

TRANSPORT FOR NSW (TfNSW)

QA SPECIFICATION R90

ROLLER COMPACTED CONCRETE SUBBASE

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REVISION REGISTER

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| Ed 1/Rev 1 | Global | References to “Roads and Maritime Services” or “RMS” changed to “Transport for NSW” or “TfNSW” respectively. | DCS | 22.06.20 |

GUIDE NOTES

(Not Part of Contract Document)

Using Specification R90

TfNSW R90 Roller Compacted Concrete Subbase is a QA specification. The use of QA specifications requires the implementation of a quality management system by the Contractor that meets the requirements specified in TfNSW Q. To comply with the intention of government policy as well as the requirements of this Specification in a TfNSW contract requires adequate surveillance and audit by the Principal.

Technical Reference Notes

The following notes are intended to provide guidance on the application of this Specification. They do not form part of the Contract.

Clause 1: General

This Specification describes the construction of a single compacted layer of roller compacted concrete at thicknesses from 155 mm to 175 mm using self-propelled paving machines and conventional rollers. Graders may be used for spreading in special cases, such as small repairs or where an intersection is being constructed in a short time period. When graders are used, the compliance requirements remain the same.

Some of the shortcomings of roller compacted concrete are its production variability, limited working time, poor workability and construction joints. It is not recommended that multiple layers of roller compacted concrete be constructed due to problems with delamination of the layers.

Roller compacted concrete is supplied under Specification TfNSW 3221 to a nominated grade, designated as RCC5, RCC10 or RCC20. It is intended that the design engineer or Principal will select the grade based on site specific information. The higher strength required in grade RCC20 is not intended for base layers with thin asphalt wearing courses or bituminous surfacing.

This Specification is intended to be used where the base layer is thick asphalt.

Clause 2.1: Roller Compacted Concrete

Roller compacted concrete is produced under Specification TfNSW 3221. The requirements for the supply and transportation of the material are given in TfNSW 3221. If the material does not meet these requirements, a deduction to the payment or rejection of the Lot may be imposed as stated in TfNSW 3221.

Clause 2.2: Curing and/or Surface Treatment

For a project requiring the construction of a roller compacted concrete subbase and asphalt base within 48 hours, a curing compound is unlikely to be used. It would be appropriate to water cure the roller compacted concrete. In these circumstances, because of the time constraints, the application of a prime or primer seal would not be feasible prior to placing the asphalt base. Technical advice should be sought on the appropriate procedure to be followed to ensure adhesion between the roller compacted concrete and the asphalt base.

Clause 3: Trial Pavement

The purpose of the section of trial pavement is to ensure that the mix and construction methods proposed by the Contractor meet the requirements of this Specification.

In instances where this Specification is used for subbase construction at locations that allow only very limited construction time, such as an intersection, the Principal may waive the requirement for a trial pavement section.

Clause 4.1: General

Once the material has been produced, the total time taken for delivery to the site from the mixing plant and spreading, shaping and compacting the material must not exceed three hours. Delays in shaping and compaction are likely to lead to nonconforming work, with rejection of the work as the outcome.

Clause 4.2: Weather Conditions

A minimum of 10°C ground temperature has been specified to ensure the cementitious reaction can proceed. An upper temperature limit of 40°C is specified to ensure that excessive cracking is minimised when placing on hot days and to ensure the working time is not reduced significantly.

In the event of rain occurring before compaction is completed, the moisture content of the roller compacted concrete will increase and may cause problems with compaction and subsequent shrinkage.

Clause 4.3: Lot Size

The Lot size for roller compacted concrete placed with a grader is lower than that for roller compacted concrete placed with a paver as it is more difficult to place the material with a grader.

When the day's production exceeds 500 m² for paving machine operations, the Contractor is required to nominate the size of the Lots.

Clause 4.4: Joints

Care will need to be taken where edges are unsupported to minimise rollover during compaction. Joints which are not fresh must be placed under lane lines or in the shoulder area. These joints tend to result in longitudinal cracks.

Cutting back at longitudinal and transverse joints is required to ensure that areas that may have lower compaction are removed. Where rollover of edges has occurred, additional cutting back may be required to ensure that the specified subbase thickness and finished levels are achieved (see Clause 6.1.3).

Clause 4.6: Spreading

For small works, such as intersections, the use of graders to spread the roller compacted concrete may be preferable to using a paving machine.

Clause 4.9: Moist Curing

Where the Contractor elects not to apply a curing compound immediately but to moist cure the roller compacted concrete, the surface must not be allowed to dry out as this will induce increased shrinkage cracking and variable strength development.

Clause 4.10: Emulsion Curing

The purpose of applying a surface treatment is to assist in the curing of roller compacted concrete, resulting in both uniform strength development and a uniform crack pattern.

It is desirable that a bitumen emulsion curing compound or prime or primer seal be placed immediately after final compaction has been completed. The curing compound is applied to the exposed surfaces (and should include the edges) of the roller compacted concrete. Drying shrinkage

on the edge may cause cracking. The type of curing and/or surface treatment is specified in Annexure R90/A.

Clause 4.12.3: Trafficking of Subbase

The Contractor is not permitted to commence placing the asphalt base layer until the roller compacted concrete has reached an insitu compressive strength of a minimum of 4 MPa. It is anticipated that grades RCC10 and RCC20 are likely to be used on intersections where time constraints require the use of higher strengths of roller compacted concrete to enable early trafficking.

At locations with short construction time, it may not be feasible to take cores. In such cases, the Contractor may propose other methods to evaluate insitu strength for approval by the Principal.

Clause 5.2.3.2: Insitu Density

Laboratory technicians should be on site at the time of placing and compaction of the roller compacted concrete to ensure that sampling and testing can be carried out within the time constraints.

Clause 5.2.5: Surface Level and Deviation

Where roller compacted concrete is placed using a self-propelled paver, this operation should eliminate the need for trimming the surface to meet the thickness and level requirements.

Where a grader is used for trimming, the material trimmed off must be cut to waste to avoid the likelihood of constructing a false pavement which will delaminate and cause a premature failure.

Annexure R90/A Details of Work

The Principal must complete this Annexure.

A trial pavement section may not be applicable for small projects.

Annexure R90/D Information to be Included in the PROJECT QUALITY PLAN

The Contractor's PROJECT QUALITY PLAN should not necessarily be limited to the listed items.



ROLLER COMPACTED CONCRETE SUBBASE

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FOREWORD

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW R90 Edition 1 Revision 0.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

PROJECT SPECIFIC CHANGES

Any project specific changes are indicated in the following manner:

- (a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. *Additional Text*.
- (b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

TfNSW QA SPECIFICATION R90

ROLLER COMPACTED CONCRETE SUBBASE

1 GENERAL

1.1 SCOPE

This Specification sets out the requirements for roller compacted concrete to be used as a subbase under an asphalt base.

The work to be executed under this Specification consists of:

- (a) placement;
- (b) compaction;
- (c) trimming where required;
- (d) curing of roller compacted concrete subbase; and
- (e) provision of a bitumen emulsion curing membrane, prime or primer seal where specified.

Details of the work are shown in Annexure R90/A.

Roller compacted concrete must be manufactured in a stationary mixing plant and placed with a paving machine, or with a grader where approved by the Principal.

The time from mixing to final compaction and trimming must not exceed three hours.

The thickness of the roller compacted concrete layer must not exceed 175 mm. Multiple layers are not permitted.

Roller compacted concrete used in the Works must be of the grade specified in Specification TfNSW 3221.

1.2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

1.2.1 Details of Work

Details of work are shown in Annexure R90/A.

1.2.2 Measurement and Payment and Disposition of Nonconformities

The method of measurement and payment is detailed in Annexure R90/B.

The method of acceptance of materials and work must conform to Annexure R90/B.

1.2.3 Schedules of HOLD POINTS, WITNESS POINTS and Identified Records

The schedules in Annexure R90/C list the **HOLD POINTS** and **WITNESS POINTS** that must be observed. Refer to Specification TfNSW Q for the definitions of **HOLD POINTS** and **WITNESS POINTS**.

The records listed in Annexure R90/C are **Identified Records** for the purposes of TfNSW Q Annexure Q/E.

1.2.4 Planning Documents

The PROJECT QUALITY PLAN must, as a minimum, include each of the documents and requirements shown in Annexure R90/D and must be implemented.

1.2.5 Testing Procedures

The Inspection and Test Plan must nominate the proposed testing frequency to verify conformity of the item, which must not be less than the frequency specified in Annexure R90/L. Where a minimum frequency is not specified, nominate an appropriate frequency. Frequency of testing must conform to the requirements of TfNSW Q.

1.2.6 Referenced Documents

Unless specified otherwise or is specifically supplied by the Principal, the applicable issue of a referenced document, is the issue current at the date one week before the closing date for tenders, or where no issue is current at that date, the most recent issue.

Standards, specifications and test methods are referred to in abbreviated form (eg AS 1478). For convenience, the full titles are given in Annexure R90/M.

1.3 DEFINITIONS

- (a) **“Binder”**: A combination of cement and fly ash.
- (b) **“Coarse aggregate”**: That portion of a mineral aggregate retained on a 4.75 mm AS sieve.
- (c) **“Compactibility Index”**: A measure of the workability of roller compacted concrete.
- (d) **“Construction joint”**: A construction joint which includes all joint types except fresh joints.
- (e) **“Fine aggregate”**: That portion of a mineral aggregate passing a 4.75 mm AS sieve.
- (f) **“Fresh joint”**: A fresh joint is a joint where the pavement material on both sides of the joint has been placed within three hours from the time of mixing of the material placed prior to one side of the joint.
- (g) **“Nominated mix”**: A laboratory trial mix designated by a supplier to meet the specified requirements.
- (h) **“Production mix”**: A mix produced by a supplier using a stationary mixing plant to meet the specified requirements.
- (i) **“Roller compacted concrete”**: A relatively dry concrete mix with very low slump and compacted using smooth drum rollers.

- (j) **“Rollover”**: Reduction in the layer thickness, typically at the edges, as a result of the compaction process.

2 MATERIALS

2.1 ROLLER COMPACTED CONCRETE

The roller compacted concrete used in the Works must comply with Specification TfNSW 3221 for the designated grade specified in Annexure 3221/A.

2.2 CURING AND/OR SURFACE TREATMENT

The material(s) used for curing and/or surface treatment as specified in Annexure R90/A must comply with the requirements of the relevant Specifications below:

- (a) Specification TfNSW 3254 for Cationic Rapid Set bitumen emulsion;
- (b) Specification TfNSW R106 for a prime or primer seal.

For each nominated curing and/or surface treatment, provide to the Principal a written certificate that the material complies with the relevant Specification, together with NATA endorsed test certificates.

3 TRIAL PAVEMENT

Where specified in Annexure R90/A, construct a section of trial pavement prior to the commencement of general pavement work using the same materials, equipment and methods described in the PROJECT QUALITY PLAN.

The section of trial pavement must be between 100 m and 200 m long and the width must be as proposed for the work.

The section of trial pavement must demonstrate that the specified compaction, thickness, finished pavement properties and survey levels can be achieved.

WITNESS POINT

Process Witnessed: Construction of section of trial pavement.

Submission Details: Notification of the trial at least three working days prior to the commencement of the trial.

HOLD POINT

| | |
|------------------------|--|
| Process Held: | General Pavement Works. |
| Submission Details: | Documentation confirming conformity of the section of trial pavement, including results from process control testing and details of joint locations. |
| Release of Hold Point: | The Principal will consider the submitted documents prior to authorising the release of the Hold Point. |

In the event of nonconformities in the section of trial pavement, the Principal may require the construction of a further trial pavement section before releasing the Hold Point.

For nonconformities in the trial pavement section, the Principal may require the disposition to include modifications to the equipment or methods of construction. Deal with the nonconforming trial pavement section as described in Clause 6.2.

The Principal may order a new trial pavement section at any stage of the Work under the Contract when changes are made to the equipment, methods of construction, materials, mix, plant, or rate of work or when material or work produced does not comply with this Specification.

4 CONSTRUCTION REQUIREMENTS

4.1 GENERAL

Place and work the roller compacted concrete so as to:

- (a) prevent segregation or loss of material;
- (b) achieve the specified compaction;
- (c) provide the specified compacted thickness in a single layer;
- (d) provide the specified surface finish and profile;
- (e) produce a product which is uniform between joints and edges;
- (f) prevent slurring of the surface; and
- (g) prevent the development of laminations in the layer.

Where it is necessary to trim the surface, do not incorporate into the Works any material which has been cut to waste.

Provide in the PROJECT QUALITY PLAN details of the equipment and methods to be used for placement, compaction (including the proposed rolling pattern) and trimming of the roller compacted concrete, and disposal of the waste material.

4.2 WEATHER CONDITIONS

Measure and record the temperature in the roller compacted concrete and the air temperature at the point of placement. Include in the PROJECT QUALITY PLAN the frequency and method of measurement and recording of the concrete temperature and air temperature.

Do not place roller compacted concrete under the following circumstances:

- (a) during rain;
- (b) when rain is imminent;
- (c) when the temperature measured at a depth of 50 mm in the underlying layer is below 10 C;
- (d) when the air temperature measured in the shade is above 40°C;
- (e) during conditions that, in the opinion of the Principal, may cause nuisance to people, property or the environment.

Include in the PROJECT QUALITY PLAN details of the procedures for ceasing operations in the event of rain or unsuitable temperatures.

4.3 LOT SIZE

Advise the Principal at the start of each day's work the quantity of work estimated to be undertaken during that day. The Lot size must not exceed:

- (a) 500 m² where a paving machine is used;
- (b) 250 m² where other than a paving machine is used.

4.4 JOINTS

4.4.1 General

Joints are deemed to be fresh when the pavement material on both sides of the joint has been placed within three hours from the time of mixing of the first delivery load. All other joints are construction joints. Spread materials in a manner which minimises the number of joints. The location of fresh joints is not to be regarded as a Lot boundary.

The layout of joints must conform to the following requirements:

- (a) Transverse joints must be formed at an angle of $90^\circ \pm 5^\circ$ to the road centreline;
- (b) Longitudinal joints must be formed within the zone 0.25 ± 0.15 m offset from the separation lines of the travel lanes, or in the shoulder area a minimum of 300 mm outside the travel lanes, unless shown otherwise on the Drawings;
- (c) The full width between fresh longitudinal joints must be compacted as a single unit and within three hours from the time of mixing of the first delivery load;
- (d) The width between fresh longitudinal joints must not exceed 5 m; and
- (e) Longitudinal joints must not be located within areas likely to be under the permanent wheel paths of the completed road pavement.

4.4.2 Transverse Construction Joints

Transverse construction joints must be:

- (i) provided at discontinuities in the placement of roller compacted concrete determined by the paving operations;
- (ii) continuous over the paving width without steps or offsets in any axis, so that the line of the joint does not deviate by more than 20 mm from a 3 m straight edge;
- (iii) formed by full-depth sawcutting of the end of the day's paving; and
- (iv) reinstated or repaired if initially nonconforming or damaged prior to the placement of adjoining roller compacted concrete.

Cut back the placed concrete at transverse construction joints a minimum of 75 mm, or until a position where the roll over is not more than 3 mm deviation under a 3 m straight edge placed parallel to the centreline at transverse joints is reached.

4.4.3 Transverse Contraction Joints

Provide transverse contraction joints by sawcutting when Grade RCC20 is specified. The sawn transverse contraction joint:

- (i) must be sawn to 25% of the layer depth;
- (ii) must be continuous across the full width of the subbase without steps or offsets in any axis so that the line of the joint does not deviate by more than 10 mm from a 3 m straight edge;
- (iii) must be constructed at an angle of $90^\circ \pm 5^\circ$ to the road centre line;
- (iv) does not require sealing.

Manage the material from cutting to waste or sawcutting operations in accordance with Specification TfNSW G36. Do not incorporate this material into the subbase.

Include in the PROJECT QUALITY PLAN details of the locations and types of joints and unsupported edges.

4.5 MOISTURE CONTENT

The moisture content of the roller compacted concrete determined by Test Method TfNSW T120, T121 or T180 at the time of delivery must be consistent within the concrete and must not be greater than the optimum moisture content determined by Test Method TfNSW T130. The moisture content must be:

- (a) sufficient for hydration and binding reactions to occur;
- (b) such that the material is able to restrict ravelling under traffic after placement; and
- (c) such that it does not allow excessive rutting or shoving.

4.6 SPREADING

Spread, shape and initially compact the concrete using self-propelled paving machines equipped with dual tamping screeds and automatic level control unless otherwise specified in Annexure R90/A. Schedule the supply of material and operate the self-propelled paving machine at a uniform rate to avoid stop/start operation.

Automatic level control must be by sensors connected to string lines, or where mixed material is laid against another run of the same layer, by a levelling beam or joint matching shoe on the side of the paving machine adjacent to a completed paving run, or by other methods. Include in the PROJECT QUALITY PLAN details of the procedures for level control during spreading.

4.7 COMPACTION

Compact the concrete in a continuous operation, commencing immediately after the material has been placed. Complete all activities associated with compaction and trimming for a Lot within three hours from the time of mixing for the first delivery load. Compact the full depth of the concrete over the entire area.

4.8 SUBBASE THICKNESS

Include in the PROJECT QUALITY PLAN details of the survey control methods that will ensure the compacted subbase thickness is not reduced to an extent that it fails to comply with the requirements of Clause 6.1.2.

4.9 MOIST CURING

Commence moist curing of a Lot immediately after compaction is completed by frequent uniform applications of water which are light enough to produce no significant run off. Apply water in such a manner to avoid slurring of the surface, pavement instability, erosion or leaching of the binder.

Keep the surface continuously moist until covered with a curing membrane and/or surface treatment as specified in Annexure R90/A and detailed in Clause 4.10.

Include in the PROJECT QUALITY PLAN details of the procedures for complying with the requirements for moist curing.

4.10 EMULSION CURING

Where specified in Annexure R90/A, provide a cationic rapid setting (CRS) bitumen emulsion curing membrane to the surface of the roller compacted concrete. Apply the CRS bitumen emulsion membrane in accordance with Specification TfNSW R111 within 1.5 hours of completion of compaction and at a rate of 0.5 L/m² of residual bitumen.

4.11 SURFACE TREATMENT

Where specified in Annexure R90/A, provide a prime or a primer seal to the surface of the roller compacted concrete.

Apply a prime or primer seal in accordance with TfNSW R106 within six days of completion of compaction.

HOLD POINT

Process Held: Priming or primer sealing of the roller compacted concrete.

Submission Details: Conformity reports verifying that all compaction, thickness and level requirements of the Specification have been met for each Lot.

Release of Hold Point: The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

4.12 PROTECTION OF WORK

4.12.1 Temperature

Ensure that the temperature of the roller compacted concrete does not fall below 5°C during the first 24 hours after placement. Include in the PROJECT QUALITY PLAN details of the proposed procedures and equipment to be implemented to protect the work from temperatures below 5°C during the first 24 hours after placement.

4.12.2 Rain

Protect the work from rain damage. Include in the PROJECT QUALITY PLAN details of the proposed procedures and equipment to be implemented to protect the work from rain damage. The procedures and equipment must not damage the work and must be such that finishing and curing operations can be completed.

4.12.3 Trafficking

Do not allow traffic on the roller compacted concrete until the insitu compressive strength has reached at least 4 MPa using the approach in Annexure R90/L. Include in the PROJECT QUALITY PLAN details of the proposed procedures and equipment to allow trafficking of the subbase, including acceptable vehicles permitted on the subbase.

Vehicles required to undertake the following activities may be permitted on the new work where approved by the Principal:

- (a) for inspection and testing;
- (b) for moist curing the roller compacted concrete; and
- (c) for applying a curing and/or surface treatment.

5 PROCESS CONTROL

5.1 PROCESS CONTROL FOR PRODUCTION

Process control testing for the production of roller compacted concrete must be in accordance with TfNSW 3221.

5.2 PROCESS CONTROL FOR CONSTRUCTION

5.2.1 Testing for Process Control

Testing must be completed by a laboratory accredited with the National Association of Testing Authorities Australia (NATA) for the relevant tests within seven working days after sampling. Where tests require curing, the maximum number of working days between sampling and completion of testing is seven plus the number of days specified for curing.

5.2.2 Core Strength Testing

Where early trafficking of the subbase is proposed, the requirements in Clause 4.12.3 and Annexure R90/L must be met.

5.2.3 Compaction

5.2.3.1 Maximum Wet Density

The location of the sample for determination of maximum wet density must be the same as that for determination of insitu density. Take samples from the Lot prior to field compaction but not longer than 1.5 hours after the binder has been incorporated.

Determine the maximum wet density in accordance with TfNSW T162 and compact within 2 hours of sampling in the field. Record and report the times of mixing, sampling and laboratory compaction.

5.2.3.2 Insitu Density

Provide a smooth surface at each test location. Test the layer in accordance with TfNSW T173 within 4 hours following final compaction and trimming. Record and report the values of wet density, test location and time of mixing. Repair nuclear density test holes using freshly mixed material of the same type as was used in the surrounding pavement. Compact the material used for the repair of test holes to a degree similar to that of the surrounding pavement. Include in the PROJECT QUALITY PLAN details of the proposed procedures for repairing test holes.

5.2.3.3 Relative Compaction

Calculate the relative compaction in accordance with Test Method TfNSW T166.

5.2.3.4 Progressive Compaction

If you propose to use progressive compaction, describe the procedure to be followed in the PROJECT QUALITY PLAN.

At the completion of compaction and trimming, assess compaction on Lots which conform to the homogeneity requirements defined in TfNSW Q. Test for maximum wet density in accordance with TfNSW T162 within 3.5 hours of the incorporation of the binder.

If retesting of any sub-Lot is necessary, the testing must cover the whole of the Lot containing the sub-Lot. Retesting of an individual sub-Lot is not permitted.

5.2.4 Subbase Thickness

Select test sites for determining subbase thickness on a random basis. Determine levels for thickness calculations by survey or by such other methods as will produce the required accuracy of ± 5 mm. Site locations must be recoverable in the horizontal plane to an accuracy of ± 100 mm.

Obtain levels on the top of the layer directly under the roller compacted concrete subbase. At the same locations, obtain levels on the top of the roller compacted concrete subbase following final trimming and compaction of the subbase. Include in the PROJECT QUALITY PLAN details of the proposed procedure for assessing the subbase thickness.

5.2.5 Surface Level and Deviation

Determine levels to an accuracy of ± 5 mm at centres not exceeding 15 m longitudinally, on a grid pattern submitted as part of the PROJECT QUALITY PLAN. Report levels to the nearest millimetre.

Determine the surface deviation by using a 3 m straight edge laid in any direction.

No roller marks must remain on the finished surface.

6 CONFORMITY

6.1 CONFORMITY FOR CONSTRUCTION

6.1.1 Compaction

Conformity of a Lot for compaction is achieved if the Characteristic Value of Relative Compaction of the Lot, determined in accordance with TfNSW Q and reported to one decimal place, is not less than 102.0 %.

6.1.2 Subbase Thickness

The thickness of the Lot is deemed to be conforming when the thickness of the roller compacted concrete is not more than zero below or 20 mm above the thickness specified in Annexure R90/A.

Reject Lots in which the subbase thickness is nonconforming.

6.1.3 Finished Surface Level and Deviation

After final compaction and trimming, the finished subbase surface must be parallel to the proposed finished asphalt wearing surface. The levels at any point on the top of the subbase must not vary by more than 0 mm below to 10 mm above ($-0 / +10$ mm) the design levels shown on the Drawings specified in Annexure R90/A.

The finished subbase surface must not deviate from the bottom of a 3 m straight edge laid in any direction by more than 5 mm.

Surface levels and deviations from a straight edge which do not meet this requirement are deemed to be nonconforming and must be rejected.

6.1.4 Pavement Width

The constructed width of the roller compacted concrete subbase must be as specified in Annexure R90/A with a tolerance of less than zero to greater than 100 mm ($-0 / + 100$ mm) or as shown on the Drawings. When the subbase width exceeds the tolerance, full depth saw cutting and removal of subbase concrete is permitted to achieve conformity.

Nonconforming widths must be rejected.

6.2 TREATMENT OF NONCONFORMING LOTS

Where material is nominated to be removed and replaced with material that conforms to this Specification, make a transverse sawcut at each end of the Lot to be removed as follows:

- (a) in a straight line at an angle of $90^\circ \pm 5^\circ$ to the centre line for the width of the Lot; and
- (b) to the full subbase depth.

Remove the nonconforming roller compacted concrete within these sawcuts.

Transverse sawcuts must not extend more than 150 mm beyond the construction joint which defines the limits of removal.

Oversawing is not permitted on any additional internal sawcuts made to aid the removal of the rejected Lot.

Where material is nominated to be removed and replaced with material that conforms to this Specification, apply all conditions of this Specification in the removal and replacement operations.

HOLD POINT

| | |
|------------------------|---|
| Process Held: | Removal and replacement of roller compacted concrete subbase. |
| Submission Details: | A nonconformity report for each location to be removed at least three workings days before the work is expected to commence. |
| Release of Hold Point: | The Principal will consider the submitted documents prior to authorising the release of the Hold Point and approval of the nonconformity disposition. |

ANNEXURE R90/A – DETAILS OF WORK

NOTES TO TENDER DOCUMENTER: (Delete this boxed text after customising Annexure R90/A)

Complete the tables below by filling in the required details. Use separate sheets if required.

Where “Yes / No” options are shown below, delete whichever is not applicable.

Location Details:

| Site Number | Location | | Reference |
|-------------|----------|-----|-----------|
| | From: | To: | |
| | | | |
| | | | |
| | | | |
| | | | |

| | |
|--|------------|
| Trial Pavement required (Clause 3) | Yes / No |
| Spreading (Clause 4.6) | |
| (a) self-propelled paving machine | Yes / No |
| (b) grader | Yes / No |
| Subbase Thickness (Clause 6.1.2) | (mm) |
| Subbase Design Levels * (Clause 6.1.3) | |
| * State the reference drawing numbers. Write “N/A” for “Not Applicable” when levels are not specified. | |
| Pavement width (Clause 6.1.4) | (m) |
| Emulsion Curing and/or Surface Treatment | |
| (a) Bitumen emulsion treatment (Clause 4.10) | Yes / No |
| (b) Prime (Clause 4.11) | Yes / No |
| (c) Primerseal (Clause 4.11) | Yes / No |
| Nominal size of aggregate for the primerseal | (mm) |

ANNEXURE R90/B – MEASUREMENT AND PAYMENT AND DISPOSITION OF NONCONFORMITIES

B1 MEASUREMENT AND PAYMENT

Payment will be made for all costs associated with completing the work detailed in this Specification in accordance with the following Pay Items.

Where no specific pay items are provided for a particular item of work, the costs associated with that item of work are deemed to be included in the rates and prices generally for the Work Under the Contract.

Unless specified otherwise, a lump sum price for any of these items will not be accepted.

Where the roller compacted concrete is rejected because of its failure to meet the requirements of this Specification, all costs associated with rectification including removal and replacement or correction of the subbase and any extra costs incurred by you in respect of delays caused by such removals, replacements and corrections as well as laboratory testing and/or pavement design must be borne by you.

Pay Item R90P1 – Supply and Delivery, Spread Compact and Finish Roller Compacted Concrete

The unit of measurement is the cubic metre.

The quantity is determined by multiplying the specified width defined in Annexure R90/A by the specified length executed and by the specified thickness executed. Additional areas (eg parking areas, slip lanes etc) must be included when calculating the total volume. No account must be made for areas spread outside the area directed for treatment and the allowable tolerances.

This Pay Item includes all costs associated with supplying, delivering, placing the roller compacted concrete subbase, compaction, trimming, disposal of excess material, moist curing and testing.

Pay Item R90P2 – Emulsion Curing

The unit of measurement is the square metre.

The area is determined using the methods for determining length and width for Pay Item R90P1, applied to the area of curing. The sides of the concrete must not be included in the measurement of surface area.

Pay Item R90P3 – Prime or Primer Seal

The unit of measurement is the square metre.

The area is determined using the methods for determining length and width for Pay Item R90P1, applied to the area of prime or primer seal. The sides of the concrete must not be included in the measurement of surface area.

The areas measured must not include any areas of prime or primer seal included in the Pay Items of any other specification.

B2 DISPOSITION OF NONCONFORMITIES**B2.1 General**

If the nonconformity is not acceptable in accordance with Annexure R90/B2, the nonconforming material must be replaced or the nonconforming section of roller compacted concrete must be either replaced or corrected.

The cost of rectifying nonconformities, including any restoration work to any underlying or adjacent surface or structure which becomes necessary as a result of such replacement or correction, must be borne by you. Materials removed from the site by you must be replaced with materials that conform to this Specification.

B2.2 Rectification or Replacement of Nonconforming Roller Compacted Concrete

Roller compacted concrete removed from the Works by intervention of weather or misuse of plant must be replaced with roller compacted concrete conforming to the requirements of this Specification.

A method of rectification must be used that avoids damage to, and does not affect the performance of, the underlying structures, utilities, utility covers and similar structures.

B2.3 Acceptance of Nonconformities

Nonconformities in the properties shown below may be accepted by the Principal subject to deductions to the schedule rate, as specified hereunder, applied to the quantity of material represented by the failed sample.

B2.3.1 Supply of Binder

Where the calculated proportion of binder in the mix, calculated in accordance with Clause 5.1 of TfNSW 3221 for the specified grade, is less than the nominated proportion in Clause 3.4 of TfNSW 3221, deductions apply in accordance with Table R90/B.1.

Table R90/B.1 - Deductions for Binder Content

| Percentile range of binder content below nominated binder content | Deductions per cent of Pay Item R90P1 |
|--|--|
| 0.1% to less than 0.6% | 2% |
| 0.6% to less than 1.0% | 5% |
| 1.0% to less than 2.0% | 15% |
| 2% or greater | Mix to be rejected |

B2.3.2 Compressive Strength

Where the compressive strength of the specified grade is less than the specified compressive strength in Table 3221.3 of TfNSW 3221 for the production mix, deductions apply in accordance with Table R90/B.2.

Table R90/B.2 - Deductions for Compressive Strength

| Percentile range of compressive strength below production mix strength | Deductions per cent of Pay Item R90P1 |
|---|--|
| 1% to less than 10% | 10% |
| 10% to less than 20% | 30% |
| 20% or greater | Material to be rejected |

B2.3.3 Deductions where both the Binder Content and Compressive Strength are Nonconforming

Where both the binder content and the compressive strength are nonconforming, only the deduction for compressive strength is applied.

B2.3.4 Compaction

Where the Characteristic Value of Relative Compaction is nonconforming, deductions in accordance with Table R90/B.3 apply to the whole of the Lot.

Table R90/B.3 - Deductions for Characteristic Value of Relative Compaction

| Characteristic Value of Relative Compaction (%) | Deductions per cent of Pay Item R90P1 |
|--|--|
| 101.0 – 101.9 | 10% |
| 100.0 – 100.9 | 20% |
| Less than 100.0 | Lot to be rejected |

B2.3.5 Compactibility Index

Where the Compactibility Index is outside the nominated value ± 10 , the Lot is to be rejected.

ANNEXURE R90/C – SCHEDULES OF HOLD POINTS, WITNESS POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.2.3.

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

| Clause | Type | Description |
|---------------|-------------|--|
| 3 | Witness | Construction of section of trial pavement |
| 3 | Hold | General Pavement Works |
| 4.11 | Hold | Priming or primer sealing of the roller compacted concrete subbase |
| 6.2 | Hold | Removal and replacement of roller compacted concrete subbase |

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

| Clause | Description of Identified Record |
|---------------|--|
| 2.2 | Certificate for material compliance |
| 3 | Documentation confirming conformity of the section of Trial Pavement |
| 4.11 | Conformity reports |

ANNEXURE R90/D – PLANNING DOCUMENTS

Refer to Clause 1.2.4.

The following documents are a summary of documents that must be included in the PROJECT QUALITY PLAN. The requirements of this Specification and others included in the Contract must be reviewed to determine additional documentation requirements.

- (a) Details of equipment and methods of placement, compaction, joints, and trimming and disposal of waste (Clause 4.1);
- (b) Method and frequency of measurement and recording roller compacted concrete temperature and air temperature (Clause 4.2);
- (c) Details of procedures for ceasing operations in the event of rain (Clause 4.2);
- (d) Details of the location and construction of joint types and unsupported edges (Clause 4.4);
- (e) Procedures for level control during spreading (Clause 4.6);
- (f) Survey control methods for subbase thickness (Clause 4.8);
- (g) Method of moist curing (Clause 4.9);
- (h) Procedures for the protection of work (Clause 4.12);
- (i) Procedures and equipment to ensure temperature does not fall below 5°C (Clause 4.12.1);
- (j) Procedures and equipment to protect work against rain damage (Clause 4.12.2);
- (k) Procedures to allow trafficking of subbase (Clause 4.12.3);
- (l) Procedures for repairing test holes (Clause 5.2.3.2);
- (m) Procedure for progressive compaction (Clause 5.2.3.4);
- (n) Procedure for determining subbase thickness (Clause 5.2.4);
- (o) Surface level measurement and grid pattern (Clause 5.2.5);
- (p) Manufacturer's recommendations referred to in this Specification.

ANNEXURES R90/E TO R90/K – (NOT USED)

ANNEXURE R90/L – TESTING PROCEDURES**L1 INSITU STRENGTH TESTING FOR EARLY TRAFFICKING OF SUBBASE****L1.1 Core Test Groups**

A test group of cores is defined as a group of two cores secured from the work within a distance of 0.3 m to 1.0 m apart, except that:

- (a) if either of the cores has a compressive strength of less than 80% of the nominated grade; and
- (b) the difference between the strengths is greater than 1.0 MPa,

then a third core must be taken within 0.3 m to 1.0 m from the others and included in the test group.

The insitu compressive strength of the sample of roller compacted concrete is the mean (rounded to the nearest 0.1 MPa) of the corrected compressive strengths of all the cores in the test group.

L1.2 Test Specimens

Specimens must be in the form of cores of roller compacted concrete, which must be secured, accepted, conditioned, capped and tested in accordance with AS 1012.14, but subject to the following amendments:

- (a) Roller compacted concrete must have hardened enough to permit removal without disturbing the bond between the mortar and the coarse aggregate.
- (b) Clause 6.3.2(b) is amended to read as follows:
"The diameter at any cross-section deviates from the mean diameter by more than 5 mm.
- (c) Clause 6.4(d) is amended to exclude dry-conditioning. Cores must be wet conditioned by submersion in water at a temperature of $23 \pm 5^{\circ}\text{C}$ for not less than 24 hours nor more than 72 hours immediately prior to testing.
- (d) Clauses 9(k), 9(l), 10(h) and 10(i) are amended by the addition of the following words:

"..... except where the strength is less than 10 MPa, in which case it must be calculated to the nearest 0.1 MPa."

The individual core strengths must be corrected for length/diameter ratio and age in accordance with Table R90/L.1

Table R90/L.1 – Shape Correction Factors (for Cores)

| Length/Diameter Ratio of Core | Factor SF |
|--------------------------------------|------------------|
| 2.0 | 1.00 |
| 1.75 | 0.98 |
| 1.5 | 0.96 |
| 1.25 | 0.93 |
| 1.0 | 0.87 |

Bitumen seal, if applied, must be trimmed from the cores prior to testing.

L1.3 Frequency and Location of Core Groups

The location for coring must be selected at random in accordance with TfNSW Q Annexure Q/L Clause L3 and as set out below.

In mechanically paved subbase, the zones within 3 m each side of a transverse construction joint constitute Transition Zones and must form separate sub-Lots for the purpose of core strength acceptance testing.

One test group of cores must be taken from;

- (i) each Lot of mechanically paved roller compacted concrete; or
- (ii) each Lot of grader paved roller compacted concrete.

If a nonconforming result is obtained, the frequency of testing, commencing from the nonconforming Lot, must revert to that specified in subclause (i).

Additional cores must not be taken for this purpose without the prior approval of the Principal.

In accordance with TfNSW Q, take further samples at specific (non-random) locations which are visually non-homogeneous and/or non representative.

L1.4 Restoration of Core Holes

Clean and restore all core holes taken in the subbase with low-shrink cementitious concrete having a compressive strength of not less than that in the subbase. The approved roller compacted concrete subbase mix may be used.

Complete the restoration prior to the application of any surface debonding treatment. The finished surface must be flush with the adjoining surface.

The cost of restoring all holes in the subbase must be borne by you except in the case of additional cores ordered by the Principal.

L2 MINIMUM FREQUENCY OF TESTING

| Clause | Characteristic Analysed | Test Method | Minimum Frequency of Testing |
|---|--|---------------------------|--|
| Placement | | | |
| 4.2 | Temperature Air temperature Concrete temperature | | As per PROJECT QUALITY PLAN As per PROJECT QUALITY PLAN |
| 4.5 | Moisture content | TfNSW T120, T121 or T180 | 4 per Lot |
| Finished requirements | | | |
| 5.2.2 | Insitu compressive strength by coring | AS 1012.8.1 and AS 1012.9 | 1 per 50 tonnes or part thereof |
| 5.2.3.1 | Maximum Wet Density | TfNSW T162 | 4 per Lot |
| 5.2.3.2 | Insitu Density | TfNSW T173 | 4 per Lot |
| 5.2.4 | Subbase Thickness | | Minimum of 2 determinations per Lot |
| 5.2.5 | Surface Levels Deviation from Straight Edge | | As per PROJECT QUALITY PLAN Minimum 1 per 20 m ² |
| 6.1.4 | Pavement Width | | Minimum of 1 per 20 lineal metres |
| Emulsion Curing and/or Surface Treatment | | | |
| 2.2 and 4.10 | Bitumen emulsion membrane | | As per TfNSW R111 |
| 2.2 and 4.11 | Prime or primer seal | | As per TfNSW R106 |

ANNEXURE R90/M – REFERENCED DOCUMENTS

Refer to Clause 1.2.6.

TfNSW Specifications

| | |
|------------|--|
| TfNSW Q | Quality Management System |
| TfNSW R106 | Sprayed Bituminous Surfacing (with Cutback Bitumen) |
| TfNSW R111 | Sprayed Bituminous Surfacing (with Bitumen Emulsion) |
| TfNSW 3221 | Roller Compacted Concrete |
| TfNSW 3254 | Bitumen Emulsion |

TfNSW Test Methods

| | |
|-------------|---|
| TfNSW T120 | Determination of Moisture Content of Road Materials (Standard Method) |
| TfNSW T121 | Determination of Moisture Content of Road Materials (Sand Bath or Hot Plate Method) |
| TfNSW T130 | Dry Density – Moisture Relations for Mixtures of Road Materials Stabilised or Modified with Proportions of Cement, Lime or other Cementitious Materials |
| TfNSW T162 | Compaction Control Test (Rapid method) |
| TfNSW T166 | Determination of Relative Compaction |
| TfNSW T173 | Determination of Field Wet Density of Pavement Materials Using a Nuclear Gauge in Direct Transmission |
| TfNSW T180 | Determination of Moisture Content of Road Materials (Microwave Oven Method) |
| TfNSW T2105 | Moisture Content Correlation |

Australian Standards

| | |
|-------------|---|
| AS 1012 | Methods of testing concrete |
| AS 1012.8.1 | Method for making and curing concrete – Compression and indirect tensile test specimens |
| AS 1012.9 | Compressive strength tests – Concrete, mortar and grout specimens |
| AS 1012.14 | Method for securing and testing cores from hardened concrete for compressive strength |