stated otherwise in Appendix 7/16, the Contractor shall perform the processing and analysis of the FWD measurements in accordance with Clause 719 and shall present the results to the Overseeing Organisation for interpretation and instruction. The Contractor shall remove debris from the cracked pavement in the re-assessment trial length before FWD measurements are made. The production cracking re-assessment trial length shall be seated with the number of passes of the roller specified in Appendix 7/15.

Assessment of Saw-cutting and Cracking Re-assessment Trial

34 (11/07) Compliance with the saw-cutting and cracking and seating requirements for the saw-cutting and cracking re-assessment trial shall be assessed in accordance with sub-Clauses 22 and 23 above.

TABLE 7/4: (11/07) **Saw-cut, Crack and Seat of Existing Jointed Reinforced Concrete Pavements - Assessment Criteria for Acceptance of Trials and for the Main Production Work**

TYPE OF TRIAL OR WORK CATEGORY	CRITERIA				
	Transverse spacings and depths of saw-cuts	Crack quality and extent	Coring to determine depth of saw-cut and severity, depth and vertical direction of cracking	Seating	FWD monitoring (where required) [not part of the assessment of Contractor's work]
	1	2	3	4	5
Main trial Stage 1	(i) As specified in Appendix 7/15; (ii) Checked by the Contractor.	(i) No longitudinal crack length > saw-cut spacing; (ii) Monitored by the Contractor.	(i) Cores shall be taken through saw-cuts at locations chosen by the Contractor.	(i) Monitored by the Contractor; (ii) Roll with the number of passes of the roller specified in Appendix 7/15.	None required. May be done for/ by theOverseeing Organisationat his request.
Main trial Stage 2 and subsequent stages	(i) As specified in Appendix 7/15; (ii) Monitored by the Overseeing Organisation.	(i) No wheeltrack longitudinal crack length > saw-cut spacing; (ii) Monitored by the Overseeing Organisation.	(i) Cores shall be taken at locations chosen by the Overseeing Organisation; (ii) Not less than 5 cores in each Stage with not less than 1 core per alternate transverse saw-cut.	(i) Monitored by the Overseeing Organisation; (ii) Roll with the number of passes of the roller specified in Appendix 7/15.	The Contractor to either: (a) Determine and record the minimum effective stiffness modulus from FWD measurements and core details provided by the Contractor; or (b) Determine vertical movement at joints before and after treatment.
Acceptance of main trial Stage 2 and subsequent stages	(i) Required tolerance on transverse spacing and depth of saw-cutting achieved.	(i) Crack pattern complies with (i) above.	(i) No multiple cracks or shattering within the core; (ii) Cores shall have a single crack from thebottom of the saw-cut to the full depth of the concrete; (iii) Cracks shall be predominantly vertical; (iv) Depths of saw-cut to be within specified tolerances; (v) Depth of each saw-cut > depth to bottom of local transverse steel.	(i) Certification by the Contractor that each point has been rolled with the number of passes of the roller specified in Appendix 7/15.	The Contractor to either: (a) Produce a record of the measured effective stiffness modulus for (i) the concrete pavement and (ii) the foundation combination after the saw-cutting and cracking and/or seating; or (b) Produce a record of measurements of vertical movement at joints before and after treatment.

TABLE 7/4: (11/07) **Saw-cut, Crack and Seat of Existing Jointed Reinforced Concrete Pavements - Assessment Criteria for Acceptance of Trials and for the Main Production Work (continued)**

TYPE OF TRIAL OR WORK CATEGORY	CRITERIA				
	Transverse spacings and depths of saw-cuts	Crack quality and extent	Coring to determine depth of saw-cut and severity, depth and vertical direction of cracking	Seating	FWD monitoring (where required) [not part of the assessment of Contractor's work]
	1	2	3	4	5
Main production work	(i) As sepcified in Appendix 7/15; (ii) Monitored by the Contractor.	(i) No wheeltrack longitudinal crack length > saw-cut spacing; (ii) Monitored by the Contractor.	(i) Cores shall be taken at locations chosen by the Overseeing Organisation; (ii) Not less than 1 core per area specified in Appendix 7/15; (iii) Monitored by the Contractor.	(i) Roll each point with the number of passes of the roller specified in Appendix 7/15. (ii) Monitored by the Contractor.	The Contractor to either: (a) Determine and record the effective stiffness modulus from FWD measurements and core details provided by the Contractor on every 5 m length after cracking and/or seating; or (b) Determine the vertical movement at joints after treatment.
Acceptance of the main production work	(i) Required tolerance on transverse spacing of saw-cutting achieved.	(i) Crack pattern complies with (i) above.	(i) No multiple cracks or shattering within the core; (ii) Cores shall have a single crack from the bottom of the saw-cut to the full depth of the concrete; (iii) Cracks shall be predominantly vertical; (iv) Depths of saw-cut to be within specified tolerances; (v) Depth of each saw-cut > depth to bottom of local transverse steel.	(i) Certification by the Contractor that each point has been rolled with not less than the number of passes specified in Appendix 7/15.	(i) Not required for compliance monitoring; (ii) Required for confirmation of structural design.
Saw-cutting and cracking re-assessment trial	(i) Saw-cut spacing as specified by the Overseeing Organisation to the tolerance specified in Appendix 7/15; (ii) Monitored by the Overseeing Organisation.	(i) No wheeltrack longitudinal crack length > transverse crack spacing; (ii) Monitored by the Overseeing Organisation.	(i) Cores shall be taken at locations chosen by the Overseeing Organisation; (ii) Not less than 5 cores with not less than 1 core per alternate transverse saw-cut; (iii) Monitored by the Overseeing Organisation.	(i) Roll each point with not < the number of passes of the roller specified in Appendix 7/15; (ii) Monitored by the Overseeing Organisation.	The Contractor to either: (a) Determine and record the minimum effective stiffness modulus on every 5 m length after seating from FWD measurements and coredetails provided by the Contractor; or (b) Determine vertical movement at joints before and after treatment.

TABLE 7/4: (11/07) **Saw-cut, Crack and Seat of Existing Jointed Reinforced Concrete Pavements - Assessment Criteria for Acceptance of Trials and for the Main Production Work (continued)**

TYPE OF TRIAL OR WORK CATEGORY	CRITERIA				
	Transverse spacings and depths of saw-cuts	Crack quality and extent	Coring to determine depth of saw-cut and severity, depth and vertical direction of cracking	Seating	FWD monitoring (where required) [not part of the assessment of Contractor's work]
	1	2	3	4	5
Acceptance of a saw-cutting and cracking re-assessment trial	(i) Required tolerance on transverse saw-cutting achieved.	(i) Crack pattern complies with (i) above.	(i) No multiple cracks or shattering within the core; (ii) Cores shall have a single crack to the full depth of the concrete; (iii) Cracks shall be predominantly vertical; (iv) Depths of saw-cut to be within specified tolerances; (v) Depth of each saw-cut > depth to bottom of local transverse steel.	(i) Certification by the Contractor that each point has been rolled with not less than the number of passes specified in Appendix 7/15.	The Contractor to either: (a) Produce a record of the measured effective stiffness modulus for (i) the concrete pavement and (ii) the foundation combination both before, and after the saw-cutting and cracking and/or seating; or (b) Produce a record of measurements of vertical movement at joints before and after treatment.

(11/07) **Consent to Use the Method and Acceptance of the Saw-cutting and Cracking Re-assessment Trial**

35 (11/07) The Contractor shall not resume the main work until the Overseeing Organisation has given its consent that the plant, equipment and methods used in the saw-cutting and cracking re-assessment trial comply with the requirements given in Table 7/4.

Consent to the plant equipment and methods will be given by the Overseeing Organisation following a successful demonstration in the saw-cutting and cracking re-assessment trial that the saw-cutting and cracking and seating complies with the requirements of this Clause. When consent to the method by the Overseeing Organisation has been given, the plant, equipment and methods shall not be changed thereafter without the prior consent of the Overseeing Organisation except for normal adjustment and maintenance of plant. Should it be necessary for the Contractor to otherwise change any plant, equipment and/or method the Contractor shall carry out a further saw-cutting and cracking re-assessment trial.

716 (11/07) Cracking and Seating of Existing Jointed Unreinforced Concrete Pavements and Hydraulically Bound Mixture (HBM) Bases

General

1 (11/07) Where shown on the drawings listed in Appendix 7/16, the existing unreinforced hydraulically bound pavement layer or layers shall be cracked and seated with plant and equipment to which the Overseeing Organisation's consent has been given, and shall comply with this Clause. The treated surface shall be then be prepared in accordance with Clause 920 and tack or bond coated in accordance with Appendix 7/4 prior to overlaying where specified in Appendix 7/1.

2 (11/07) Prior to the commencement of any operations to induce cracks, any existing asphalt overlay and surfacing shall be removed from the area to be treated for the full width of each lane up to the adjacent longitudinal joints unless directed otherwise by the Overseeing Organisation. Removal of any overlay shall be completed ahead of the works at a distance of not less than 50 m from the cracking

operation. The Contractor shall also ensure that adequate reference marks based on the Overseeing Organisation's chainage have been clearly marked and agreed with the Overseeing Organisation for purposes of accurately recording progress and locations of changes to equipment settings.

3 (11/07) Before any of the main crack and seat work is commenced, a main trial shall be carried out in accordance with sub-Clauses 17 to 20 of this Clause. After the main trial, the Contractor shall locate all bay joints and repair joints, or existing cracks in the concrete pavement or HBM, and shall pre-plan and mark the positions of the intended induced cracks at these locations using the transverse crack spacing determined from the main trial. If the Contractor foresees any difficulty in complying with this sub-Clause, he shall immediately draw this to the attention of the Overseeing Organisation and shall not proceed with cracking in such areas until he has received appropriate instructions from the Overseeing Organisation.

4 (11/07) Cracking and seating operations shall not take place unless there is adequate side restraint in place from the adjacent verge(s) and central reserve assisted by any Temporary Works which may be necessary. All cracking and seating operations shall be completed before the commencement of any excavation which, in the opinion of the Overseeing Organisation, would remove adequate side restraint in the adjacent verge(s) and/or central reserve.

5 (11/07)Compliance with this Clause shall be assessed by (i) examining the generated crack pattern on the surface of the jointed concrete or HBM base layer, (ii) examining the depth and severity of cracking by means of core extraction, (iii) measuring the spacing of the induced cracks, and (iv) recording the number of passes of the seating roller. The effective stiffness modulus of the cracked hydraulically bound layer or layers and underlaying foundation will be calculated from Falling Weight Deflectometer (FWD) measurements. The Overseeing Organisation may then instruct any variation required in the method and pattern of cracking or subsequently confirm or otherwise the thickness of overlay required.

6 (11/07) The sequence of operations for the main production work shall be: (i) where necessary, pre-planning and marking of the positions of induced transverse cracks, (ii) application of clean water to assist examination of the crack pattern, (iii) inducing transverse cracks, (iv) observation of the surface crack pattern, (v) extracting cores and (vi) seating. The observation of the surface crack pattern and examination of the cores shall be carried out in daylight or under sufficient artificial light provided by the Contractor to the satisfaction of the Overseeing Organisation. FWD measurements will follow the seating operation and shall be performed by the Contractor in accordance with Clause 717 unless stated otherwise in Appendix 7/16. Processing and analysis of the FWD results shall be performed by the Contractor in accordance with Clause 719 unless stated otherwise in Appendix 7/16. The road shall be neither overlaid nor re-opened to highway traffic without the Overseeing Organisation's written confirmation that the Overseeing Organisation has completed its intepretation of the FWD measurements and that the condition of the treated pavement is in accordance with the design requirements.

7 (11/07) Once the main crack and seat operation has commenced, its efficacy shall be kept under review by the Contractor in accordance with sub-Clauses 21 to 25 of this Clause. If, due to variations in the strength or other physical characteristics of the hydraulically bound pavement layer or of the foundation or otherwise, the crack pattern varies from that confirmed in the main trial, the equipment shall be adjusted as described in sub-Clauses 10 and 22 of this Clause to produce the required crack pattern. If the crack pattern obtained in the main trial is not re-established within 4 bays for jointed unreinforced concrete pavements, or within 20 m for HBM bases, then production cracking shall stop immediately. The Contractor shall report such circumstances to the Overseeing Organisation orally within 1 hour and confirm it in writing within 2 hours. A production cracking re-assessment trial shall then be carried out in accordance with sub-Clauses 28 to 30 of this Clause before any further cracking and seating work is executed at the relevant area.

8 (11/07) If, for reasons other than those in sub-Clause 22 of this Clause, it either (i) becomes necessary for the Contractor to change any plant, equipment and/or method or (ii) the Contractor makes unplanned use of different or additional plant, he shall carry out a Special Trial which shall be so named but otherwise shall be in accordance with sub-Clauses 28 to 30 of this Clause.

Cracking

9 (11/07) Induced cracking of existing pavement layer or layers shall be carried out to comply with this Clause including the particular requirements in Appendix 7/16.

10 (11/07) Transverse cracks at the required spacing shall be induced by suitable plant with a guillotine action capable of delivering variable pre-set impact loads to the concrete surface. The plant used to crack the hydraulically bound pavement layer or layers shall be self-propelled and have all wheels fitted with rubber tyres. The compressive strength of the existing concrete

shall be provided by the Overseeing Organisation in Appendix 7/16. The required spacing of cracks for the main trial in sub-Clauses 17 to 20 of this Clause shall be as specified in Appendix 7/16. The required spacing thereafter shall be as confirmed by the Overseeing Organisation on completion of the main trial. The Contractor shall keep records of (i) the settings to his plant and equipment, (ii) the crack spacing, (iii) the chainage and (iv) the time at which each and every adjustment is made to the plant and equipment. Such records shall be in accordance with the pro forma in Appendix 7/17 for the 'Cracking Plant and Equipment Progress Record' and shall be available on demand for inspection by the Overseeing Organisation. Cracks shall be induced by one strike of the impacting head of such plant without producing undue surface shatter. The plant and impact head shall be of sufficient mass and geared to prevent both head bounce and any associated surface damage arising therefrom. The impact force shall be adjustable to achieve the cracking specified using the minimum force consistent with no surface shatter. Excessive impact forces which cause multiple cracking or shattering of the underside of the concrete slab, or to the underlying or adjacent layers shall not be permitted. If such damage does occur, the Contractor shall carry out remedial measures in accordance with sub-Clauses 26 or 27 of this Clause, as appropriate.

11 (11/07) The induced cracks shall be predominantly vertical and shall be transverse to the direction of the road. They shall extend the full width of each concrete bay or the lane width of a HBM base. The generation of longitudinal cracks is undesirable and those produced within the highway traffic wheel track zones of length greater than the spacing of the induced transverse cracks shall constitute a failure under Clause 27 of this Clause.

12 (11/07) Where the full width of any existing pavement layer cannot be cracked transversely with one pass of the crack inducing plant further parallel passes shall be made as necessary so that all subsequent transverse cracks are aligned with those from the preceding pass within the tolerances specified in Appendix 7/16.

13 (11/07) The Contractor shall be responsible for (i) adjusting his equipment and methods so that the requisite crack pattern is maintained, (ii) producing full depth fine vertical cracks in the hydraulically bound layer or layers, and (iii) rendering treated areas suitable for overlaying, to the satisfaction of the Overseeing Organisation. For all trials and for all production cracking operations the Contractor shall provide clean water and shall saturate the surface area of the pavement which is to be cracked. The surface shall be allowed to dry naturally or shall be dried artificially so that it becomes surface dry before visual inspection is made of the induced crack pattern. The cracking operation shall not proceed more than 100 metres beyond the last accepted core in the assessment under sub-Clause 22 of this Clause.

Coring

14 (11/07) The Contractor shall take cores in accordance with sub-Clauses 18, 23, 24, and 27 of this Clause and with Appendix 7/16 at locations selected by the Overseeing Organisation. All holes from which core samples have been extracted shall be filled with new hydraulically bound material equivalent to that in the surrounding pavement and adequately compacted in layers each not exceeding 50 mm thickness.

Seating

15 (11/07) Following cracking, all of the cracked pavement layer shall be seated with a multi-wheeled pneumatic-tyred roller with a weight specified in Appendix 7/16 and with the number of passes specified in Appendix 7/16. The load including any ballast shall be distributed uniformly over all the wheels. The drive gear shall provide a progressive, variable speed, forward and reversing capability. Such compaction plant shall have articulating wheels on both front and rear axles. The wheel arrangement shall provide an overlap of not less than 40 mm with the adjacent wheels. The internal pressure of the tyres shall be adjustable to provide variable ground contact pressure (GCP). The Contractor shall certify in an agreed form on a daily basis the exact extent of work completed under this sub-Clause and shall deliver each such certificate to the Overseeing Organisation before noon the next day.

16 (11/07) Once cracking and seating and any remedial work under sub-Clause 26 of this Clause have been completed, the pavement shall be prepared to Clause 920 before overlay.

Main Trial

17 (11/07) The Contractor shall demonstrate that the plant, equipment and method that he proposes for the cracking and seating of the existing hydraulically bound layer or layers are capable of producing the required type and pattern of cracks. This shall be demonstrated by first executing a main trial over an area of neither less than 250 m2 nor greater than 420 m2 of existing pavement. The location of the trial shall be as directed by the Overseeing Organisation and shall include a length of the most heavily trafficked lane. The Contractor shall demonstrate that the cracking operation can achieve consistent compliance with this sub-Clause and with sub-Clauses 10 and 18 of this Clause and with Appendix 7/16. If the road pavement to be treated

contains known areas where there are differences in the concrete thickness or strength or in the foundation conditions, then a main trial shall be conducted in each such area. The locations of pre-existing transverse cracks within the area of the Main Trial shall be recorded by the Contractor. The work on the main trial length shall proceed as follows:

(i) (11/07) Cracking shall proceed in stages as directed by the Overseeing Organisation in groups of four to six bays in jointed concrete pavements, or in lengths of 20 m for HBM bases. Each group that is cracked and seated shall be assessed in accordance with sub-Clause 18 of this Clause.

(ii) (11/07) In Stage 1 of the main trial the Contractor shall set up his plant and equipment and demonstrate that he can produce the required pattern and quality of transverse cracks in accordance with this Clause including Appendix 7/16. This shall be assessed in accordance with sub-Clause 18 of this Clause.

(iii) (11/07) In Stage 2 and each subsequent Stage of the main trial, a group of four bays in jointed concrete pavements, or a length of 20 m for HBM bases, shall be cracked starting from one end to produce transverse cracks at each of the spacings stated in item 6(i) of Appendix 7/16. For each Stage, the settings of the cracking plant and equipment shall be recorded in accordance with the pro forma in Appendix 7/17.

(iv) (11/07) Seating: After cracking in both Stage 1 and Stage 2, the pavement shall be seated with the number of roller passes specified in Appendix 7/16 and as described in sub-Clause 15 of this Clause.

Assessment of Main Trial

18 (11/07) Compliance with the cracking and seating requirements for the main trial shall be assessed as follows:

(i) (11/07) The surface pattern of cracking shall be checked before seating but after applying clean water and allowing to dry as specified in sub-Clause 13 of this Clause.

(ii) (11/07) In Stage 1 of the main trial, the induced crack pattern shall be inspected by the Contractor. In Stage 2 and in subsequent Stages, visual inspection of the crack pattern shall be made by the Overseeing Organisation.

(iii) (11/07) In Stage 2 and in subsequent Stages of the main trial, the spacing of transverse cracks will be monitored by the Overseeing Organisation.

(iv) (11/07) The depth and the vertical direction of cracking shall be determined by coring through the full depth of the hydraulically bound pavement layer symmetrically at the crack position. Core diameter shall be in accordance with Appendix 7/16. In Stage 2 and in subsequent Stages of the main trial, the number of cores shall be in accordance with Table 7/5. In cases where cracks are not visible in the surface, the locations of cores will be generally within the impact points and transversely in line with the impact points. If any shattering or multiple cracking is present in the extracted core then there is deemed to have been 'shattering failure'.

(v) (11/07) The Contractor's certificates required under sub-Clause 15 of this Clause will be checked by the Overseeing Organisation. If the number of roller passes required for seating is not in accordance with sub-Clause 15 of this Clause, the Contractor shall roll again the entire area in accordance with sub-Clause 15 of this Clause and with not less than the number of roller passes specified in Appendix 7/16.

19 (11/07) The Contractor shall make allowance in his programme for the undertaking of FWD measurements which will be performed by the Contractor in accordance with Clause 717, unless stated otherwise in Appendix 7/16, both (i) before cracking and (ii) after seating in accordance with this Clause. Unless stated otherwise in Appendix 7/16, the Contractor shall perform the processing and analysis of the FWD measurements in accordance with Clause 719 and shall present them to the Overseeing Organisation for interpretation and instruction. The Contractor shall remove all debris from the cracked pavement in the main trial lengths before FWD measurements are made. Cracking of Stage 2 or subsequent Stages of the Main Trial shall not commence until the Overseeing Organisation has interpreted the analysed FWD measurements undertaken before cracking and has confirmed or otherwise the suitability of the area selected for the Main Trial.

Consent to the Method and Acceptance of the Main Trial

20 (11/07) The Contractor shall not proceed with the main crack and seat work until the Overseeing Organisation has given its consent that the plant,

equipment and methods used in the main trial length comply with the requirements in Table 7/5. Consent to the plant equipment and methods of cracking and seating will be given by the Overseeing Organisation following a successful demonstration in the main trial that the cracking and seating complies with the requirements of this Clause and that the effective stiffness modulus of the cracked and seated pavement and/or underlying foundation derived from FWD testing meets the design criteria. When consent by the Overseeing Organisation to the method has been given, the plant, equipment and methods shall not be changed thereafter without the prior consent of the Overseeing Organisation except for normal adjustment and maintenance of plant. Should it be necessary for the Contractor to otherwise change any plant, equipment and/or method the Contractor may be required to carry out a further main trial Stage.

Main Production Work

21 (11/07) The cracking operation for the main production work shall proceed at the crack spacing determined after the main trial, or from any relevant subsequent production cracking re-assessment trial. The seating operation shall be completed by rolling the pavement for the number of passes specified in Appendix 7/16. The main production work shall be assessed in accordance with sub-Clause 24 of this Clause. The Contractor shall make allowance in his programme for FWD measurements which will be made by the Contractor according to Clause 717 after seating in accordance with this Clause, unless stated otherwise in Appendix 7/16. The Contractor will perform the processing and analysis of the FWD measurements in accordance with Clause 719, unless stated otherwise in Appendix 7/16, and will present the results to the Overseeing Organisation for interpretation and instruction. The Contractor shall remove all debris from the cracked pavement before FWD measurements are made.

22 (11/07) The surface pattern of cracking shall be checked after applying water as specified in sub-Clause 13 of this Clause. The Contractor shall be responsible for the continuous observation of the crack pattern. The location of pre-existing transverse cracks shall be recorded by the Contractor. If without the prior agreement of the Overseeing Organisation the crack spacing on the main work is shorter than that specified following the main trial, the Contractor shall so notify the Overseeing Organisation in not less than 2 hours. Should the crack pattern vary from that to which consent was given in the main trial, or from any relevant subsequent production cracking re-assessment trial, with the consent of the Overseeing Organisation the Contractor shall adjust the plant and equipment in order to produce the agreed crack pattern. The new settings of the plant and equipment shall be recorded by the Contractor, together with the chainage at which the settings were changed. These particulars shall be delivered to the Overseeing Organisation within not more than 24 hours of the changes being completed. If the agreed crack pattern is not restored within 4 bays in jointed concrete pavements or within 20 m in HBM bases production cracking shall cease in accordance with sub-Clause 7 of this Clause. A production cracking re-assessment trial shall then be carried out in accordance with sub-Clauses 28 to 30 of this Clause before any further production cracking and seating work is executed.

23 (11/07) The depth and quality of the induced cracks shall be monitored by inspection of extracted cores. If there has been 'shattering failure' in accordance with sub-Clause 18(iv) of this Clause, production cracking shall cease immediately. The extent of the area affected shall be determined as specified in sub-Clause 27 of this Clause.

Assessment of the Main Production Work

24 (11/07) Compliance with the cracking and seating requirements shall be assessed during the main work in accordance with the following criteria:

(i) (11/07) The spacing of transverse cracks shall be checked by the Contractor and will be monitored by the Overseeing Organisation.

(ii) (11/07) The surface pattern of cracking of all areas that have been cracked shall be checked after applying water as specified in sub-Clause 13 of this Clause.

(iii) (11/07) The depth and the vertical direction of cracking shall be determined through the full depth of the hydraulically bound pavement layer or layers symmetrically at the crack position. Core diameter shall be in accordance with Appendix 7/16. Not less than one core shall be extracted in every 300 m^2 of cracked concrete at locations selected by the Overseeing Organisation. In cases where cracks are not visible in the surface, the locations of cores will be generally in line with the impact points.

(iv) (11/07) The seating shall be assessed in accordance with sub-Clause 18(v) of this Clause.

Acceptance of the Main Production Work

25 (11/07) The main production work under this Clause shall be accepted when it complies fully with the requirements of this Clause and with Table 7/5.

TABLE 7/5: (11/07) **Crack and Seat of Existing Jointed Unreinforced Concrete Pavements and HBM Bases – Assessment Criteria for Acceptance of Trials and for the Main Production Work**

TYPE OF TRIAL OR WORK CATEGORY	CRITERIA				
	Surface crack pattern	Transverse crack spacing	Coring to determine severity, depth and vertical direction of cracking	Seating	FWD monitoring required by Appendix 7/16 [Not part of the assessment of Contractor's work]
	1	2	3	4	5
Main trial Stage 1	(i) Fine (i.e. < 0.5mm wide); (ii) In a transverse direction; (iii) No wheeltrack longitudinal crack length > transverse crack spacing; (iv) Monitored by the Contractor.	As specified in Appendix 7/16;	Cores shall be taken at locations chosen by the Contractor.	(i) Monitored by the Contractor; (ii) Roll with the number of passes of the roller specified in Appendix 7/16.	None required. May be done by the Contractor if desired.
Main trial Stage 2 and subsequent stages	(i) Fine (i.e. < 0.5mm wide); (ii) In a transverse direction; (iii) No longitudinal crack length > transverse crack spacing; (iv) Monitored by the Overseeing Organisation.	(i) Each stage at one crack spacing as specified in Appendix 7/16; (ii) Monitored by the Overseeing Organisation.	(i) Cores shall be taken at locations chosen by the Overseeing Organisation; (ii) Not less than 5 cores in each Stage with not less than 1 core from each bay or from a 5m length in HBM bases, as appropriate.	(i) Monitored by the Overseeing Organisation; (ii) Roll with the number of passes of the roller specified in Appendix 7/16.	Unless stated otherwise in Appendix 7/16 the Contractor to determine and record the minimum effective stiffness modulus from FWD measurements and core details provided by the Contractor.
Acceptance of main trial Stage 2 and subsequent stages	(i) Crack pattern complies with (i) to (iii) above.	(i) Required tolerance on transverse crack spacing achieved.	(i) No multiple cracks or shattering within the core; (ii) Cores shall have a single crack to the full depth of the concrete; (iii) Cracks shall be predominantly vertical.	Certification by the Contractor that each point has been rolled with not < the number of passes of the roller specified in Appendix 7/16.	Unless stated otherwise in Appendix 7/16 the Contractor to produce a record of the measured effective stiffness moduli for (i) the concrete pavement and (ii) the foundation both before, and after cracking and/or seating.

TABLE 7/5: (11/07) **Crack and Seat of Existing Jointed Unreinforced Concrete Pavements and HBM Bases – Assessment Criteria for Acceptance of Trials and for the Main Production Work (continued)**

TYPE OF TRIAL OR WORK CATEGORY	CRITERIA				
	Surface crack pattern	Transverse crack spacing	Coring to determine severity, depth and vertical direction of cracking	Seating	FWD monitoring required by Appendix 7/16 [Not part of the assessment of Contractor's work]
	1	2	3	4	5
Main production work	(i) Fine (i.e. < 0.5mm wide); (ii) In a transverse direction; (iii) No wheeltrack longitudinal crack length > transverse crack spacing; (iv) Monitored by the Contractor.	(i) Crack spacing determined from the main trial or from the re-assessment trial, as appropriate, to the tolerance specified in Appendix 7/16; (ii) Monitored by the Contractor.	(i) Cores shall be taken at locations chosen by the Overseeing Organisation; (ii) Not less than 1 core every 300sq m; (iii) Monitored by the Contractor.	(i) Monitored by the Contractor; (ii) Roll each point with not < the number of passes of the roller specified in Appendix 7/16.	Unless stated otherwise in Appendix 7/16 the Contractor to determine and record the effective stiffness modulus from FWD measurements and core details provided by the Contractor on every bay or 5 m length of HBM base after cracking and/or seating.
Acceptance of the main production work	(i) Crack pattern complies with (i) to (iii) above.	(i) Required tolerance on transverse crack spacing achieved.	(i) No multiple cracks or shattering within the core; (ii) Cores shall have a single crack to the full depth of the hydraulically bound layer; (iii) Cracks shall be predominantly vertical.	Certification by the Contractor that each point has been rolled with not < the number of passes of the roller specified in Appendix 7/16.	(i) Not required for compliance monitoring; (ii) Required for confirmation of structural design.
Production cracking re-assessment trial	(i) Fine (i.e. < 0.5mm wide); (ii) In a transverse direction; (iii) No wheeltrack longitudinal crack length > transverse crack spacing; (iv) Monitored by the Overseeing Organisation.	(i) Crack spacing as specified by the Overseeing Organisation to the tolerance specified in Appendix 7/16; (ii) Monitored by the Overseeing Organisation.	(i) Cores shall be taken at locations chosen by the Overseeing Organisation; (ii) Not less than 5 cores with not less than 1 core from each bay or 5m length in HBM bases, as appropriate; (iii) Monitored by the Overseeing Organisation.	(i) Monitored by the Overseeing Organisation; (ii) Roll each point with not < the number of passes of the roller specified in Appendix 7/16.	Unless stated otherwise in Appendix 7/16 the Contractor to determine and record the minimum effective stiffness modulus on every bay or 5 m length of HBM base after cracking and/or seating from FWD measurements and core details provided by the Contractor.
Acceptance of a production cracking re-assessment trial	(i) Crack pattern complies with (i) to (iii) above.	(i) Required tolerance on transverse crack spacing achieved.	(i) No multiple cracks or shattering within the core; (ii) Cores shall have a single crack to the full depth of the hydraulically bound layer; (iii) Cracks shall be predominantly vertical.	Certification by the Contractor that each point has been rolled with not < the number of passes of the roller specified in Appendix 7/16.	Unless stated otherwise in Appendix 7/16 the Contractor to produce a record of the measured effective stiffness moduli for (i) the concrete pavement and (ii) the foundation combination both before and after cracking and seating.

Failure to Comply and Remedial Work

26 (08/08) The results of the crack and seat operations for any jointed unreinforced concrete slab, or any 5 m length of HBM base, shall be rejected if it fails to comply with any of the criteria in sub-Clause 23 of this Clause. If:

(i) (11/07) shattering or multiple cracking of hydraulically bound material occurs within the extracted core; or

(ii) (11/07) the length of any longitudinal cracks in the highway traffic wheel track zones are in excess of the specified crack spacing of the induced transverse cracks;

(iii) the transverse crack spacing determined for the particular portion of the work is outside the tolerance specified in Appendix 7/16;

or any combination of these, then the following remedial measures shall be taken. The size of the affected area shall be determined and the rejected section(s) shall be broken out, excavated to full depth and reinstated with equivalent material, unless otherwise instructed by the Overseeing Organisation. The positions of the wheel track zones to which reference is made in this Clause shall be as defined in sub-Clause 903.21.

If the number of roller passes required for seating is less than the specified minimum at each and every point on the pavement, or less than such other increased number of passes which has been specified by the Overseeing Organisation following a trial or otherwise then the Contractor shall roll the entire area again with not less than the number of passes specified in Appendix 7/16, unless otherwise instructed by the Overseeing Organisation.

27 (11/07) The extent of shattering or multiple cracking shall be determined by extracting and inspecting cores. Such cores shall be taken at the location of induced transverse cracks within the area between the position of the crack-inducing plant and the last core in which the cracking complied with the requirements of sub-Clause 25 of this Clause. The extent of longitudinal cracking in the wheel track zones shall be determined by visual inspection.

Production Cracking Re-assessment Trial

28 (11/07) When in the opinion of the Overseeing Organisation, the conditions so require, a Production Re-assessment Trial shall take place. The Production Cracking Re-assessment Trial described in this sub-Clause and in sub-Clauses 7, 22, 29 and 30 of this Clause shall require the Contractor to demonstrate that the plant, equipment and method to which consent was given by the Overseeing Organisation for use in the main work are capable of producing the required type and pattern of cracks in the existing hydraulically bound layer or layers by executing this trial over an area of neither less than 75 m^2 nor greater than 120 m^2 of existing pavement. The location of the trial shall be as directed by the Overseeing Organisation. The crack spacing(s) shall be as directed by the Overseeing Organisation within the tolerances specified in Appendix 7/16. The Contractor shall demonstrate that the cracking operation can achieve consistent compliance with sub-Clause 29 of this Clause. The Contractor shall make programme allowance for FWD measurements which shall be made by the Contractor according to Clause 717 before cracking and after seating in accordance with this Clause unless stated otherwise in Appendix 7/16. Unless stated otherwise in Appendix 7/16 the Contractor shall perform the processing and analysis of the FWD measurements in accordance with Clause 719 and shall present the results to the Overseeing Organisation for interpretation and instruction. The Contractor shall remove all debris from the cracked pavement in the re-assessment trial length before FWD measurements are made. The production cracking re-assessment trial length shall be seated with the number of passes of the roller specified in Appendix 7/16.

Assessment of Production Cracking Re-assessment Trial

29 (11/07) Compliance with the cracking and seating requirements for the production cracking re-assessment trial shall be assessed in accordance with sub-Clauses 24 and 25 above.

Consent to the Method and Acceptance of the Production Cracking Re-assessment Trial

30 (11/07) The Contractor shall not resume the main work until the Overseeing Organisation has given its consent that the plant, equipment and methods used in the production cracking re-assessment trial comply with the requirements given in Table 7/5.

Consent to the plant equipment and methods will be given by the Overseeing Organisation following a successful demonstration in the Production Cracking Re-assessment Trial that the cracking and seating complies with the requirements of this Clause. When consent to the method has been given by the Overseeing Organisation, the plant, equipment and methods shall not be changed thereafter without the prior consent of the Overseeing Organisation except for normal adjustment and maintenance of plant. Should it be necessary for the Contractor to otherwise change any plant, equipment and/or method the Contractor shall carry out a further Production Cracking Re-assessment Trial.

717 (11/07) Monitoring of Cracked and Seated Jointed Unreinforced Concrete Pavements and HBM Bases using the Falling Weight Deflectometer (FWD)

General

1 This Clause specifies the procedures to be followed when the Falling Weight Deflectometer (FWD) is to be used to acquire the measurements required to determine the load-spreading properties of cracked and seated concrete as required by Clause 716. Specifically, the FWD shall be used to validate whether the effective stiffness modulus of the cracked and seated hydraulically bound layer or layers exceeds the threshold value determined from the structural design calculations. The type of equipment is specified together with the procedures for its use on site and the parameters to be used to acquire the deflection data. The effective stiffness moduli of the cracked and seated hydraulically bound layer or layers and of the underlying foundation shall be calculated by the Contractor using back-analysis of the FWD measurements obtained by the Contractor in accordance with Clause 719.

2 FWD measurements shall be made on the surface of the concrete after the removal of any existing asphalt overlay or surfacing from the area to be tested. Removal of overlay shall be completed ahead of the FWD testing at a distance of not less than 100 m from the FWD equipment. The cracking and seating operation shall be completed ahead of the FWD testing at a distance of not less than 100 m from the FWD equipment in order to minimise the effect of pavement vibration. FWD measurements shall follow the seating operation. The Contractor shall ensure that a sufficient frequency of clearly-marked locational reference markers have been put in place to the satisfaction of the Overseeing Organisation for the purpose of accurately recording the locations of the FWD measurements and therefore correlating the results with the settings used by the cracking plant.

3 The Overseeing Organisation will use the effective stiffness moduli obtained from the main trial in accordance with Clause 719 in conjunction with the other criteria specified in sub-Clause 17 of Clause 716 to determine the required transverse crack spacing to be used in the main production work.

4 The Overseeing Organisation may instruct any variation required in the method and pattern of cracking or subsequently confirm or otherwise the suitability of the proposed thickness of overlay required as a result of the effective stiffness modulus of the cracked and seated hydraulically bound layer or layers determined from FWD measurements.

5 The road shall be neither overlaid nor re-opened to highway traffic without the Overseeing Organisation's written confirmation that the FWD measurements have been assessed and any required remedial action taken.

Measuring Equipment

6 Any FWD used to monitor the effectiveness of the cracking and seating operation as specified in this Clause and in Clause 716 shall have been tested and approved in an annual FWD correlation trial organised by the Highways Agency, designed to check the adequacy of the FWD for trunk road testing.

7 Evidence of a satisfactory absolute calibration by the equipment manufacturer and consistency checks by the operator shall be provided as required by the Overseeing Organisation. The absolute calibration of the deflection sensors, load cell and system processor shall be carried out annually. Consistency checks of the dynamic response of the machine as a whole should take place at intervals of six weeks or less during periods of operation and after any major service involving replacement parts.

8 For the monitoring of the crack and seat operation on jointed unreinforced concrete pavements and on HBM bases, the load level shall be set at 50kN ± 10%. The load pulse shall be applied through a 300mm diameter plate and have a rise time from start of pulse to peak of between 5 and 15 milliseconds. Most FWDs in the UK have a 60 Hz smoothing filter option. The use of this filter has been shown to improve the agreement between machines and, where available, smoothing shall be activated. Deflections shall be measured to a resolution of at least 1 micron over the range 0-2mm by a minimum of 7 sensors situated at radii up to a distance of 2.25m from the centre of the loading plate at positions shown in Table 7/6. While more than 7 geophones can be fitted to an FWD, Clause 719 requires that the data input to the approved back-analysis software program shall contain measurements only from the geophones located at the positions shown in Table 7/6.

Operation on site

9 FWD testing shall not be performed while standing water is present on the surface to be tested.

10 The Contractor shall ensure that there is no detritus on the road surface prior to the FWD testing. Care shall be taken to ensure that the whole area of the FWD loading plate is in contact with the pavement surface. A minimum of 3 drops, plus a small initial drop for settling the load plate, should be made at each test point. The Contractor shall make checks for machine consistency during the survey and before analysis.

TABLE 7/6: Deflection Sensor Positions for Monitoring Cracking and Seating

Type of Pavement	Distance (mm) from Centre of Loading Plate Geophone number						
	d1	d2	d3	d4	d5	d6	d7
Jointed unreinforced concrete or HBM base	0	300	600	900	1,350	1,800	2,250

11 During FWD testing, it is essential for subsequent analysis that the deflection values (for d1 to d7) decrease as the distance from the applied load increases. Should the deflection measured by a geophone of a higher number (see Table 7/6) be greater than the deflection measured by a geophone of lower number, then the FWD shall be moved forwards or backwards by a small distance and the measurement cycle repeated. If it is not possible to obtain a decreasing deflection bowl after two shifts of position, then the measurement should be discarded and the Overseeing Organisation informed of the location of the test position for possible further investigation. Measurements of pavement temperature at 100 mm depth should be recorded at no less than hourly intervals.

Main Trial Area Testing

12 In Stage 2 and subsequent Stages of a Main Trial, FWD measurements shall be made both before and after cracking to determine the reduction in the effective stiffness modulus of the concrete produced by the cracking and seating operation. Stage 2 and subsequent Stages shall consist of an area as described in sub-Clause 17 of Clause 716. The area of concrete to be tested shall be adequately marked to enable FWD testing to be performed on the same locations both before and after cracking and seating.

13 On jointed concrete pavements, FWD measurements shall be made along the centre line of the bays. For each crack spacing specified in Appendix 7/15, the location of the centre of the loading plate for the first measurement shall be 1 m beyond the transverse joint at the start of a bay with all the geophones located within the bay. Subsequent measurements shall be made at intervals of 0.5 m along the centre line of the slab up to and including the centre of the slab. Test positions coincident with transverse cracks shall be omitted and the location of the crack recorded by the Contractor. For each measurement, the location of the FWD loading plate shall be adequately recorded so that the position of each measurement can be clearly identified.

14 On HBM bases, FWD measurements shall be made along the centre line of each traffic lane unless this alignment coincides with a longitudinal shrinkage or construction crack, in which case the measuring line shall be shifted towards the nearside wheelpath until the FWD test plate is not located within 0.5 m of a longitudinal crack. The location of the centre of the loading plate for the first measurement shall be 1m past the start of the test area for the Stage. Subsequent measurements shall be made at intervals of 1 m along the centre line of the lane until the outer geophone d7 (see Table 7/6) is outside the other end of the test area for the Stage. Test positions coincident with transverse cracks shall be omitted and the location of the crack recorded by the Contractor. For each measurement, the location of the FWD loading plate shall be adequately recorded such that the position of each measurement can be clearly identified.

15 After completion of the FWD measurements on the Main Trial, the deflection data and layer thickness details derived from cores taken in accordance with Clause 716, and supplemented by Ground Penetrating Radar (GPR) measurements when required by Appendix 7/16, shall be used by the Contractor to calculate effective stiffness moduli of the pavement layers in accordance with Clause 719. The moduli values shall be supplied to the Overseeing Organisation who will determine the required transverse crack spacing to be used in the main production with reference to the other criteria specified in sub-Clause 17 of Clause 716. For jointed unreinforced concrete pavements, the analysis will also provide the location on each bay where FWD measurements shall be made following production cracking and seating in the main works.

Consent to the Results of the FWD Measurements on the Main Trial

16 The Contractor shall not proceed with the main production cracking works until the Overseeing Organisation has specified the transverse crack spacing and given its consent that the effective stiffness modulus of the cracked and seated concrete exceeds the threshold value required by the structural design.

17 Consent to the plant, equipment and methods will be given by the Overseeing Organisation following a successful demonstration in the main trial that the

cracking and seating complies with the requirements of Clause 716 and this Clause. When consent by the Overseeing Organisation to the method has been given, the plant, equipment and methods shall not be changed thereafter without the prior consent of the Overseeing Organisation except for normal adjustment and maintenance of plant. Should it be necessary for the Contractor to otherwise change any plant, equipment and/or method, the Contractor shall carry out a further main trial Stage.

Main Production Work Testing

18 The cracking operation for the main production work shall proceed at the crack spacing determined from the main trial, or from any relevant subsequent production cracking re-assessment trial. The main production work shall be assessed in accordance with sub-Clause 24 of Clause 716 with reference to sub-Clause 21 of this Clause.

19 FWD measurements shall be made along the centre line of every bay of jointed concrete pavement after cracking and seating at the bay location determined by the Overseeing Organisation from the results of the main trial. For HBM bases, the FWD measurements shall be made every 5 m along the centre line of each traffic lane, and shifting by 0.5 m where necessary to avoid the location of pre-existing transverse cracks.

20 If the crack characteristics or patterns vary from those to which consent was given in the main trial, or from any relevant subsequent production cracking re-assessment trial and are not restored within 4 bays in jointed concrete pavements or within 20 m in HBM bases, production cracking shall cease in accordance with sub-Clause 7 of Clause 716. A production cracking re-assessment trial shall then be carried out in accordance with sub-Clause 28 of Clause 716 before any further production cracking and seating work is executed.

21 After completion of the FWD measurements on the Main Production Work, the deflection data and layer thickness details derived from cores taken in accordance with Clause 716, and supplemented by Ground Penetrating Radar (GPR) measurements when required by Appendix 7/16, shall be used by the Contractor to calculate effective stiffness moduli of the pavement layers in accordance with Clause 719. The moduli values shall be supplied to the Overseeing Organisation within 24 hours of the cracking operations.

Acceptance of the Main Production Work Testing

22 The effective stiffness moduli of the cracked and seated concrete calculated in accordance with Clause 719 from the FWD measurements collected in accordance with this Clause shall be assessed by the Overseeing Organisation in conjunction with the other criteria specified in sub-clause 24 of Clause 716. The Overseeing Organisation shall instruct or otherwise on any remedial actions that may be required. The road shall be neither overlaid nor re-opened to highway traffic without the Overseeing Organisation's written confirmation that he has completed his interpretation of the FWD measurements and that all required remedial actions have been completed.

Production Cracking Re-assessment Trial

23 Should a production cracking re-assessment trial be required for the reasons specified in sub-Clause 7 of Clause 716, then FWD measurements will be required for assessment of the trial. These measurements shall be made by the Contractor in accordance with sub-Clauses 12 to 17 of this Clause both before and after cracking and seating.

Assessment of Production Cracking Re-assessment Trial

24 After completion of the FWD measurements on the re-assessment trial, the deflection data and layer thickness details derived from cores taken in accordance with Clause 716 shall be used by the Contractor to calculate effective stiffness moduli of the pavement layers in accordance with Clause 719. The Overseeing Organisation will use these moduli values, in conjunction with the other criteria specified in sub-Clause 18 of Clause 716, to determine the transverse crack spacing to be used in the main production work. For jointed unreinforced concrete pavements, the analysis will also provide the location on individual bays where FWD measurements will be made following cracking and seating in the main works.

Consent to the Method and Acceptance of the Production Cracking Re-assessment Trial

25 The Contractor shall not resume the main crack and seat works until the Overseeing Organisation has given his consent that the plant, equipment and methods used in the production cracking re-assessment trial comply with the requirements given in Table 7/5 of Clause 716 and sub-Clauses 23 and 24 of this Clause.

718 (11/07) Monitoring of Saw-cut, Cracked and Seated Jointed Reinforced Concrete Pavements Using the Falling Weight Deflectometer (FWD)

General

1 This Clause specifies the procedures to be followed when the Falling Weight Deflectometer (FWD) is to be used to acquire the measurements used to determine the load-spreading properties of saw-cut, cracked and seated reinforced concrete as required by Clause 715. Specifically, the FWD shall be used to validate whether the effective stiffness modulus of the saw-cut, cracked and seated hydraulically bound layer or layers exceeds the threshold value determined from the structural design calculations. The type of equipment is specified together with the procedures for its use on site and the parameters required to acquire the deflection data. The effective stiffness moduli of the saw-cut, cracked and seated hydraulically bound layer or layers and of the underlying foundation shall be calculated by the Contractor using back-analysis of the FWD measurements obtained by the Contractor in accordance with Clause 719.

2 FWD measurements shall be made on the surface of the concrete after the removal of any existing asphalt overlay or surfacing from the area to be tested. Removal of overlay shall be completed ahead of the FWD testing at a distance of not less than 100 m from the FWD equipment. The cracking and seating operation shall also be completed ahead of the FWD testing at a distance of not less than 100 m from the FWD equipment in order to minimise the effect of pavement vibration. FWD measurements shall follow the seating operation. The Contractor shall ensure that a sufficient frequency of clearly-marked locational reference markers have been put in place to the satisfaction of the Overseeing Organisation for the purpose of accurately recording the locations of the FWD measurements and therefore correlating the results with the settings used by the cracking plant.

3 The Overseeing Organisation will use the effective stiffness moduli obtained from the main trial in accordance with Clause 719 in conjunction with the other criteria specified in sub-Clause 21 of Clause 715 to determine the required transverse crack spacing to be used in the main production work.

4 The Overseeing Organisation may instruct any variation required in the method and pattern of saw-cutting and/or cracking or subsequently confirm or otherwise the suitability of the proposed thickness of overlay required, as a result of the effective stiffness modulus of the saw-cut, cracked and seated hydraulically bound layer or layers determined from FWD measurements.

5 The road shall be neither overlaid nor re-opened to highway traffic without the Overseeing Organisation's written confirmation that the FWD measurements have been assessed and any required remedial action taken.

Measuring Equipment

6 Any FWD used to monitor the effectiveness of the saw-cut, cracking and seating operation as specified in this Clause and in Clause 715, shall have been tested and approved in an annual FWD correlation trial organised by the Highways Agency and designed to check the adequacy of the FWD for trunk road testing.

7 Evidence of a satisfactory absolute calibration by the equipment manufacturer and consistency checks by the operator shall be provided as required by the Overseeing Organisation. The absolute calibration of the deflection sensors, load cell and system processor shall be carried out annually. Consistency checks of the dynamic response of the machine as a whole should take place at intervals of six weeks or less during periods of operation and after any major service involving replacement parts.

8 For the monitoring of the saw-cut, crack and seat operation, the load level shall be set at 50kN ± 10%. The load pulse shall be applied through a 300 mm diameter plate and have a rise time from start of pulse to peak of between 5 and 15 milliseconds. Most FWDs in the UK have a 60 Hz smoothing filter option. The use of this filter has been shown to improve the agreement between machines and, where available, smoothing shall be activated. Deflections shall be measured to a resolution of at least 1 micron over the range 0-2 mm by a minimum of 7 sensors situated at radii up to a distance of 2.25m from the centre of the loading plate at positions shown in Table 7/7. While more than 7 geophones can be fitted to an FWD, Clause 719 requires that the data input to the approved back-analysis software program shall contain measurements only from the geophones located at the positions shown in Table 7/7.

Table 7/7: Deflection Sensor Positions for Monitoring Cracking and Seating

Type of Pavement	Distance (mm) from Centre of Loading Plate						
	Inner		>>>> Geophone number			Outer	
	d1	d2	d3	d4	d5	d6	d7
Jointed reinforced concrete	0	300	600	900	1,350	1,800	2,250

Operation on site

9 FWD testing shall not be performed while standing water is present on the surface to be tested.

10 The Contractor shall ensure that there is no detritus on the road surface prior to the FWD testing. Care shall be taken to ensure that the whole area of the FWD loading plate is in contact with the pavement surface. A minimum of 3 drops, plus a small initial drop for settling the load plate, should be made at each test point. The Contractor shall make checks for machine consistency during the survey and before analysis.

11 During FWD testing, it is essential for subsequent analysis that the deflection values for d1 to d7 reduce as the distance from the applied load increases. Should the deflection measured by a geophone of a higher number (see Table 7/7) be greater than the deflection measured by a geophone of a lower number, then the FWD shall be moved forwards or backwards by a small distance and the measurement cycle repeated. If it is not possible to obtain a decreasing deflection bowl after two shifts of position, then the measurement should be discarded and the location of the test position noted for further investigation by the Overseeing Organisation.

Main Trial Area Testing

12 In Stage 2 and subsequent Stages of the Main Trial, the Contractor shall make FWD measurements both before saw-cutting and then after cracking and seating, in order to determine the reduction in the effective stiffness modulus of the concrete produced by the saw-cut, cracking and seating operation. Stage 2 and subsequent Stages, shall consist of an area as described in sub-clause 21 of Clause 715. The area of concrete to be tested shall be adequately marked to enable FWD testing to be performed on the same locations both before saw-cutting and after cracking.

13 FWD measurements shall be made along the centre line of the reinforced slabs. For each saw-cut spacing, the location of the centre of the loading plate for the first measurement shall be at the midpoint between the first two saw-cuts. Subsequent measurements shall be made directly on the saw-cuts and at the midpoint between adjacent saw-cuts. Test positions coincident with transverse cracks should be omitted and the location of the crack recorded by the Contractor. The location of the FWD loading plate shall be adequately recorded so that the location of each measurement can be clearly identified.

14 After completion of the FWD measurements on the main trial, the deflection data and layer thickness details derived from cores taken in accordance with Clause 715, and supplemented by Ground Penetrating Radar (GPR) measurements when required by Appendix 7/15, shall be used by the Contractor to calculate effective stiffness moduli of the pavement layers in accordance with Clause 719. The moduli values shall be supplied to the Overseeing Organisation who will determine the required transverse saw-cut spacing to be used in the main production work with reference to the other criteria specified in sub-Clause 21 of Clause 715.

Consent to the Results of the FWD Measurements on the Main Trial

15 The Contractor shall not proceed with the main saw-cut, crack and seat works until the Overseeing Organisation has specified the transverse saw-cut spacing and given its consent that the effective stiffness modulus of the cracked and seated concrete exceeds the threshold value required by the structural design.

16 Consent to the plant, equipment and methods will be given by the Overseeing Organisation following a successful demonstration in the main trial that the saw-cut, cracking and seating complies with the requirements of Clause 715 and this Clause. When consent by the Overseeing Organisation to the method has been given, the plant, equipment and methods shall not be changed thereafter without the prior consent of the Overseeing Organisation except for normal adjustment and maintenance of plant. Should it be necessary for the Contractor to otherwise change any plant, equipment and/or method the Contractor shall carry out a further main trial Stage.

Main Production Work Testing

17 The cracking operation for the main production work shall proceed using the saw-cut spacing determined from the main trial, or from any relevant subsequent production cracking re-assessment trial. The main production work shall be assessed in accordance with sub-Clause 29 of Clause 715 with reference to sub-Clause 23 of this Clause.

18 FWD measurements shall be made every 5 m along the centre line of the slabs in each traffic lane, and shifting by 0.5 m where necessary to avoid the location of pre-existing transverse cracks.

19 If the crack characteristics or patterns vary from those to which consent was given in the main trial, or from any relevant subsequent production cracking re-assessment trial and are not restored within 20 m, production cracking shall cease in accordance with sub-Clause 6 of Clause 715. A production cracking re-assessment trial shall then be carried out in accordance with sub-Clause 33 of Clause 715 before any further production saw-cut and cracking and seating work is executed.

20 After completion of the FWD measurements on the Main Production Work, the deflection data and layer thickness details derived from cores taken in accordance with Clause 715, and supplemented by Ground Penetrating Radar (GPR) measurements when required by Appendix 7/15, shall be used by the Contractor to calculate effective stiffness moduli of the pavement layers in accordance with Clause 719. The moduli values shall be supplied to the Overseeing Organisation within 24 hours of the cracking operations.

Assessment of the Main Production Work Testing

21 The effective stiffness moduli of the cracked and seated concrete calculated by the Contractor in accordance with Clause 719 from the FWD measurements collected in accordance with this Clause shall be assessed by the Overseeing Organisation in conjunction with the other criteria specified in sub-Clause 29 of Clause 715. The Overseeing Organisation shall instruct or otherwise on any remedial actions that may be required. The road shall be neither overlaid nor re-opened to highway traffic without the Overseeing Organisation's written confirmation that he has completed his interpretation of the FWD measurements and that all required remedial actions have been completed.

Production Cracking Re-assessment Trial

22 Should a production cracking re-assessment trial be required as specified in sub-Clause 33 of Clause 715, then FWD measurements will be required for assessment of the trial. These measurements shall be made by the Contractor in accordance with sub-Clauses 12 to 16 of this Clause both before saw-cutting and after cracking and seating.

Assessment of Production Cracking Re-assessment Trial

23 After completion of the FWD measurements on the re-assessment trial, the deflection data and layer thickness details derived from cores taken in accordance with Clause 715 shall be used by the Contractor to calculate effective stiffness moduli of the pavement layers in accordance with Clause 719. The Overseeing Organisation will use these moduli values, in conjunction with the other criteria specified in sub-Clause 21 of Clause 715, to determine the transverse crack spacing to be used in the main production work.

Consent to the Method and Acceptance of the Production Cracking Re-assessment Trial

24 The Contractor shall not resume the main saw-cut, crack and seat works until the Overseeing Organisation has given its consent that the plant, equipment and methods used in the production cracking re-assessment trial comply with the requirements given in Table 7/4 of Clause 715 and sub-Clauses 15 and 16 of this Clause.

719 (11/07) Back-analysis of Falling Weight Deflectometer (FWD) Measurements Made on Concrete Pavements Treated by Fractured Slab Techniques

General

1 For the purposes of this Clause, 'Fractured Slab' techniques shall comprise the following:

(i) Crack and seat of jointed unreinforced concrete pavements and HBM bases in accordance with Clause 716.

(ii) Saw-cut and crack and seat of jointed reinforced concrete pavements in accordance with Clause 715.

2 The Contractor shall produce the FWD deflection measurements to be used in this Clause in accordance with Clause 717 for crack and seat or Clause 718 for saw-cut, crack and seat.

3 The effective stiffness modulus of the fractured concrete, together with that of the foundation, shall be derived from the back-analysis of FWD deflection bowl

measurements by means of the MODULUS-HA computer program. MODULUS-HA shall be used for all back-analysis of FWD measurements performed in accordance with Clause 717 for crack and seat or Clause 718 for saw-cut, crack and seat. Detailed instructions for the use of this program are contained in its accompanying MODULUS-HA User Guide.

4 The back-analysis procedure to be used utilises a two-layer model and, therefore, only the thickness of the bound layers is required. The unbound layers are modelled as a single layer of infinite depth. Thickness information for the bound layers is obtained from core samples obtained from the assessment of the cracking operations in accordance with Clause 715 or Clause 716, and may be supplemented by Ground Penetrating Radar measurements when required by Appendix 7/16 for crack and seat or Appendix 7/15 for saw-cut, crack and seat.

5 The pavement deflection data to be back-analysed shall be divided into uniform sections with similar total thicknesses of hydraulically bound material for the purposes of back-analysis. The mean total thickness of hydraulically bound material present shall be calculated for each section. The measured bound-layer thicknesses within a uniform section should lie within ±10 per cent of the bound-layer thickness used for that section.

6 The Overseeing Organisation may instruct any variation required in the method and pattern of cracking or subsequently confirm or otherwise the suitability of the proposed thickness of overlay required as a result of the effective stiffness modulus of the fractured hydraulically bound layer or layers determined from FWD measurements.

7 Following submission of the electronic tables and graphs produced in accordance with sub-Clauses 11 and 12 of this Clause, the Contractor shall allow the period of time set out in Appendix 7/19 for the Overseeing Organisation to carry out his assessment and interpretation of the results.

8 The pavement shall be neither overlaid nor re-opened to highway traffic without the Overseeing Organisation's written confirmation that he has completed his assessment of the FWD measurements and that any required remedial action has been completed.

Processing and Back-analysis Using MODULUS-HA

9 The Contractor shall use MODULUS-HA to create .OUT files with the required format from standard .F20 or .FWD output files in accordance with Chapter 3 of the MODULUS-HA User's Guide. Deflection measurements from a maximum of seven geophones shall be used. The additional parameters required by MODULUS-HA shall be as specified in Appendix 7/19. If the FWD deflection measurement data is not output in .F20 or .FWD file formats then the Contractor shall produce suitable .OUT files containing the measured FWD data with the required structure by an alternative method of his own devising.

10 Following production of a suitable .OUT file, the Contractor shall back-analyse the FWD deflection data obtained from a length of pavement defined in accordance with sub-Clause 5 of this Clause. The back-analysis shall be performed in accordance with the procedure set out in Chapter 4 of the MODULUS-HA Users Guide. The additional parameters required by MODULUS-HA shall be as specified in Appendix 7/19.

11 The Contractor shall save the back-analysed data as an ASCII data file in accordance with the procedure set out in Chapter 5 of the MODULUS-HA Users Guide. The structure of the data contained within the output data files shall be as specified in Appendix F of the MODULUS-HA Users Guide.

12 The Contractor shall compile and present the back-analysed data created by MODULUS-HA to the Overseeing Organisation in tabulated form in accordance with the electronic spreadsheet format specified in Appendix 7/19. For each FWD test point, the presented data shall include, as a minimum, the:

(i) Station identification; eg carriageway, lane and chainage.

(ii) Magnitude of the applied load (in kN).

(iii) Absolute measured deflections at each geophone position (in microns).

(iv) Back-analysed effective stiffness modulus of the hydraulically bound layer (in MPa).

(v) Back-analysed effective stiffness modulus of the foundation layer (in MPa).

(vi) Calculated thickness of hydraulically bound material used in the back-analysis (in mm).

(vii) Root Mean Square Deviation (RMS).

(viii) Absolute Mean Deviation (AMD) (in microns).

(ix) Estimated depth to a stiff layer (bedrock) (in mm).

The tabulated data shall also contain the actual measured core thicknesses and their locations relative to the FWD test positions.

Back-analysis and Presentation of Results of FWD Monitoring of Main Trial

13 The Contractor shall back-analyse and present the results of his FWD testing of the Main Trial carried out in accordance with Clause 717 for crack and seat or Clause 718 for saw-cut, crack and seat in accordance with sub-Clauses 9 to 11 of this Clause. The results shall also be presented graphically. The layout of the graphs shall display the relationships specified in Appendix 7/19 in a format acceptable to the Overseeing Organisation.

Back-analysis and Presentation of Results of FWD Monitoring of Main Production Works

14 The Contractor shall back-analyse and present the results of his FWD testing of the Main Production Works carried out in accordance with Clause 717 for crack and seat or Clause 718 for saw-cut, crack and seat in accordance with sub-Clauses 9 to 11 of this Clause. The results shall also be presented graphically. The layout of the graphs shall display the relationships specified in Appendix 7/19 in a format acceptable to the Overseeing Organisation

Back-analysis and Presentation of Results of FWD Monitoring of Production Cracking Reassessment Trials

15 The Contractor shall back-analyse and present the results of his FWD testing of any Production Cracking Reassessment Trial carried out in accordance with Clause 717 for crack and seat or Clause 718 for saw-cut, crack and seat in accordance with sub-Clauses 9 to 11 of this Clause. The results shall also be presented graphically. The layout of the graphs shall display the relationships specified in Appendix 7/19 in a format acceptable to the Overseeing Organisation.

NATIONAL ALTERATIONS OF THE OVERSEEING ORGANISATION OF NORTHERN IRELAND

702NI Horizontal Alignments, Surface Levels and Surface Regularity of Pavement Courses

Horizontal Alignments

1 (05/04) Horizontal alignments shall be determined from one edge of the pavement surface as described in Appendix 1/12. The edge of the pavement as constructed and all other parallel alignments shall be correct within a tolerance of ± 25 mm therefrom, except for kerbs and channel blocks which shall be laid with a smooth alignment within a tolerance of ± 13 mm. Longitudinal road markings lateral tolerances shall be in accordance with sub-Clause 1212.20NI.

Surface Levels of Pavement Courses

2 The design levels of pavement courses shall be calculated from the vertical profile, crossfalls and the pavement course thicknesses described in Appendix 7/1. The level of any point on the constructed surface of the pavement courses shall be the design level subject to the appropriate tolerances stated in Table 7/1NI.

TABLE 7/1NI: (11/04) **Tolerances in Surface Levels of Pavement Courses**

Road surfaces - general - adjacent to a surface water channel*	 ± 6 mm + 10 - 0 mm
Binder course *	± 6 mm
Base *	± 15 mm
Subbase under concrete pavement surface slabs laid full thickness in one operation by machines with surface compaction	± 10 mm
Subbases other than above	+ 10 - 30 mm

* Where a surface water channel is laid before the adjacent road pavement layer the top of that layer, measured from the top of the adjacent edge of the surface water channel, shall be to the tolerances given in Table 7/1NI.

3 (05/04) Notwithstanding the tolerances permitted in surface levels of pavement courses, the cumulative tolerance shall not result in a reduction in thickness of the pavement, excluding the subbase and filter layer, by more than 15 mm from the specified thickness nor a reduction in the thickness of the bituminous surface course by more than 5 mm from that specified.

4 For checking compliance with sub-Clause 2 of this Clause, measurements of the surface levels of all courses will be taken on a grid of points located as described in Appendix 7/1. In any length of pavement, compliance shall be deemed to be met for all surfaces, other than the final road surface, when not more than one of ten consecutive measurements taken longitudinally or one in any transverse line, exceeds the tolerances permitted in Table 7/1NI, provided that this one measurement shall not exceed by more than 5 mm the tolerance for the course concerned. For the final road surface the tolerance given in Table 7/1NI shall apply to any point on that surface.

Surface Regularity

5 (11/06) The longitudinal regularity of the surfaces of surface courses, binder courses and concrete slabs shall be such that the number of surface irregularities is within the relevant limits stated in Table 7/2NI.

An irregularity is a variation of not less than 4 mm or not less 7 mm of the profile of the road surface as measured by the rolling straight-edge set at 4 mm or 7 mm as appropriate, or equivalent apparatus capable of measuring irregularities within the same magnitudes over a 3 m length. No irregularity exceeding 10 mm shall be permitted.

6 (11/02) Prior to checking any final road surface, binder course or top surface of base in pavements without binder course for level, regularity or macrotexture depth, it shall be cleaned of loose or extraneous materials. These operations shall be carried out without damaging the surface of the pavement, as soon as possible and within 3 days of construction of the pavement.

7 Compliance with Table 7/2NI shall be checked by the rolling straight-edge along any line or lines parallel to the edge of pavement on sections of 300 m at regular intervals as stated in Appendix 7/1, whether or not it is constructed in shorter lengths. Sections shorter than 300 m forming part of a longer pavement shall be assessed using the number of irregularities for a 300 m length pro - rata to the nearest whole number.

Where the total length of pavement is less than 300 m, the measurements shall be taken on 75 m lengths.

8 (11/04) Pavements shall be measured transversely for irregularities at regular intervals as stated in Appendix 7/1, by a 3 m long straight-edge to BS 8420 placed at right angles to the centre line of the road. The maximum allowable difference between the pavement surface and the straight-edge shall be 3 mm.

9 A straight-edge 3 metres long, shall be used to check longitudinal surface regularity in the following cases:

(i) (11/04) for lengths of less than 75 m of surface course, binder course and concrete slabs;

(ii) where use of the rolling straight-edge or equivalent apparatus is impracticable;

(iii) (05/04) for all lengths of subbase under concrete pavement slabs laid full thickness in one operation by machine with surface compaction.

The maximum allowable difference between the surface and the underside of the straight-edge, when placed parallel with, or at right angles to, the centre line of the road shall be:

for pavement surfaces	3 mm
(05/02) for binder courses	6 mm
(05/04) for subbases under concrete pavements (as in (iii) above)	10 mm

TABLE 7/2NI: (11/06) **Maximum Permitted Number of Surface Irregularities**

	Surfaces of each lane of carriageway, each hard strip and each hard shoulder for each irregularity limit				**Surfaces of each lane of bituminous binder courses for carriageway, hard strip and hard shoulder for each irregularity limit**				**Surfaces of lay-bys, service areas, and associated bituminous binder courses for each irregularity limit**			
Irregularity Limits	4 mm		7 mm		4 mm		7 mm		4 mm		7 mm	
Length (m)	300	75	300	75	300	75	300	75	300	75	300	75
Category A* Roads	20	9	2	1	40	18	4	2	40	18	4	2
Category B* Roads	40	18	4	2	60	27	6	3	60	27	6	3

* The Category of each section of road is described in Appendix 7/1.

Rectification

10 (11/02) Where any pavement area does not comply with the Specification for regularity, surface tolerance, thickness, macrotexture depth, material properties or compaction, the full extent of the area which does not comply with the Specification shall be made good and the surface of the pavement course shall be rectified in the manner described below:

(i) Unbound and Hydraulically bound materials

The top 75 mm shall be scarified, reshaped with material added or removed as necessary, and re-compacted. The area treated shall be not less than 30 m long and 2 m wide or such area as necessary to obtain compliance with the Specification.

(ii) (08/08) Cement bound subbases and bases

The method of correction will depend on the period which has elapsed between detection of the error and the time of mixing of the material. If this is less than 4 hours, the surface shall be scarified to a depth of not less than 50 mm, surplus material removed or freshly mixed material added as necessary, and re-compacted in accordance with the Specification. If the period is 4 hours or more the full depth of the layer shall be removed from the pavement and replaced with material in accordance with the Specification. In either case the area treated shall be at least 5 m long and the full width of the paving laid in one operation. If the Contractor proposes rectification within 7 days of laying he shall comply with sub-Clause 1048.4. Alternatively, for subbases under concrete pavements the Contractor may make up low areas to a level within the tolerances of this Clause with a 1:4 cement and sand mortar or with an AC4 fine surface course complying with Clause 914.

(iii) (11/04) Bituminous bases

With coated macadam or asphalt bases, the full depth of the top layer as laid shall be removed and be replaced with fresh material

laid and compacted in accordance with the Specification. Any area so treated shall be at least 5 m long and the full width of the paving laid in one operation. Alternatively for low areas in bituminous bases, the Contractor may make up the level with additional binder course material.

(iv) (11/04) Surface courses and binder courses

These shall have the full depth of the course removed and replaced with fresh material laid and compacted in accordance with the Specification.

The area rectified shall be the full width of the paving laid in one operation, and at least 5 m long if binder course or base on pavements without binder course, or 15 m if surface course.

Where the number of surface irregularities exceeds the limits in Table 7/2NI, the area to be rectified shall be 300 m or 75 m long as appropriate and the full width of the lanes affected, or such lesser area as necessary to make the number of surface irregularities conform with the limits.

Checking of the surface course for compliance with this Clause shall be carried out as soon as possible after completion of the surfacing and remedial works completed before the road is opened to traffic.

Where the macrotexture depth requirement is not met for:

(a) a section 1000 m in lane length; or

(b) the full lane length of a section less than 1000 m long as the balance of a complete scheme; or

(c) the full lane length of a scheme less than 1000 m long;

then sufficient 50 m lengths shall be replaced, starting with that length having the least macrotexture depth, until the average requirement for the section length is complied with.

A minimum length of 50 m and the full lane width shall be removed and replaced either:

(a) (05/02) to the full depth of the surface course; or

(b) to a depth of 20 mm when replaced by the repave method process in compliance with Clause 926.

Areas to be removed shall be delineated both longitudinally and transversely by saw cutting prior to the material being removed. Joints shall be formed either by coating the exposed sawn face with hot bitumen or heating by suitable heater. The heater shall raise the temperature of the full depth of the course immediately before laying the new material to a figure within the range of minimum rolling temperature and maximum temperature at any stage specified for the material and for a width of not less than 75 mm.

(v) Concrete slabs

Concrete slabs shall be rectified by planing, grinding or bump cutting. Large depressions, which cannot be dealt with in this way, shall be rectified by cutting out the surface and replacing by a thin bonded surface repair complying with Clause 1032.

Retexturing of hardened concrete shall be carried out by sawing grooves in accordance with the Specification. Texturing of replaced surfaces shall be by brushing in accordance with the Specification. Where the slab cannot be rectified as above, the full depth of slab shall be removed and replaced with a slab constructed in compliance with Clause 1033 to the extent required to obtain compliance with the Specification. Remedial works involving the placing of fresh concrete shall be completed in sufficient time for the concrete strength to have developed as required in Clause 1048, before that section of pavement is opened to traffic.

706NI (05/01) Excavation, Trimming and Reinstatement of Existing Surfaces

General

1 The Contractor shall not excavate pits, trenches or other openings in paved areas which have been constructed as part of the Permanent Works in order to construct other parts of the Works, including Statutory Undertakers and other service works except with the prior approval of the Overseeing Organisation.

2 Where excavation and trimming of existing paved areas and highways not constructed as part of the Permanent Works are required in Appendix 7/2, they shall be carried out and reinstated in compliance with this Clause and with any additional requirements described in Appendix 7/2. Excavations shall be carried out to the dimensions described in Appendix 7/2, or, if

not so described, to the minimum dimensions, subject to sub-Clause 3 of this Clause, necessary to carry out the work.

Excavations

3 (05/04) Excavations in existing pavements and other paved areas, except those described in sub-Clause 4 of this Clause, including surfacing, base and subbase, shall be cut to neat lines to dimensions at least 75 mm greater on each side than the dimensions of any further excavation below formation level. Excavations in capping shall be taken at least 75 mm outside the dimensions of any excavation below. Road surfacing of bituminous material shall be cut back by sawing or planing to a further 75 mm on each side. Planing shall be carried out in accordance with Clause 709. Concrete surfacing and concrete roadbases, except CBM, shall be cut back by sawing by at least 300 mm on each side to the level of any reinforcement in reinforced slabs and to the full depth of the slab in unreinforced slabs.

If excavations are required to inspect the condition of lower layers, each layer shall be excavated separately and cleaned of debris to permit inspection.

4 Concrete blocks, clay pavers and precast concrete flags, kerbs and channels shall be lifted without cutting, to the nearest joint satisfying sub-Clause 3 of this Clause and carefully stored for re-use or dealt with as described in Appendix 2/3. In situ kerbs and channels shall be broken out to at least 150 mm beyond the excavation.

5 All excavations shall be carried out in compliance with the Specification and adequately supported at all times. Support shall be withdrawn as backfilling proceeds.

Backfilling

6 Backfilling of excavations shall be carried out as quickly as possible after completion of the work for which the excavation is required, to formation or sub-formation, in compliance with the appropriate Clauses in Series 500, 600, 1200, 1300 and 1400 or as otherwise described in Appendix 7/2 using fill material and compaction described therein.

Reinstatement of Paved Areas

7 The layers of capping and pavement and other paved area materials shall be reinstated consecutively, as soon as possible, in compliance with the appropriate Clauses in the 600, 700, 800, 900, 1000 and 1100 Series, to match the thicknesses and constituents of the existing material or as otherwise described in Appendix 7/2. They shall be laid and compacted in compliance with the appropriate Clauses in the above Series within the tolerances given in Table 7/1.

To allow for settlement in backfill under concrete pavements, temporary repairs to the pavement shall be carried out using bituminous materials. Alternatively, foamed concrete shall be used up to the base of the slab and the slab reinstated as soon as possible. The reinstatement of the concrete slab shall be carried out as described in Appendix 7/2.

8 Block and flag paving and precast and in situ kerbs and channels shall be reinstated in compliance with Series 1100 to match the existing construction.

9 (05/04) Where settlement of the reinstatement occurs, the surface level shall be brought to correct levels and surface regularity. Where an existing pavement has been trimmed for a new pavement to abut it, regulating layers for changes in crossfall or level shall comply with the requirements for the appropriate subbase, base or surface layer.

10 Immediately before bituminous layers are reinstated, the edges of the existing material shall be cleaned of all loose material and be coated with an appropriate hot bituminous binder or equivalent treatment. Where joints in concrete slabs are affected by the excavation they shall be reinstated by cutting back to at least 0.5 m on each side of a transverse joint and forming an expansion joint on one side of the excavation and a contraction joint on the other and provide longitudinal joints where necessary in the same line before reinstatement in compliance with Series 1000 to match the existing construction.

Reinstatement of Unpaved Areas and Other Surfaced Highways

11 Where the excavation affects verges, grassed areas, footpaths and bridleways they shall be reinstated to match the existing surface, after backfilling in compliance with sub-Clause 6 of this Clause to a depth of 150 mm below the existing surface. The reinstatement shall be completed by topsoil and seeding or turfing in compliance with the Specification, in both cases re-using any topsoil or turves cut and stored for re-use, or, when surfaced, with material matching the existing foundation and surface.

12 Levels between existing and newly constructed footpaths, footways, verges and bridleways shall be matched by removing the minimum area of existing material necessary, to enable the total thickness of surfacing material to be laid abutting the existing surface. Where settlement of the reinstatement occurs the levels shall be brought up to existing levels.

Surfaces may be left proud of the adjacent existing surfaces by an amount not exceeding 50 mm, adequately ramped to avoid sharp changes in level, to cater for subsequent settlement.

Junctions Between New Pavement Construction and Existing Pavement or Other Paved Areas

13 (05/01) Where new pavement construction abuts an existing bituminous pavement which has to be reduced in level or overlaid to match alignment and levels, the existing surface shall be trimmed by the minimum amount of cold-milling (planing) to a depth which will allow the specified thickness of new construction to be laid, the edge being trimmed and treated in compliance with this Clause. Where the difference in level makes it necessary, a regulating course as described in Appendix 7/1 and specified in Clause 907 shall be provided. The locations to be trimmed are given in Appendix 7/2.

14 (05/01) Junctions between concrete pavements and between concrete and bituminous pavements shall be constructed as described in Appendix 7/2. Junctions in porous asphalt shall comply also with Clause 938. Junctions between porous asphalt surfacing and other pavement surfaces shall be constructed as described in Appendix 7/2.

(05/01) **Compressed Air**

15 When compressed air is used to clean dust, dirt and debris from prepared faces of existing concrete or bituminous pavements which are otherwise ready for reinstatement, only oil-free compressed air shall be used and this shall be at a pressure of not less than 0.5 N/mm^2.