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REVISION REGISTER

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<td></td>
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<td>GM, CB</td>
<td>07.09.16</td>
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<td>2.5</td>
<td>Thickness of polyethylene plastic sheets for curing changed to 0.125 mm.</td>
<td>MCQ</td>
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<td>5.3.2, 5.7.1</td>
<td>Requirement to measure air temperature during concrete placing clarified to be for areas outside tunnels or within 100 m from tunnel portals inside tunnels.</td>
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<td></td>
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<td>Subclause (b) requirement for joint under asphalt bases deleted.</td>
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NO FINES CONCRETE SUBBASE

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IC-QA-R81

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification RMS R81 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.
RMS QA SPECIFICATION R81

NO FINES CONCRETE SUBBASE

1 GENERAL

1.1 SCOPE

This Specification sets out the requirements for the construction of no fines concrete (NFC) subbase. It includes the requirements for:

(a) materials;
(b) mix design;
(c) production and transport of no fines concrete;
(d) no fines concrete subbase paving;
(e) survey;
(f) sampling and testing;
(g) end product criteria.

This Specification is not applicable to no fines concrete used as structural subbase layer in an asphalt composite pavement.

1.2 STRUCTURE OF THE SPECIFICATION

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

1.2.1 Project Specific Requirements

Project specific details of work are shown in Annexure R81/A.

1.2.2 Measurement and Payment

The method of measurement and payment is detailed in Annexure R81/B.

1.2.3 Schedules of HOLD POINTS and Identified Records

The schedules in Annexure R81/C list the HOLD POINTS that must be observed. Refer to Specification RMS Q for the definition of HOLD POINTS.

The records listed in Annexure R81/C are Identified Records for the purposes of RMS Q Annexure Q/E.

1.2.4 Planning Documents

The PROJECT QUALITY PLAN must include each of the documents and requirements listed in Annexure R81/D and must be implemented.
In all cases where this Specification refers to the manufacturer’s recommendations, these must be included in the PROJECT QUALITY PLAN.

1.2.5 Frequency of Testing

The Inspection and Test Plan must nominate the proposed frequency of testing to verify conformity of the item, which must not be less than the frequency specified in Annexure R81/L. Where a minimum frequency is not specified, nominate an appropriate frequency. Frequency of testing must conform to the requirements of RMS Q.

You may propose to the Principal a reduced minimum frequency of testing. The proposal must be supported by statistical analysis verifying consistent process capability and product characteristics. The Principal may vary or restore the specified minimum frequency of testing, either provisionally or permanently, at any time.

1.2.6 Referenced Documents

Unless otherwise specified, the applicable issue of a referenced document, other than an RMS Specification, 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 (e.g. AS 1234). For convenience, the full titles are given in Annexure R81/M.

1.3 DEFINITIONS, ACRONYMS AND SYMBOLS

1.3.1 Definitions

The terms “you” and “your” mean “the Contractor” and “the Contractor’s” respectively.

The following definitions apply to this Specification:

**Agitator**  
An item of plant or equipment which maintains the plastic concrete in the mixed state. Consistent with common usage, this term is also used (for convenience) in lieu of “mobile mixer”.

**Authorised nominated mix**  
A mix design which has been authorised by the Principal.

**Batch**  
A quantity of concrete containing a fixed amount of ingredients and produced in a discrete operation.

**Batching**  
The process of combining the concrete ingredients in fixed proportions by mass or by volume, including charging and mixing.

**Blended cement**  
Material complying with Specification RMS 3211 and this Specification.

**Cement**  
A hydraulic cement as defined by RMS 3211 that is manufactured by inter-grinding of portland cement clinker, calcium sulfate and optional mineral or minor constituents. If blended with supplementary constituents by the manufacturer, it is referred to as blended cement.

**Cementitious materials**  
Cement and supplementary cementitious materials as defined by RMS 3211.
Concrete
A thoroughly mixed combination of cementitious materials, aggregates and water, with or without the addition of chemical admixtures or other materials, all of which separately and, when combined, comply with the requirements of this Specification.

Completion of batching
(a) For a stationary batch mixer discharging into a storage bin or tipper truck, this will be the time at which discharge from the mixer commences.
(b) For a stationary batch mixer discharging into a mobile mixer, this will be the time at which mixing and slump adjustment ceases at the batching plant, or 10 minutes after the completion of charging of the stationary mixer, whichever occurs first.
(c) For direct charging of a mobile mixer, this will be the time at which mixing and slump adjustment ceases at the batching plant, or 10 minutes after the completion of charging, whichever occurs first.
(d) For a continuous mixer discharging into a tipper truck, this will be the time at which discharge into the truck commences.
(e) For a continuous mixer discharging into a storage bin, this will be the time of earliest discharge (from the mixer) of that concrete within the bin.

Debonding
The application of a material to the surface of the subbase concrete to prevent the formation of bond between the subbase concrete and the base concrete.

Delivery time
The elapsed time measured from the completion of batching to the arrival at Site within 100 m of the point of placement.

Edge, outer (subbase)
An edge against which material other than subbase concrete is to be placed (such as granular backfill).

Fixed-form paving
Also referred to as “manual” and “hand” paving. Paving between fixed formwork using manually operated equipment such as plate vibrators and vibrating bull-floats.

Fly ash
Pozzolanic material complying with RMS 3211 and this Specification.

Formed joint
All joints except for induced joints. This includes slipformed and fixed-formed joints.

Forming time
The elapsed time measured from the completion of batching to the incorporation of the concrete into the Works, including compaction and final forming, but excluding hand finishing and texturing (where applicable).

Load
A single truckload of concrete comprising one or more batches.

Lot
As defined in RMS Q, refer to Clause 7.1.1.
Mixers

(a) **Stationary mixer**: a mixer in a fixed location adjacent to the batching equipment. This category includes stationary batch mixers and stationary continuous mixers:

- **Stationary batch mixer**: a mixer which produces a fixed amount of concrete produced in a discrete operation.
- **Stationary continuous mixer** or **through mixer**: a mixer where ingredients are continuously added to one end of the chamber while mixed concrete is continuously discharged from the other end.

(b) **Mobile mixer** (or **Agitator**): a truck-mounted drum mixer which is used for mixing and delivery. Mobile mixer can be used as a mixer or as an Agitator.

See AS 1379 Clauses 4.2 and 4.3 for further information.

**Mixing time**

Applicable to batch mixers only; the mixing time for each batch must be measured from the time all the ingredients are in the mixing drum until the time mixing at the specified rate, or after specified revolutions, ceases.

**No fines concrete (NFC)**

Concrete material with interconnecting voids and no fine aggregates to allow water to penetrate and flow through the material.

**Retemper**

The addition of water to a batch after “completion of batching” to restore consistence. See also “temper”.

The addition of an admixture (such as a high range water reducer) is not considered to constitute retempering.

**Supplementary cementitious material (SCM)**

Material complying with RMS 3211 and this Specification.

**Temper**

The addition of water, and mixing of concrete (or mortar), to bring it initially to the required consistence. See also “retemper”.

**Test result**

The result from a single test specimen or sample.

**Test value**

The value calculated from single test results to represent the Lot (in accordance with relevant clauses of this specification). For example, single cylinder compressive strength ‘results’ are averaged (after application of correction factors) to derive a “test value”.

**Transition zone**

Area of machine paved concrete which requires hand vibration due to ineffective slipform vibration such as at both sides of transverse construction joints.
Transition point  The point at which vibration on a paving machine commences or ceases effective compaction. Examples include:
- transition zones;
- boundary of a zone where a vibrator becomes faulty or irregular;
- boundary of a zone where operation of paver becomes unsystematic and/or nonconforming.

A periodic interruption to paving (due, for example, to irregular concrete supply) does not necessarily constitute a transition point.

Yielded cubic metre  As per the determination of mass per unit volume in accordance with AS 1012.5.

1.3.2  Acronyms

The following acronyms apply to this Specification:
ATIC  Australian Technical Infrastructure Committee (formerly Cement and Concrete User Review Group - CCURG)
NATA  National Association of Testing Authorities, Australia
NFC  No fines concrete
RMS  Roads and Maritime Services, New South Wales
SCM  Supplementary cementitious materials
SF  Shape correction factor for cores; see Clause 7.1.2

1.3.3  Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_{28\text{Min}}^{(1)}$</td>
<td>The specified minimum 28-day (cylinder) compressive strength in the nominated mix</td>
</tr>
<tr>
<td>$f_{\text{Min}}^{(1)}$</td>
<td>The specified minimum 28-day (core) compressive strength in the pavement</td>
</tr>
</tbody>
</table>

Note:
(1) The leading uppercase “F” refers to results in the nominated mix. The leading lowercase “f” refers to results in the Works.

2  MATERIALS

2.1  COARSE AGGREGATE

2.1.1  General

Coarse aggregates for no fines concrete must consist of clean, durable materials sourced from natural gravel, crushed stone or air-cooled iron blast furnace slag. Basic Oxygen and Electric Arc Furnace Steel slag aggregates are not acceptable.

During the Contract, all aggregate testing must be on samples taken either from dedicated stockpiles or from materials delivered to site.
Coarse aggregate must conform to AS 2758.1 with the following supplementary requirements in Clauses 2.1.2 and 2.1.3.

2.1.2 Requirements

The properties of the coarse aggregate must comply with Table R81.1.

Table R81.1 – Coarse Aggregate Property Requirements

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>Requirement (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk Density (1)</td>
<td>AS 1141.4 Clause 7.2</td>
<td>Minimum 1200 kg/m³</td>
</tr>
<tr>
<td>Particle Density</td>
<td>AS 1141.6.1 or AS 1141.6.2</td>
<td>Minimum 2100 kg/m³</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>AS 1141.6.1 or AS 1141.6.2</td>
<td>Maximum 2.5%</td>
</tr>
<tr>
<td>Wet Strength (2)</td>
<td>RMS T215</td>
<td>Minimum 50 kN</td>
</tr>
<tr>
<td>Wet/Dry Strength variation</td>
<td>RMS T215</td>
<td>Maximum 35%</td>
</tr>
<tr>
<td>Particle Size Distribution</td>
<td>AS 1141.11.1</td>
<td>Nominated by the Contractor. Refer Clause 3.6.2.</td>
</tr>
<tr>
<td>Particle shape:</td>
<td>AS 1141.14</td>
<td>Maximum 35%</td>
</tr>
<tr>
<td>2:1 ratio</td>
<td></td>
<td>Maximum 10%</td>
</tr>
<tr>
<td>3:1 ratio</td>
<td>RMS T239 (4)</td>
<td>Minimum 80%</td>
</tr>
<tr>
<td>Fractured Faces: two or more (3)</td>
<td>RMS T363 and T364</td>
<td>As per Clause 2.1.3</td>
</tr>
</tbody>
</table>

Notes:
(1) “Bulk density” in AS 2758.1 means the same as “unit mass” in AS 1141.4.
(2) The fraction to be tested is the particle size distribution interval in Table 1 of AS 1141.22 which represents at least 50% of the aggregate by mass.
(3) Testing can be waived for aggregate which has been extracted from mineral rock quarries by drilling and blasting.
(4) If two or more coarse aggregates are to be blended, the aggregate from each source must comply with these requirements.

2.1.3 Alkali-aggregate Reactivity

Testing for alkali-aggregate reactivity is not required for SCMs, provided the binder proportions meet the requirements of RMS 3211 Annexure 3211/E4. Otherwise, conduct the alkali-aggregate reactivity testing on aggregates from each source of supply individually for potential alkali-aggregate reactivity within 18 months prior to the commencement of paving.

Take action for AAR potential as follows according to the results from Test Method RMS T363:

(a) non-reactive: no action is required.
(b) where any of the aggregates in the mix show slow/mild reactivity: use a blended cement.
(c) where any of the aggregates in the mix show substantial reactivity: either:
   (i) use an alternative aggregate, or;
(ii) re-test using blended cement and assess AAR potential using Test Method RMS T364.

Do not use aggregates that are classified as reactive by RMS T364. Alternative aggregates and/or alternative concrete mix designs must be used subject to compliance with the requirements of this Specification.

Blended cements used for the control of potential AAR must conform to RMS 3211.

2.2 CEMENTITIOUS MATERIALS

Cementitious materials must comply with RMS 3211.

2.3 WATER

Water used in the production of concrete must be free from materials harmful to concrete, and be neither salty nor brackish. The water must conform to AS 1379 Clause 2.4 and Table 2.2, and the following:

(a) chloride ion: maximum 500 mg/L determined by AS 1478.1 Appendix C; and
(b) sulfate ion: maximum 400 mg/L determined by AS 1289.4.2.1.

Water which is drawn solely from a reticulated drinking water supply is deemed to conform to the above.

If the water contains a component from a source other than reticulated drinking water supply, the combined mixing water must conform to the requirements of this Clause.

2.4 ADMIXTURES

Chemical admixtures and their use must conform to AS 1478.1 and AS 1478.2. Admixtures must not contain calcium chloride. The following conditions also apply:

(a) For combinations of two or more admixtures, their compatibility with each other must be certified in writing by their manufacturers.
(b) For mixes with less than 50 kg/m³ fly ash, the total alkali contribution (measured as Na₂O equivalent in accordance with AS 1478) from all admixtures used in any mix must not exceed 0.20 kg/m³.
(c) Provide details in the PROJECT QUALITY PLAN of the criteria for initiating changes in admixture type with changes in season. If the same admixture is proposed for use across all seasons, provide also dose rate charts for various temperature ranges. Additional testing in the mix design process is not required if admixture dose rate changes are based solely on ambient temperature.

2.5 CURING MEMBRANE

Curing membrane must consist of 0.125 mm thick opaque polyethylene sheets at a minimum width of 1.2 m.
3  **DESIGN OF CONCRETE MIXES**

3.1  **BINDER CONTENT AND WATER/CEMENTITIOUS BINDER RATIO**

Comply with RMS 3211 Annexure 3211/E.

The water to cementitious binder ratio must provide for complete cementitious paste coverage of the aggregate and must be in the range of 0.30 to 0.45 by mass. The paste content must not be such as to cause the paste to flow during mixing, handling or placing.

3.2  **COMPRESSION STRENGTH**

Concrete compressive strength must comply with the requirements listed in Table R81.2. To determine the compressive strength \( F_{28} \) for each laboratory mix, use a minimum of three specimens tested at age 28 days. \( F_{28} \) is the average of all individual results within 2.0 MPa of the median value.

<table>
<thead>
<tr>
<th>Description</th>
<th>Nominated Mix</th>
<th>Production Concrete (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test specimen size</td>
<td>Cylinder 150 mm diameter</td>
<td>Cores (refer to Clause 7.1)</td>
</tr>
<tr>
<td>Test methods</td>
<td>RMS T376 for moulding</td>
<td>AS 1012.14 (as amended by Clause 7.1.2)</td>
</tr>
<tr>
<td></td>
<td>AS 1012.9 for testing</td>
<td></td>
</tr>
<tr>
<td>Compressive Strength (^{(1)})</td>
<td>@ 28 days minimum 6 MPa ( (F_{28Min}) )</td>
<td>@ 28 days minimum 5 MPa ( (f_{cMin}) )</td>
</tr>
</tbody>
</table>

Notes:

\(^{(1)}\) Each sample must have a minimum air void content of 25% for the concrete strength to be valid. Determine air void content using Test Method RMS T378.

\(^{(2)}\) Pavement core concrete strength requirements are provided in this clause for comparison with the strength requirements of cylinders in the nominated mix.

3.3  **PERMEABILITY**

Mould a nominal 150 mm diameter cylinder and cure the specimens in accordance with Test Method RMS T376.

Test the permeability in accordance with Test Method RMS T377.

Permeability must not be less than 0.015 m/s unless otherwise specified in Annexure R81/A.

3.4  **CHLORIDE AND SULFATE CONTENT**

Chloride and sulfate ion contents must comply with Table R81.3.
Table R81.3 – Chloride and Sulfate Ion Content Requirements

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Test Method</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloride ion content</td>
<td>Clause 3.5</td>
<td>1.2% maximum relative to cement mass (^{(1)})</td>
</tr>
<tr>
<td>Sulfate ion content</td>
<td>Clause 3.5</td>
<td>5% maximum relative to cement mass (^{(1)})</td>
</tr>
</tbody>
</table>

Note:

\(^{(1)}\) Calculate the chloride and sulfate ion content relative to the cement mass (i.e. excluding supplementary cementitious materials such as fly ash and slag).

3.5 CHLORIDE AND SULFATE CONTENT TESTING

Carry out testing for chloride and sulfate ion contents by either:

(a) testing of concrete constituents, or
(b) testing of hardened concrete.

3.5.1 Testing of Concrete Constituents

(a) Determine the chloride content of the mix by testing in accordance with:

(i) AS 1012.20 for aggregates;
(ii) AS 1478.1 Appendix C for water and admixtures dissolved in water;
then calculate the total chloride content and percentage in the mix.

(b) Determine the sulfate content of the mix by testing in accordance with:

(i) AS 1012.20 for aggregates;
(ii) AS 1289.4.2.1 for water and admixtures dissolved in water;
(iii) AS 2350.2 for cementitious materials,
then calculate the total sulfate content and percentage in the mix.

For water, test the source proposed for the Works. If the mixing water is drawn solely from a reticulated drinking water supply, test values provided by the supply authority can be used.

For admixtures, the chloride and sulfate contents may be taken as the values certified in writing by the manufacturer.

3.5.2 Testing of Hardened Concrete

Determine the chloride and sulfate content of the hardened concrete in accordance with AS 1012.20.

The water used in the concrete must be from the source proposed for the Works.

To determine the chloride ion content, use a representative sample of at least 20 grams of crushed and ground concrete, with the titrating solution being 0.01 N to 0.02 N. Use the Volhard method calibrated using a concrete with known chloride content for the test.
3.6 NOMINATED MIXES

Each nominated mix must comply with the requirements of Clauses 3.6.1, 3.6.2 and 3.6.3:

3.6.1 Constituent Materials

(a) Cement – supplier, product name, ATIC registration number and source.

(b) Supplementary cementitious materials – supplier, product name, ATIC registration number and source (for each).

(c) Water – source.

(d) Admixtures – proprietary source, type, name and dosage recommended by manufacturer.

(e) Aggregates – source, geological type, moisture condition on which mix design is based (oven dry, saturated surface dry or nominated moisture content).

(f) Relevant test results for all constituents.

(g) Test results for chloride and sulfate content, in accordance with Clause 3.5.

3.6.2 Mix Design

(a) Constituent quantities, per yielded cubic metre of concrete.

(b) Nominated particle size distribution of aggregates

3.6.3 Test Results of Nominated Mix

For each nominated mix (Clauses 3.1 to 3.5), determine nominated maximum water cementitious ratio and demonstrate conformity for:

(a) Water to cementitious binder ratio.

(b) Compressive strength (F28) and air void content at age 28 days.

(c) Permeability.

Mould all test specimens from the same homogeneous batch. Certify that the specimens were prepared in accordance with the requirements of this Specification.

3.6.4 Submission of Nominated Mixes

Before commencing production of each subbase concrete mix, you must:

(a) submit a statement signed by you that each nominated mix and its constituents meet the requirements of this Specification;

(b) submit NATA endorsed test results for all relevant tests;

(c) submit a copy of a verification checklist covering the items listed in Clauses 3.6.1, 3.6.2 and 3.6.3;

(d) specify the nominated slump for each mix within a tolerance of ± 5 mm from the slump value of the nominated mix in the laboratory.
HOLD POINT

Process Held: Production of no fines concrete.

Submission Details: At least 5 working days before proposed date of production, submit all test results and certificates together with a statement that the nominated mix complies with all the requirements of this Specification.

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

The date of testing of both the nominated mix and the aggregates must be within 18 months before the nominated mix is proposed to be used.

If sufficient production mix test results are available within this period, the Principal may reduce the scope of the laboratory mix or may waive it.

After the nominated mix has been accepted for production, it becomes the authorised nominated mix for use.

3.6.5 Variations to Nominated Mixes

You may vary the authorised nominated mix without resubmitting a new nominated mix, unless the proposed variations from the current authorised nominated mix exceed the following amounts:

(a) Cement: 10 kg/m³;
(b) Other cementitious material: 20 kg/m³;
(c) Other solid constituents: 5% by mass;
(d) Admixture dosages in accordance with Clause 2.3.
(e) Water, unspecified.

Notify the Principal of such variations to an authorised nominated mix before commencing production with the varied quantities.

If you intend to vary the quantities of the constituents in excess of the above amounts, or to change the type of admixture or the source of supply of any constituent, submit a new nominated mix in accordance with Clause 3.6.4.

4 PRODUCTION AND TRANSPORT OF CONCRETE

4.1 GENERAL

Concrete delivered to the paver must be homogeneous, without segregation or loss of materials during transport. The concrete must have workability, at the time of incorporation, which is compatible with the capacity of the paving equipment to achieve required compaction uniformly, and a surface finish requiring only minimal manual finishing.

In the case of batch mixers, after the completion of batching, the entire batch of concrete must be discharged from the mixer before any further charging takes place, with the exception of conforming retempering.
For mechanical paving, the production and transport equipment must have an operational capacity which allows continuous paving at your target paving speed. The capacity must not be less than that required to maintain a continuous paving speed, with adequate allowance for mixer efficiency and control testing. Do not pump no fines concrete from mixer to paver.

The handling, storing and batching of materials and the mixing, transport and consistence of concrete, including any retempering, must comply with AS 1379, Sections 3 and 4 (using control of water by control of water to cementitious binder ratio) and AS1379 Appendix A (except for determination of slump, air content and mass per unit volume of the air-free mortar), modified by the requirements of Clauses 4.2 to 4.6.

Detail in the PROJECT QUALITY PLAN the proposed methods of handling, storing and batching materials, and the method of charging the mixer, including the proposed sequence of addition of ingredients. The method and sequence of charging must be consistent with the recommendations of the suppliers of mix additives.

### 4.2 PRODUCTION MIXES

#### 4.2.1 General

For production mixes, always target the authorised nominated mix. Table R81.4 lists the tolerances for constituents in individual batches from the authorised nominal mix.

<table>
<thead>
<tr>
<th>Description</th>
<th>Tolerance (% by mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle Size Distribution:</td>
<td></td>
</tr>
<tr>
<td>26.50 mm sieve</td>
<td>± 2</td>
</tr>
<tr>
<td>19.00 mm sieve</td>
<td>± 5</td>
</tr>
<tr>
<td>9.5 mm sieve</td>
<td>± 2</td>
</tr>
<tr>
<td>0.075 mm sieve</td>
<td>± 1</td>
</tr>
<tr>
<td>Each Binder:</td>
<td>± 3.0</td>
</tr>
</tbody>
</table>

Notwithstanding these tolerances, the water to cementitious binder ratio must comply with Clause 3.1.

#### 4.2.2 Production Monitoring

Do not use aggregates in the Works which have become intermixed or contaminated with foreign matter.

Weigh each cementitious material separately.

For volumetric batching of water, use a measuring device calibrated in one litre increments to an accuracy of ±2 % of the value shown on the indicating device.

For liquid admixtures, the metering equipment must measure the volume, or mass, of liquid to an accuracy of ±5% of the value shown on the indicating device.
Maintain and monitor a Batching Record which records the actual masses of each constituent in every batch, together with departures beyond the allowable tolerances. Do not incorporate nonconforming batches or loads into the Works.

4.3 **MIXING OF CONCRETE**

4.3.1 **Mixing Time**

Determine the minimum mixing time \( MT_{\text{min}} \) as defined in subclause (c) hereunder.

The term “mixing time” is applicable to batch mixers only. It comprises only that mixing carried out at the specified mixing rate (i.e. excluding agitation) and is measured as follows:

(a) For stationary batch mixers, mixing time is measured from the time when at least 90% of the total water content and all other ingredients are in the mixing drum, until mixing ceases, or after the completion of specified revolutions. Up to 10% of the total water may be added beyond the defined mixing time on the following conditions:

(i) for split-drum mixers, a minimum of 30 seconds of mixing must be provided after the final addition of water;

(ii) for twin-shaft mixers, a minimum of 15 seconds of mixing must be provided after the final addition of water.

(b) For mobile mixers, mixing time is measured from the time all the ingredients, including the total added water content, are in the mixing drum until mixing ceases or after specified revolutions.

For mobile mixers, see Clause 4.5 for retempering provisions.

(c) Determine the minimum mixing time \( MT_{\text{min}} \) from mixer uniformity testing in accordance with Clause 4.3.2, and the following:

(i) For twin-shaft mixers, the mixing time after charging must not be less than 30 seconds plus five seconds for each cubic metre (or part thereof);

(ii) For all other stationary batch mixers, the mixing time after charging must not be less than 54 seconds plus 6 seconds for each cubic metre (or part thereof);

(iii) For mobile mixers, the mixing time must not be less than that shown on the mixer identification plate or 3.0 minutes, whichever is the greater.

The full period of mixing must be provided at either the testing station or the point of placement. All other mixing and agitation must be ignored for the purpose of assessing the actual mixing time for a specific batch.

For mixers which do not have a mixer identification plate, the minimum mixing time must be 3.5 minutes.

(d) The maximum mixing time is 5 minutes for split-drum and twin-shaft mixers, or 10 minutes otherwise.

4.3.2 **Mixer Uniformity Testing**

Conduct mixer uniformity testing in accordance with the procedure specified in Annexure R81/E.
HOLD POINT

Process Held: Paving of NFC subbase (including the Paving Trial).
Submission Details: Results that demonstrate conformity of mixer uniformity.
Release of Hold Point: The Principal will consider the submitted results, within 2 working days of receipt of the results, prior to authorising the release of the Hold Point.

4.3.3 Admixture Addition

Admixtures must be separately and thoroughly diluted in the mixing water prior to their introduction to other materials.

Incorporate admixtures in accordance with the manufacturer’s instructions, and by a method which ensures that no adverse interaction occurs.

Detail in the PROJECT QUALITY PLAN how admixtures will be incorporated in accordance with the requirements of this Specification.

4.4 TRANSPORT OF CONCRETE

4.4.1 Batch Delivery Docket

Each batch or load of concrete must be accompanied by an identification certificate (delivery docket) which is pre-numbered and which must be issued sequentially in accordance with the order of batching. The certificate must record the details required to establish the time of completion of batching as defined in Clause 1.3.

Depending on the mixer and transport types, this may require the recording of times for charging, and/or mixer discharge and/or slump adjustment.

Detail in the PROJECT QUALITY PLAN how the identification certificate will be monitored for compliance with the requirements of this Specification.

4.4.2 Transport of Mixes for Manual Paving

Use mobile mixers to deliver concrete which will be placed manually except that material transfer placers and tipper trucks may be used where slump and haul lengths are such that segregation does not occur and compaction and finishing of the mix is not compromised.

4.5 RETEMPERING

For concrete which is delivered by other than a mobile mixer, do not add water or any other ingredient to the mixed batch.

Concrete which is delivered by mobile mixer may be retempered in accordance with the following conditions:
(a) Retempering is allowed only within 40 minutes of the completion of batching;
(b) Retemper only in the presence of your representative who has been previously nominated to the Principal for this purpose;
(c) Retemper only at the batch plant, the testing station, or the point of placement;
(d) Immediately after retempering, re-mix the batch at the designated mixing speed for not fewer than 30 revolutions or for such additional time as may be necessary to re-establish uniformity of the mix.

(e) Record the quantity of added water on the identification certificate for that batch. If water is added after the commencement of discharge, record the estimated remaining quantity of concrete at that time;

(f) Immediately after condition (d) has been satisfied, test the slump for conformity;

(g) Mould test cylinders for compressive strength from the retempered mix, in accordance with this Specification. These cylinders are additional to the routine testing requirements.

Do not use nonconforming concrete in the Works.

Detail in the PROJECT QUALITY PLAN how concrete supply will be monitored for conformity with these retempering provisions.

4.6 FORMING TIME

Determine the maximum forming time as defined in Clause 1.3 for each nominated mix with consideration of the prevailing weather conditions and concrete temperature.

Monitor the actual forming time and record it for any batch exceeding:

(a) 90 minutes for air temperatures less than 30°C;
(b) 60 minutes for air temperatures greater than or equal to 30°C.

Conformity of such a batch will be conditional on the conformity with compressive strength of cores from that specific batch. Record the specific location of the load placed in the Works.

Detail in the PROJECT QUALITY PLAN the procedure to determine the maximum forming time.

5 CONSTRUCTION

5.1 PREPARATION OF SURFACE WITH DENTAL CONCRETE

Use dental concrete where the excavated surface is uneven with a risk of ponding of water under the NFC subbase layer.

Dental concrete may be either:

(a) lean mix concrete complying with Specification RMS R82, or
(b) concrete of Strength Grade N20 complying with Annexure R53/E of Specification RMS R53.

5.2 PAVING NO FINES CONCRETE IN SUBBASE

5.2.1 General

Place, pave and finish the no fines concrete subbase so as to:

(a) avoid segregation or loss of materials.
(b) avoid premature stiffening.
(c) produce a homogeneous product throughout the pavement.
(d) meet strength and permeability requirements.
(e) provide the specified thickness and surface finish.

The minimum and maximum thickness of NFC subbase is 150 mm and 300 mm respectively. Where the NFC subbase extends over subsurface drains with no fines concrete, the placing of the no fines concrete in the drains may occur in the same shift as the subbase layer.

Where practicable, carry out paving by the slipform method using equipment in accordance with this Specification.

Program the slipform and fixed-form paving operations to optimise the quality of the finished pavement in accordance with this Specification.

Detail in the PROJECT QUALITY PLAN the equipment and methods to be used for placing, spreading and finishing the concrete.

For each of the proposed slipform paving configurations, nominate the following parameters:
(i) maximum paving speed (i.e. instantaneous, not average);
(ii) target (optimum) paving speed;
(iii) gross operating mass per linear metre of paving width.

Provide staff training in paving techniques for no fines concrete in accordance with RMS Q. Include in the PROJECT QUALITY PLAN details of this training.

Maintain records showing the location of each batch/load of concrete in the finished work, in accordance with the provisions for traceability in RMS Q. The method of traceability must be sufficiently accurate to enable subsequent identification of specific batches/loads for examination and/or testing.

Detail in the PROJECT QUALITY PLAN the method of traceability.

5.2.2 Slipform (Mechanical) Paving

The slipform paver must be a self-propelled machine and must include the following features:
(a) an automatic control system with a sensing device to control line and level to the specified tolerances;
(b) means of spreading the mix uniformly and regulating the flow of mix to the paver and conforming plate without segregation of the components;
(c) a tamping device as part of the paver for compaction of concrete. Roller compaction is not permitted;
(d) capability of paving to the widths and depths shown on the Drawings.

The paver must spread, compact, screed and finish the freshly placed concrete so as to produce a slab with uniform aggregate to aggregate contact and with a uniform finish requiring a minimum of hand finishing. An unsupported longitudinal edge must maintain its shape and must not sag or tear.

Detail in the PROJECT QUALITY PLAN the equipment and methods to be used for placing, spreading and finishing the NFC subbase including the parameters nominated in Clause 5.2.1 for each of the proposed paving configurations.
5.2.3 Fixed-Form (Manual) Paving

Design and construct formwork so that it is braced in an unyielding manner. Formwork must be debonded so that it can be removed without damaging the concrete. Formwork must be mortar tight.

Set the formwork to tolerances equivalent to those specified for the finished NFC subbase surface.

Deposit and spread the concrete uniformly in the formwork by means other than vibration and without segregation.

Compact the concrete by at least two passes of a hand-guided vibratory screed traversing the full width of the slab on each pass. The screed’s length must be consistent with the width of the slab under construction.

Detail in the PROJECT QUALITY PLAN the equipment and methods to be used for placing, spreading and finishing the NFC subbase, including the parameters nominated in Clause 5.2.1 and suitable operating parameters for the specific site conditions in order to yield a homogeneous slab with uniform compaction.

5.2.4 Paving in Transition Zones

For transition zones, use methods of placing which will ensure adequate compaction and provide the following information:

(a) proposed technique for paving at transverse construction joints, for both slipform and fixed form paving, at both the start and finish of paving runs;

(b) distance between the transverse construction joint and the point of effective paver tamping, at both the start and finish of paving runs (the length of start transitions may be different from the finish transitions, depending on the paving techniques employed);

(c) details of vibratory screed devices for manual paving;

(d) method of side forming to prevent edge slump;

(e) proposals to ensure suitable workability for manual placement of the mix within the transition zone.

5.3 Placement Temperatures and Rain and Tunnel Leakage

5.3.1 Concrete Temperature

Measure and record concrete temperature at the point of placement.

Do not place concrete in the Works if its temperature at the point of discharge from transport vehicles is less than 10°C or more than 32°C.

5.3.2 Air Temperature

When placing concrete in areas outside tunnels or within 100 m from the tunnel portals inside tunnels, measure and record the air temperature in the shade at the paving site, but remote from artificial influences such as machinery exhaust outlets.

Monitor the air temperature at intervals not exceeding 30 minutes. Stop concrete batching when the air temperature reaches 32°C and is rising.

Do not place concrete in the Works when the air temperature is below 5°C or above 35°C.
5.3.3 Rain and Tunnel Leakage

Do not place concrete in the Works:

(a) during rain or when rain appears imminent, for areas outside tunnels or within 20 m from the tunnel portal inside tunnels;

(b) when water is continually leaking in drops or streams from the roof of the tunnel onto the paved area unless such water is temporarily diverted from above the area being paved;

(c) the surface has water ponding.

5.4 Prevention of Moisture Loss

Detail in the PROJECT QUALITY PLAN what meteorological or other data will be collected, how such data will be used and what measures will be taken to restrict the evaporation of water from the concrete surface and to prevent the incidence of plastic shrinkage cracking or rapid drying of the surface leading to aggregates being dislodged from the concrete.

The use of evaporation retarders to restrict the evaporation of water is not permitted.

Inspect the plastic concrete regularly to monitor the effectiveness of the adopted procedures.

5.5 Surface Finish

The NFC subbase surface after paving must have a uniform finish, without distinct ridges or recesses.

5.6 Curing

Cure the NFC subbase by covering with polyethylene sheets complying with Clause 2.5. The sheeting must be applied immediately after finishing of the surface and must continue for a continuous period of 7 days, or until insitu concrete strength of 4 MPa is achieved, whichever occurs first. A minimum of 200 mm overlap must occur at edges of the sheeting and edges must be restrained to prevent exposed areas.

5.7 Protection of Work

5.7.1 Temperature

If the temperature at the Site is forecast by the Australian Government Bureau of Meteorology to fall below 10°C within 24 hours of paving, when placing concrete in areas outside tunnels or within 100 m from the tunnel portals inside tunnels, measure and record surface temperatures for the first 24 hours after paving, at two or more locations within each day’s paving, using purpose-made surface thermometers.

Detail in the PROJECT QUALITY PLAN the procedures and equipment proposed for the protection of concrete from low air temperatures.

Failure to maintain the temperature of the concrete, at or above 5°C for the first 24 hours after paving, is a nonconformity.
5.7.2 **Water Damage**

Protect the concrete from water damage. Keep the protective equipment on site ready for use by experienced personnel at short notice.

Detail in the PROJECT QUALITY PLAN the procedures and equipment proposed to protect the concrete from water damage.

Concrete will be deemed to be nonconforming if it is exposed to water within the period from tipping to application of the curing sheeting. Beyond this time, water-exposed surfaces must be assessed under the finished surface criteria of this Specification.

5.7.3 ** Trafficking of Subbase**

No fines concrete subbase must not be trafficked by either personnel or construction equipment, other than those associated with essential inspection and testing, until insitu compressive strength of 4.0 MPa is reached.

Thereafter, only foot traffic, vehicles with a gross mass less than 1.5 tonnes and any construction equipment necessary for the following operations are permitted to travel over the NFC subbase:

(a) surface survey measurements;
(b) repair, removal or replacement of the curing sheeting;
(c) construction equipment required to place the asphalt interlayer (refer to Clause 5.10.1).

### HOLD POINT

<table>
<thead>
<tr>
<th>Process Held:</th>
<th>Trafficking of NFC subbase.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submission Details:</td>
<td>Insitu strength test results of the NFC subbase.</td>
</tr>
<tr>
<td>Release of Hold Point:</td>
<td>The Principal will consider the submitted results, within 2 working days of receipt of the results, prior to authorising the release of the Hold Point.</td>
</tr>
</tbody>
</table>

Rectify any damage caused to the NFC subbase resulting from your operations in a way which produces a homogeneous subbase with the specified surface finish at your own cost.

### 5.8 **Concrete Paving Trial**

Prior to paving, construct a trial section of no fines concrete subbase using the nominated materials, approved concrete mix, equipment and methods.

Conduct concrete strength testing for the trial in accordance with Clause 7.1.2.

Give the Principal 5 working days written notice of your intention to commence the trial paving.

For mechanical paving, construct a trial section of between 50 m and 100 m in length in one continuous operation. Separate trials are required for each paver.

For manual paving, construct a trial section of between 15 m and 50 m in length, with a minimum volume of concrete of 20 m³.
If the trial is conducted at a paving width of less than 70% of the maximum width proposed, the Principal may call for a new trial section prior to full-width paving.

### HOLD POINT

**Process Held:** Commencement of NFC subbase paving.

**Submission Details:** Checklists and test results (excluding results for compressive strength).

**Release of Hold Point:** The Principal will inspect the trial section and consider the submitted documents, within 2 working days of their receipt, prior to authorising the release of the Hold Point.

The trial section will be accepted as part of the Works if it conforms to this Specification.

In the event of nonconformity of the trial section, the Principal may require a new trial section which must be treated as if it was the first trial section.

The Principal may call for a new trial section at any stage of the Works if:

(a) significant changes are made to the equipment, materials, plant or rate of paving;

(b) the NFC subbase fails to comply with this Specification.

### 5.9 JOINTS AND EDGES

#### 5.9.1 Transverse Construction Joints

Transverse construction joints need not be scabbled and must:

(a) be provided only at discontinuities in the placement of concrete determined by the paving operations;

(b) be 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 50 mm from a 3 m straightedge nor by more than 10mm from a 0.3 m straightedge;

(c) be constructed with a butt joint face which is square (± 5°) to the finished top surface of the NFC subbase;

(d) for the first-placed face, be compacted and free of gaps in no fines concrete and re-entrant angles;

(e) if initially nonconforming or damaged, be reinstated or repaired prior to the placement of the adjacent concrete.

#### 5.9.2 Longitudinal Construction Joints

There is no upper limit on the width of NFC subbase which may be constructed between longitudinal joints and/or edges. However, if joints are required by your placing methods, locate them only at approved locations as follows:

(a) Under rigid concrete pavement bases: within 0.1 m – 0.4 m offset from a planned longitudinal joint in the base, unless otherwise shown on the Drawings, except that, where a crown exists in the base, any underlying longitudinal crown joint in the NFC subbase must be constructed within 0.10 m of the plan location of the longitudinal joint in the base, unless shown otherwise on the Drawings;
NFC subbase longitudinal joints:

(i) need not be scabbled unless otherwise shown on the Drawings. They must not be corrugated.

(ii) must comply with the following geometric tolerances:

(A) not deviate from the plan or nominated position at any point by more than 25 mm. Where the joint location is flexible within a specified zone, advise its nominated location;

(B) along line of joint, not deviate horizontally by more than 20 mm from a 3 m straightedge placed along the joint, after due allowances for any planned curvature, nor by more than 10 mm from a 0.3 m straightedge;

(C) be square to the finished top surface of the NFC subbase with a tolerance of ± 5°;

(D) along line of joint, not deviate vertically by more than 3 mm from a 0.3 m straightedge placed along the joint;

(E) slab widths not less than 0.6 m (as measured orthogonal to the control line);

(F) slab lengths not less than 1.5 m (as measured parallel to the control line);

(G) corner angles (in plan view) not less than 70°;

(iii) must have the first-placed face dense, fully compacted, and free of honeycombing and re-entrant angles.

(iv) must be reinstated or repaired in accordance with Clause 7.3 where a joint is nonconforming or the edge is damaged in accordance with Clause 5.9.4. Reinstatement must be completed prior to the placement of the adjacent slab. Repair material must not be placed integrally with the adjacent concrete.

5.9.3 Outer Edges

Outer edges must:

(a) unless otherwise shown on the Drawings, be constructed wider than the plan position of the overlying base by:

(i) 50 mm where the overlying base is concrete base;

(ii) 25 mm for other base types,

with tolerances of ± 25 mm;

(b) be square to the finished top surface of the NFC subbase with a tolerance of ± 10°;

(c) be compacted and free of gaps in no fines concrete and re-entrant angles.

Survey each outer edge for alignment conformity at random locations and at a frequency not less than the following, commencing with trial paving and thereafter independent of the boundaries to Lots:

(i) one survey per 10 m of edge, until five conforming results are recorded; and thereafter

(ii) one survey per 50 m of edge.

The survey frequency reverts to item (i) above if nonconformity is detected.

Where the paved edge is to form a longitudinal construction joint with adjoining subbase concrete, the horizontal alignment tolerances must comply with Clause 5.9.2.
5.9.4 Inspection

Inspect each joint and edge within 24 hours of its construction, and again before paving of abutting concrete. If nonconformity is detected, implement Corrective Action before proceeding with the abutting paving.

5.10 OVERLYING PAVEMENT LAYER

5.10.1 General

Where specified in Annexure R81/A, apply an asphalt interlayer to the top surface of the NFC subbase. The asphalt must be designed to and comply with Specification RMS R116 using C450 binder. This treatment will not be considered to be a curing treatment. Asphalt must be either AC10 or AC7. Table R81.5 specifies the conformity requirement for the asphalt interlayer.

<table>
<thead>
<tr>
<th>Asphalt Designation</th>
<th>Minimum Thickness (mm)</th>
<th>Tolerance on Target ((^{(1)}) Thickness)</th>
<th>Tolerance on Level (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC7</td>
<td>25</td>
<td>±10% of the specified thickness</td>
<td>+0 to -10</td>
</tr>
<tr>
<td>AC10</td>
<td>30</td>
<td>±10% of the specified thickness</td>
<td>+0 to -10</td>
</tr>
</tbody>
</table>

Note:

\(^{(1)}\) Target thickness is the specified asphalt thickness plus any proposed increase in asphalt thickness due to deficiency in thickness or level in NFC subbase layer.

Do not apply asphalt interlayer or overlying pavement until:

(a) the NFC subbase has achieved strength of 4.0 MPa (Clause 7.1)
(b) NFC subbase level schedules are submitted and disposition for nonconformity is completed (Clause 6.1 refers).

5.10.2 Surface Preparation and Repair Treatment

Clean the NFC subbase surface of all loose, foreign and deleterious material before applying the overlying layer.

Fill spalled areas that are not deeper than 50 mm and not greater than 150 mm by 150 mm in area with asphalt prior to placing the overlying layer. Spalled areas deeper than 50 mm or greater than 150 mm by 150 mm in area must be squared up and infilled with no fines concrete.

Where the overlying layer is asphalt, a light surface spray of bitumen may be applied uniformly over the top of the NFC subbase immediately prior to pacing the asphalt.

Detail in the PROJECT QUALITY PLAN the methods used to ensure loose, foreign and deleterious material does not get carried onto the NFC subbase by the equipment wheels supplying asphalt to the paver.
6 GEOMETRY AND THICKNESS

6.1 SURVEY FOR LEVELS

6.1.1 General

Carry out survey to determine the levels in accordance with Specification RMS G71 and the Survey Procedure specified in Annexure R81/G. Conformity requirements for Geometry and Survey are specified in Clause 7.

During the progress of the Works, carry out surveys to determine the levels at the top of:
(a) underlying surface, over which the NFC subbase is to be placed;
(b) asphalt interlayer surface levels, where applicable; and
(c) finished surface of NFC subbase.

6.1.2 Survey Prior to Placing No Fines Concrete Subbase

Carry out survey for levels of underlying surface in accordance with Annexure R81/G2.

Where the survey is used for measurement for payment or the underlying layer has been constructed by others, the survey must be a joint survey for determination of payment deductions,

Prior to NFC subbase paving and upon completion of placing dental concrete, submit a Survey Report highlighting all locations where the actual levels are out of tolerance with the design levels.

<table>
<thead>
<tr>
<th>HOLD POINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Held:</td>
</tr>
<tr>
<td>Submission Details:</td>
</tr>
<tr>
<td>Release of Hold Point:</td>
</tr>
</tbody>
</table>

6.1.3 Level Survey Prior to Base Paving

Carry out a survey of the finished surface levels of the NFC subbase and asphalt interlayer (where applicable) for conformity with levels and thickness in accordance with Annexure R81/G3 within 4 days of placing an area or as otherwise agreed with the Principal.

Assess the NFC subbase and asphalt surface levels for conformity on the basis of individual survey results as follows:

(i) For Lots with levels below those shown on the Drawings and after allowing for the specified tolerance, submit a nonconformity report and attach the survey report and the relevant assessment of thickness.

(ii) NFC subbase areas which are high with levels exceeding the specified tolerance must be ground to provide a surface consistent with the adjacent concrete and complying with specified level requirements. Remove grinding debris by suction. Revise and resubmit the survey report.
Asphalt areas which are high with levels exceeding the specified tolerance must be milled and covered with a slurry seal, to provide a surface consistent with the adjacent asphalt and complying with specified level requirements. Revise and resubmit the survey report.

Alternatively, for NFC subbase and asphalt areas which are high by 20 mm or less, you may propose to redesign finished levels in accordance with Clause 6.1.4.1.

**HOLD POINT**

Process Held: Layer overlying the NFC subbase of the area surveyed.

Submission Details: At least 5 working days before commencing construction of the layer overlying the NFC subbase, submit the schedule of measured levels and any relevant nonconformity report.

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

**HOLD POINT**

Process Held: Placing overlying base pavement layer over asphalt interlayer of the area surveyed.

Submission Details: At least 5 working days before commencing placing the base layer, submit the schedule of measured levels and any relevant nonconformity report.

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

### 6.1.4 Redesign of Pavement Levels

#### 6.1.4.1 Redesign by the Contractor

Where the NFC subbase and the underlying layer are both constructed by you, and where pavement levels are high and nonconforming, you may locally redesign the pavement levels in accordance with the following criteria:

(a) The rate of level change on any longitudinal profile string, calculated relative to the approved design, must not be greater than 0.1% (1.0 mm per metre);

(b) The revised crossfall (or superelevation) at any location must not vary from the approved value by more than ± 0.3% (when expressed as actual values; hence a specified crossfall of 3.0% may be varied within the range 3.0% ± 0.3%);

(c) The transition from the redesigned pavement to abutting structures and pavements must be smooth;

(d) Vertical clearance requirements must be complied with.

The redesigned pavement must be such that:

(i) water will not pond on the carriageway;

(ii) drainage is not compromised in any aspect, including depth and rate of flow over the pavement, flow direction and capacity (both on the pavement and within the drainage network);
(iii) the risks and associated consequences (in terms of drainage) are not increased at locations such as superelevation transitions, taking into account the likely construction deviations (within the specified level tolerances) from the finished base levels.

Submit the redesign to the Principal for approval. The Principal will respond within 4 working days.

You will not be entitled to additional payment for the redesign due to nonconformity of the underlying surface levels.

6.1.4.2 Redesign by the Principal

The Principal may alter the NFC subbase and/or asphalt interlayer thickness and/or levels by up to 30 mm before the commencement of each section of work.

Payment will be made on the basis of the actual quantities of work directed by the Principal in accordance with the relevant Pay Items in the Schedule of Rates.

6.2 NFC Subbase Thickness Assessment

Assess the thickness of NFC subbase within Lots. Calculate the NFC subbase thickness at individual survey points as the difference between the finished NFC subbase surface level and the underlying surface level surveyed in accordance with Annexure R81/G.

Adjust the calculated thickness to allow for the design surface longitudinal and transverse slopes between the two surveyed points.

Detail in the PROJECT QUALITY PLAN the method of determining the thickness, with adjustment.

Measure the NFC subbase thickness on the cores taken for strength testing. If applicable, adjust the measured thickness by subtracting the average least dimension of the cover aggregate to remove the contribution of the sprayed seal on top of the underlying layer.

Wherever a core thickness result is thinner by 5 mm or more than the thickness calculated from the survey result at a location within 1.5 m of the core, or thinner by 10 mm or more at a location between 1.5 m and 2.5 m from the core, the core result will be accepted and the survey result culled from the assessment. If the frequency of such occurrences is more than 3 in any group of 10 consecutive comparisons, the NFC subbase thickness calculated from survey results is deemed to be nonconforming.

In areas where the NFC subbase thickness calculated from survey results is nonconforming, and no representative cores are available for comparison, the Principal may authorise the drilling of 50 mm diameter cores. Do not take additional cores for the purpose of thickness assessment without the prior approval of the Principal.

Calculate the mean thickness for each Lot using all results for the Lot (to the nearest 1 mm) which have not been culled. Round the calculated mean thickness to the nearest 5 mm.

6.3 Survey for Alignment

Within 4 days of placing a sub-Lot of subbase, survey the alignment and inspect each joint for conformity.
6.4 Survey for Surface Profile

Survey the surface profile within 4 days of placing a sub-Lot of subbase or as agreed with the Principal otherwise.

Determine the surface profile under a 3 m straightedge in accordance with Test Method RMS T183. Where the surface deviation is convex, place the straightedge so that the cantilever length does not exceed 0.75 m.

Test for conformity with straightedge criteria at random locations, commencing with the paving trial, at a frequency of not less than the following for each of the longitudinal and transverse alignments:

(a) one test of longitudinal and transverse surface profile per 10 m of paving run, until 5 conforming results are recorded, and thereafter
(b) one test of longitudinal and transverse surface profile per 100 m of paving run.

The testing frequency reverts to (a) if nonconformity occurs.

7 End Product Criteria

7.1 Concrete Compressive Strength

7.1.1 Lot Definition

A Lot is defined as a continuous pour of area:

(a) up to 500 m² for paver placed NFC subbase.
(b) up to 300 m² for hand-paved NFC subbase.

Treat Transition zones as separate Lots of Works.

7.1.2 Core Strength Testing

Age correction factors do not apply to cores.

Shape correction factors (SF) are given in Table R81.6.

Adjust the core compressive strength for shape by multiplying the test strength by factor SF to derive the “factored core strength”. Apply the shape correction factor to the unrounded core strength.

<table>
<thead>
<tr>
<th>Length/Diameter Ratio of Core</th>
<th>Shape Correction Factor (SF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>1.00</td>
</tr>
<tr>
<td>1.75</td>
<td>0.98</td>
</tr>
<tr>
<td>1.5</td>
<td>0.96</td>
</tr>
<tr>
<td>1.25</td>
<td>0.93</td>
</tr>
<tr>
<td>1.0</td>
<td>0.87</td>
</tr>
</tbody>
</table>
7.1.2.1 Core Test Groups

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

(a) if either of the cores has compressive strength of less than 4.5 MPa; or

(b) the difference between the strengths is greater than 1.0 MPa,

then take a third core within 0.3 m to 1.0 m from the others and included in the Test Group.

Determine the void content of the cores using Test Method RMS T378 before strength testing.

The insitu compressive strength of the sample of concrete is the mean (rounded to the nearest 0.1 MPa) of the corrected compressive strengths of all the cores in the Test Group.

7.1.2.2 Test Specimens

Specimens must be in the form of 150 mm diameter cores of hardened concrete, which must be taken, accepted, conditioned, capped and tested in accordance with AS 1012.14, subject to the following amendments:

(a) 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 ± 5°C for not less than 24 hours nor more than 72 hours immediately prior to testing.

(d) The individual core strengths must be corrected for shape (length/diameter ratio) in accordance with Clause 7.1.2 of this Specification.

(e) 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.”

Prior to testing, trim from the cores bitumen seal or asphalt where found on the core.

7.1.2.3 Frequency and Location of Core Groups

Select the locations for coring at random in accordance with RMS Q Annexure Q/L Clause L3 and as set out below.

In mechanically paved NFC subbase, the zones within 3 m of each side of a transverse construction joint (or other distance as nominated in Clause 5.9.1) constitute Transition Zones and must form separate Lots for the purpose of core strength acceptance testing.

Take one Test Group of cores from:

(a) each Lot of slipformed concrete.

(b) each Lot of fixed-form concrete.

(c) in Transition Zones, commencing with the trial section, the minimum frequency of coring is as follows:

(i) one group from each Lot until three (3) consecutive conforming Lots are obtained; and then
(ii) one group from each third Lot, selected on the basis of time sequence, until four (4) consecutive Lots conform; and then

(iii) one group from each fifth Lot, selected on the basis of time sequence.

If a nonconforming result in item (c)(ii) or (c)(iii) above is obtained, the frequency of testing, commencing from the nonconforming Lot, reverts to that specified in item (c)(i) above.

Do not take additional cores for the purpose of core compressive strength testing without the prior approval of the Principal.

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

7.1.2.4 Restoration of Core Holes

Clean and restore all core holes taken in the NFC subbase with no fines concrete having compressive strength of not less than that in the NFC subbase. The approved NFC subbase mix may be used.

The finished surface of the NFC subbase at the core hole must be flush with the surrounding surface of the NFC subbase.

The costs of restoring all holes in the NFC subbase will be borne by you, except for additional cores ordered by the Principal.

7.1.3 Conformity with Core Compressive Strength

Subbase concrete must achieve insitu compressive strength of 5.0 MPa or greater within 28 days of placement.

Subbase concrete which fails to achieve insitu compressive strength of 5.0 MPa within 28 days of placement must be removed and replaced.

7.2 GEOMETRY AND THICKNESS

7.2.1 Alignment Tolerances

Tolerances on horizontal alignment are given in Clause 5.9.3 for the outer edges of the subbase and for joints.

7.2.2 NFC Subbase Levels

The level at any point on the top of the NFC subbase must not vary by more than 0 mm above or 20 mm below the design level.

7.2.3 NFC Subbase Thickness

A Lot will conform to thickness if:

(a) the mean thickness is not less than the Design thickness, and

(b) no individual result is 15 mm or more below the Design thickness.

Lots whose mean thickness is 20 mm or less below the Design NFC Subbase thickness may be accepted subject to a deduction to Pay Item R81P1, as specified in Table R81.7.
Table R81.7 – Deduction for NFC Subbase Thickness Deficiency

<table>
<thead>
<tr>
<th>Deficiency in Mean Thickness (mm)</th>
<th>Deduction to Pay Item R81P1 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>15</td>
<td>24</td>
</tr>
<tr>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>&gt; 20</td>
<td>Remove and replace</td>
</tr>
</tbody>
</table>

Where the Contract includes the construction of rigid concrete base or asphalt interlayer and you construct the base or interlayer thicker than the specified base or interlayer thickness, the increased base or interlayer thickness may be applied as compensation for reduced NFC subbase thickness, except that the asphalt interlayer thickness must not exceed the maximum permitted layer thickness in RMS R116. In this case, deductions to Pay Item R81P1 must be made in accordance with Table R81.8 instead of Table R81.7.

Table R81.8 – Deduction with Increased Concrete Base or Asphalt Interlayer Thickness as Compensation for NFC Subbase Thickness Deficiency

<table>
<thead>
<tr>
<th>Increase in Specified Base or Interlayer Thickness (mm)</th>
<th>Deficiency in Mean NFC Subbase Thickness (mm)</th>
<th>Deduction to Pay Item R81P1 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>&gt; 15</td>
<td>0</td>
</tr>
</tbody>
</table>

7.2.4 Surface Profile

Deviations under a 3 m straightedge, laid in any direction, must not exceed 10 mm where the no fines concrete subbase is overlaid by asphalt, or 5 mm otherwise.

7.3 REMOVAL AND REPLACEMENT OF NO FINES CONCRETE SUBBASE

7.3.1 General

Deal with detritus from sawcutting operations in accordance with Specification RMS G36. Remove detritus from the cut edges of the remaining no fines concrete subbase by suction.
7.3.2 Transverse Sawcuts

Make a sawcut at each end of the section to be removed:

(a) in a straight line and continuous between adjacent longitudinal joints, edges or proposed sawcuts and at an angle of not less than 70° to the longitudinal joint; and

(b) to the full NFC subbase depth.

Transverse sawcuts must not extend more than 150 mm beyond the longitudinal sawcuts which define the limits of removal.

7.3.3 Longitudinal Edges

The longitudinal edges of the replacement slab must either coincide with existing longitudinal joints or edges, or be newly sawn along the sides of the section to be removed and replaced.

After removal of the nonconforming concrete, the exposed face along each longitudinal edge must comply with the criteria for longitudinal construction joints specified in this Specification.

Longitudinal sawcuts must not extend more than 150 mm beyond the transverse sawcuts which define the limits of removal.

7.3.4 Other Requirements

Replacement slab must also comply with the following:

(a) the locations of new sawn joints must comply with Clause 5.9.2.

(b) both the width of replacement slab and the width of residual slab (i.e. remaining after removal) must not be less than 0.6 m (as measured orthogonal to the control line).

(c) both the length of replacement slab and the length of residual slab (i.e. remaining after removal) must not be less than 1.5 m (as measured parallel to the control line).

(d) corner angles produced by the removal and replacement must not be less than 60° under concrete pavements or less than 70° under asphalt pavements.

For any additional internal sawcuts, do not over-saw to aid the removal of the NFC subbase.
ANNEXURE R81/A – PROJECT SPECIFIC REQUIREMENTS

A1 DETAILS OF WORK

**NOTES TO TENDER DOCUMENTER: (Delete this boxed text after customising Annexure R81/A)**

*Complete the table below by inserting project specific details and requirements.*

<table>
<thead>
<tr>
<th>Site Number</th>
<th>Location</th>
<th>NFC Subbase Thickness (mm)</th>
<th>Permeability (m/s)</th>
<th>Asphalt Interlayer Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From</td>
<td>To</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Notes:**

(1) The default value is 220 mm;

(2) The default value is 0.015 m/s;
ANNEXURE R81/B – 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.

**Pay Item R81P1 - Supply and Place No Fines Concrete in Subbase**

The unit of measurement is the cubic metre.

The width and length for payment is as specified on the Drawings and in the Specification. The width for payment includes the additional width 50 mm beyond the plan position of the overlying concrete base or additional width 25 mm beyond the plan position of other base (refer to Clause 5.9.3). No account will be taken of the allowable tolerances.

The NFC subbase thickness is the thickness as specified on the Drawings and in the Specification.

Where the underlying layer has been constructed by others, the specified NFC subbase thickness across any section is the difference between the design NFC subbase surface level and the actual level of the underlying layer.

**Pay Item R81P2 - Supply and Place Dental Concrete**

The unit of measurement is the cubic metre.

The width and length for payment is as specified on the Drawings and in the Specification. The width for payment includes the additional width 50 mm beyond the plan position of the overlying concrete base or additional width 25 mm beyond the plan position of other base (refer to Clause 5.9.3). No account will be taken of the allowable tolerances.

The sides of slabs must not be included in the measurement of surface area.

**Pay Item R81P3 - Supply and Place Asphalt Interlayer**

The unit of measurement is the square metre.

The width and length for payment is as specified on the Drawings and in the Specification. The width for payment includes the additional width 50 mm beyond the plan position of the overlying cement concrete base or additional width 25 mm beyond the plan position of other base (refer to Clause 5.9.3). No account will be taken of the allowable tolerances.

**Pay Item R81P4 - Deductions**

Pay Item R81P4.1 applies to nonconforming work where there is a specified disposition for acceptance that includes deductions. The value is negative.

**Pay Item R81P4.1 - Thickness**

The rate includes deductions for nonconforming works defined in Clause 6.2.
ANNEXURE R81/C – SCHEDULES OF HOLD POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.2.3.

C1 SCHEDULE OF HOLD POINTS

<table>
<thead>
<tr>
<th>Clause</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6.4</td>
<td>Production of no fines concrete</td>
</tr>
<tr>
<td>4.3.2</td>
<td>Paving of NFC subbase (including the Paving Trial)</td>
</tr>
<tr>
<td>5.7.3</td>
<td>Trafficking of NFC subbase</td>
</tr>
<tr>
<td>5.8</td>
<td>Commencement of NFC subbase paving</td>
</tr>
<tr>
<td>6.1.2</td>
<td>Paving of NFC subbase</td>
</tr>
<tr>
<td>6.1.3</td>
<td>Layer overlying NFC subbase of the area surveyed</td>
</tr>
<tr>
<td>6.1.3</td>
<td>Placing overlying base pavement layer over asphalt interlayer of the area surveyed</td>
</tr>
<tr>
<td>7.3.1</td>
<td>Removal and replacement of NFC subbase</td>
</tr>
</tbody>
</table>

C2 SCHEDULE OF IDENTIFIED RECORDS

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

<table>
<thead>
<tr>
<th>Clause</th>
<th>Description of Identified Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6.4</td>
<td>Statement and attachments referred to in Clause 3.6 regarding the nominated mix</td>
</tr>
<tr>
<td>3.6.5</td>
<td>Details of variations to a nominated mix before commencing production with the varied quantities</td>
</tr>
<tr>
<td>5.8</td>
<td>Submission of checklists and test results, excluding results for compressive strength, for paving trial</td>
</tr>
<tr>
<td>6.1.2</td>
<td>Schedule of levels on underlying layer below the no fines concrete subbase and relevant nonconformity report</td>
</tr>
<tr>
<td>7.1.2</td>
<td>Insitu strength test results of the NFC subbase</td>
</tr>
<tr>
<td>7.1.3</td>
<td>Schedule of levels on top of no fines concrete subbase and any relevant nonconformity report</td>
</tr>
<tr>
<td>7.1.3</td>
<td>Schedule of levels on top of asphalt interlay and any relevant nonconformity report</td>
</tr>
<tr>
<td>7.3.1</td>
<td>Nonconformity report for each location of NFC subbase to be removed</td>
</tr>
</tbody>
</table>
**ANNEXURE R81/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.

<table>
<thead>
<tr>
<th>Clause</th>
<th>Description of Document</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3</td>
<td>Admixture selection</td>
</tr>
<tr>
<td>4.1</td>
<td>Method of handling, storing and batching of materials</td>
</tr>
<tr>
<td>4.3.3</td>
<td>Admixture incorporation method</td>
</tr>
<tr>
<td>4.4.1</td>
<td>Monitoring of identification certificate</td>
</tr>
<tr>
<td>4.5</td>
<td>Monitoring of concrete supply for compliance with the retempering provisions</td>
</tr>
<tr>
<td>4.6</td>
<td>Determination of maximum forming time</td>
</tr>
<tr>
<td>5.2.1 to 5.2.3</td>
<td>Equipment, methods, and parameters for placing, spreading and finishing concrete</td>
</tr>
<tr>
<td>5.2.1</td>
<td>Details of staff training</td>
</tr>
<tr>
<td>5.2.1</td>
<td>Method of traceability of batches/loads of concrete placed</td>
</tr>
<tr>
<td>5.4</td>
<td>Meteorological data and measures to restrict evaporation</td>
</tr>
<tr>
<td>5.7.1, 5.7.2</td>
<td>Protection of work from low temperatures and water damage</td>
</tr>
<tr>
<td>5.10.2</td>
<td>Method to ensure loose, foreign and deleterious material does not get carried onto the NFC subbase by the equipment wheels supplying asphalt</td>
</tr>
<tr>
<td>6.2</td>
<td>Method of calculating adjusted thickness from survey</td>
</tr>
</tbody>
</table>
ANNEXURE R81/E – MIXER UNIFORMITY TESTING

E1 GENERAL

For the purpose of conducting the mixer uniformity test, charge the mixer:
(a) in accordance with the manufacturer's instructions;
(b) in the sequence proposed to be used in the Works;
(c) to the maximum volume (or throughput) proposed to be used in the Works.

Thereafter, use the same charging sequence and do not exceed the volume (or throughput) unless another uniformity test is conducted.

Concrete from the mixer uniformity test may be incorporated into any part of the Works on condition that all concrete from the test conforms to the relevant specification and is placed in a discrete Lot which must be removed in total if the mixer fails to meet the criteria as specified in Clause E2 or Clause E3.

E2 STATIONARY MIXER

E2.1 Sampling

Where concrete is to be produced and mixed by a stationary mixer, conduct mixer uniformity tests before paving with that mix, and thereafter upon production of each 30,000 m³ of concrete from that mixer (includes all mix types and clients), or as otherwise required in accordance with AS 1379 Clause 3.5.

Carry out tests on each no fines concrete subbase mix to be placed in the Works. Alternatively, tests may be carried out on the mix of lowest target slump to be placed in the Works, and the respective minimum mixing time so determined must thereafter be adopted for all NFC subbase mixes.

For stationary batch mixers, conduct tests on three consecutive batches of the same mix which conform to the requirements of this Specification.

For stationary continuous mixers, conduct tests on three consecutive batches separated by an interval equivalent to at least 2 m³ of throughput of the same mix which conform to the requirements of this Specification. Each batch must comprise not less than 5 m³ of mix.

For each batch, report the following:
(a) mixing speed;
(b) batch volume;
(c) duration of charging;
(d) total mixing time or, for continuous mixers, the throughput rate;
(e) mixing time after the last addition of water.

Discharge and sample the whole of a single batch by one of the following procedures:
(i) By discharge into a tipper truck with tray length not less than 8 m. Conduct sampling from the truck before tipping. Obtain the samples by using a shovel or scoop but exclude the top 100 mm of concrete.
By discharge into a transport vehicle typical of that to be used in the Works, and then spread evenly over a length of between 6 m and 10 m onto ground which is either sealed or pre-dampened to prevent absorption of water from the mix. Conduct sampling from the ground.

In each case, sample the batch at three points approximately 15%, 50% and 85% along the discharged length of the mix but not closer to either end than 10% of the length. Take a sample of approximately 50 litres from each point in accordance with AS 1012.1.

E2.2 Testing

Carry out tests required for the properties of concrete in AS 1379 Table A1 on each of the 50 litre samples, in accordance with Appendix A of AS 1379, and as amended by this Specification.

E2.3 Compliance

The mixer will be deemed to have passed the uniformity test if each batch complies with the following requirements:

(a) The differences between the highest value and the lowest value for the corresponding properties of the three samples do not exceed the limiting values given in AS 1379 Table A1;
(b) The average value of the slump is within \( \pm 10 \) mm of the authorised nominated slump;

E3 MOBILE MIXERS

E3.1 Sampling and Testing

Over a period of 24 months, randomly test the number of mobile mixers listed in Table R81/E.1. Take 3 samples each of approximately 50 litres at uniform interval from each of the randomly selected mobile mixers in accordance with AS 1012.1 Clause 7. Carry out tests for the properties in AS 1379 Table A1 on each sample, in accordance with Appendix A of AS 1379, and as amended by this Specification.

<table>
<thead>
<tr>
<th>Population Size</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 16</td>
<td>All</td>
</tr>
<tr>
<td>16-25</td>
<td>17</td>
</tr>
<tr>
<td>26-50</td>
<td>22</td>
</tr>
<tr>
<td>51-90</td>
<td>24</td>
</tr>
<tr>
<td>91-150</td>
<td>26</td>
</tr>
<tr>
<td>151-280</td>
<td>28</td>
</tr>
<tr>
<td>281-500</td>
<td>32</td>
</tr>
</tbody>
</table>

This sampling program is predicated on an 8% limiting quality value.

Because of the retempering provisions of the Specification, include mobile mixers which are used to transport centrally-mixed concrete in the fleet testing.
E3.2 Compliance

(a) The differences between the highest value and the lowest value for the corresponding properties of the three samples of each randomly selected mixer in accordance with Table R81/E.1 must be within the limiting values given in AS 1379 Table A1.

(b) The fleet will be deemed to conform if all the randomly selected mixers satisfy the requirements in subclause E3.2(a).

(c) Where a mixer fails to satisfy a mixer uniformity test, the entire fleet is deemed to have failed, until:

(i) Immediately stand down the mixer while reasons for the failure are investigated to determine whether the failed result is a true outlier. If it is found that the failure was due to extraordinary reasons, it may be treated as a one-off event;

(ii) Immediately test another randomly selected mixer from the same fleet and that result will determine the continued compliance of the fleet, as follows:

(A) If it passes, the fleet will carry provisional compliance until the failed mixer is either repaired and passed or is withdrawn from operational service;

(B) If it fails, proceed in accordance with subclause E3.2(c)(i).

(d) To satisfy the mixer uniformity and compliance program, regularly inspect all mixers to determine the extent of internal wear, internal build up and the ability to rotate at the required rate (revolutions/minute). Keep a progressive maintenance record for each mixer showing inspection frequency and details of any repair or rectification and make this available on request. Carry out further testing:

(i) upon evidence of non-uniformity of mixing which appears to be associated with mixer wear, or

(ii) where the discharge time for that mixer is more than 25% longer than the typical time for other trucks using the same mix.

(e) All mobile mixers must display an identification plate in accordance with AS 1379 to certify conformity with mixer uniformity criteria. Where a mixer is one of the randomly tested mixers, show the date of the latest test on its identification plate.

ANNEXURE R81/F – (NOT USED)
ANNEXURE R81/G – SURVEY PROCEDURE

G1  GENERAL

Determine the levels using a survey staff (or reflector) with a flat base of area between 300 mm² and 4000 mm².

G2  SURVEY PRIOR TO PLACING NO FINES CONCRETE SUBBASE

Carry out survey for levels of underlying surface at a spacing of 10.0 m longitudinally and at the cross-section offsets shown in Figure R81/G.1, with a tolerance of 0.5 m. Report the levels to the nearest millimetre.
Figure R81/G.1 – Survey Locations
(not to scale)

Notes:
(1) All dimensions are in metres (m).
(2) Induced longitudinal joints in an overlying concrete base must be ignored for the purpose of locating survey points and are not shown in Figure R81/G.1.
(3) In Section 1, nominate to take survey either at point 2a or 2b.
(4) In Section 3, delete survey point 2 adjoining previously placed subbase.
(5) Unless otherwise specified or agreed, in locations where the distance between a formed edge and the adjacent lane line is variable (tapered), the survey point must be altered to a location which is offset by 0.5 m from that lane line.
(6) Key:
   FJ Formed joint or edge
   W Paving width between formed joints or edges
   Lane lines
   φ Survey points

Where the underlying layer is required to be spray sealed, levels must be taken on the top of the seal and after removal of foreign or loose material, such as excess aggregate.

G3 Level Survey Prior to Placing of Asphalt Interlayer and Base Paving

Take levels at the following locations:
(a) at the same longitudinal plan locations as those surveyed for the levels on the underlying layer under Clause G2 with a tolerance of 0.5 m;
(b) randomly selected locations at a minimum frequency of at least half the frequency required to comply with (a) above.
The schedules of measured levels must show the actual and design levels and differences. Highlight all levels and differences that are out of tolerance and locations specially surveyed for apparent nonconformity. Show actual levels that are above design levels as positive difference and actual levels that are below design levels as negative difference.

**ANNEXURES R81/H TO R81/K – (NOT USED)**
# ANNEXURE R81/L – MINIMUM FREQUENCY OF TESTING

<table>
<thead>
<tr>
<th>Clause</th>
<th>Characteristic Tested</th>
<th>Test Method</th>
<th>Minimum Frequency of Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Bulk density</td>
<td>AS 1141.4</td>
<td>At nominated mix submission(^{(2)})</td>
</tr>
<tr>
<td>2.1</td>
<td>Particle density</td>
<td>AS 1141.6.1 or AS 1141.6.2</td>
<td>At nominated mix submission(^{(2)})</td>
</tr>
<tr>
<td>2.1</td>
<td>Water absorption</td>
<td>AS 1141.6.1 or AS 1141.6.2</td>
<td>At nominated mix submission(^{(2)})</td>
</tr>
<tr>
<td>2.1</td>
<td>Wet strength</td>
<td>T215</td>
<td>One per 2,000 tonnes(^{(1)})</td>
</tr>
<tr>
<td>2.1</td>
<td>Wet/dry strength variation</td>
<td>T215</td>
<td>One per 2,000 tonnes(^{(1)})</td>
</tr>
<tr>
<td>2.1 and 4.2.1</td>
<td>Particle size distribution of combined aggregate - deviation from nominated:</td>
<td>AS 1141.11.1</td>
<td>At nominated mix submission and thereafter one per 800 tonnes of aggregate</td>
</tr>
<tr>
<td>2.1</td>
<td>Particle shape</td>
<td>AS 1141.14</td>
<td>At nominated mix submission(^{(2)})</td>
</tr>
<tr>
<td>2.1</td>
<td>Fractured Faces: two or more</td>
<td>RMS T239</td>
<td>At nominated mix submission(^{(2),(3)})</td>
</tr>
<tr>
<td>2.1</td>
<td>Alkali-Aggregate Reactivity (AAR)</td>
<td>RMS T363 and T364</td>
<td>As per Clause 2.1.3</td>
</tr>
<tr>
<td>2.2</td>
<td>Cementitious materials</td>
<td>RMS 3211</td>
<td>As per RMS 3211</td>
</tr>
<tr>
<td>2.3</td>
<td>Water</td>
<td>AS 1379, AS 1478.1, AS 1289.4.2.1</td>
<td>At nominated mix submission(^{(3)}) and thereafter one per 40,000 m(^3) of concrete</td>
</tr>
<tr>
<td>3.4</td>
<td>Chloride and sulfate content</td>
<td>As per Clause 3.4</td>
<td>Once per 30,000 m(^3) of concrete</td>
</tr>
<tr>
<td>Annexure R81/E</td>
<td>Mixer Uniformity</td>
<td>AS 1379 and Annexure R81/E</td>
<td>Annexure R81/E</td>
</tr>
</tbody>
</table>

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## Placing Concrete in NFC Subbase

<table>
<thead>
<tr>
<th>Clause</th>
<th>Characteristic Tested</th>
<th>Test Method</th>
<th>Minimum Frequency of Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.7.3</td>
<td>In-situ compressive strength (for trafficking purposes)</td>
<td>Cores as per Clause 7.1.2</td>
<td>As per Clause 7.1.2</td>
</tr>
<tr>
<td>5.9.1</td>
<td>Geometric tolerance on transverse joints</td>
<td>Two tests per joint</td>
<td></td>
</tr>
<tr>
<td>5.9.2</td>
<td>Geometric tolerance on longitudinal joints</td>
<td>Initially and also after each nonconformity: One per 10 linear m of joint until 5 conforming results are recorded, then one per 25 linear m.</td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>Levels</td>
<td>Annexure R81/G</td>
<td>Annexure R81/G</td>
</tr>
<tr>
<td>6.2</td>
<td>Thickness of no fines concrete subbase</td>
<td>As per Clause 6.2</td>
<td>As per Clause 6.2 and Annexure R81/G</td>
</tr>
<tr>
<td>6.3</td>
<td>Alignment</td>
<td>As per</td>
<td>As per Clause 5.9.3</td>
</tr>
<tr>
<td>Clause</td>
<td>Characteristic Tested</td>
<td>Test Method</td>
<td>Minimum Frequency of Testing</td>
</tr>
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<td>--------</td>
<td>-----------------------</td>
<td>-------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>6.4</td>
<td>Surface profile</td>
<td>As per Clause 6.4</td>
<td>As per Clause 6.4</td>
</tr>
<tr>
<td>7.1.2</td>
<td>Core compressive strength of concrete within 28 days</td>
<td>As per Clause 7.1.2</td>
<td>As per Clause 7.1.2</td>
</tr>
</tbody>
</table>

Notes:

1. Provided that all of the six previous tests have met specification requirements for both wet strength and wet/dry strength variation, then the following reduced frequency applies:
   - where all wet/dry variation results are < 25% : 1 per 10,000 tonnes
   - where all wet/dry variation results are < 30% : 1 per 4,000 tonnes

2. As tested within 18 months before the start of paving and to be included in the nominated mix submission.

3. Testing can be waived for aggregate which has been extracted from mineral rock quarries by drilling and blasting.
ANNEXURE R81/M – REFERENCED DOCUMENTS

Refer to Clause 1.2.6.

**RMS Specifications**

- RMS Q  Quality Management System
- RMS G36  Environmental Protection
- RMS G71  Construction Surveys
- RMS R53  Concrete (for General Use) Mortar and Grout
- RMS R82  Lean Mix Concrete Subbase
- RMS R116  Heavy Duty Dense Graded Asphalt
- RMS 3211  Cements, Binders and Fillers

**RMS Test Methods**

- RMS T183  Surface Deviation Using a Straightedge
- RMS T215  Wet/Dry Strength Variation
- RMS T239  Fractured Faces of Coarse Aggregate
- RMS T363  Accelerated Mortar Bar Test for the Assessment of Alkali-Reactivity of Aggregate
- RMS T364  Concrete Prism Test for AAR Assessment
- RMS T376  Moulding of No Fines Concrete Specimens
- RMS T377  Water Permeability of No Fines Concrete (Falling Head Laboratory Permeameter)
- RMS T378  Void Content of No Fines Concrete

**Australian Standards**

- AS 1012  Methods of testing concrete
  - AS 1012.1  Sampling of concrete
  - AS 1012.5  Determination of mass per unit volume of freshly mixed concrete
  - AS 1012.9  Compressive strength tests – Concrete mortar and grout specimens
  - AS 1012.14  Method for reading and testing cores from hardened concrete for compressive strength
  - AS 1012.20  Determination of chloride and sulphate in hardened concrete and concrete aggregates
- AS 1141  Methods for sampling and testing aggregates
  - AS 1141.4  Bulk density of aggregate
  - AS 1141.6.1  Particle density and water absorption of coarse aggregate – Weighing-in-water method
  - AS 1141.6.2  Particle density and water absorption of coarse aggregate – Pycnometer method
<table>
<thead>
<tr>
<th>Standard Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>AS 1141.11.1</td>
<td>Particle size distribution – Sieving method</td>
</tr>
<tr>
<td>AS 1141.14</td>
<td>Particle shape by proportional calliper</td>
</tr>
<tr>
<td>AS 1141.22</td>
<td>Wet/dry strength variation</td>
</tr>
<tr>
<td>AS 1289.4.2.1</td>
<td>Soil chemical tests – Determination of the sulfate content of a natural soil and the sulfate content of the groundwater – Normal method</td>
</tr>
<tr>
<td>AS 1379</td>
<td>Specification and supply of concrete</td>
</tr>
<tr>
<td>AS 1478</td>
<td>Chemical admixtures for concrete, mortar and grout</td>
</tr>
<tr>
<td>AS 1478.1</td>
<td>Admixtures for concrete</td>
</tr>
<tr>
<td>AS 1478.2</td>
<td>Methods of sampling and testing admixtures for concrete, mortar and grout</td>
</tr>
<tr>
<td>AS 2350.2</td>
<td>Method of testing Portland, blended and masonry cements – Chemical composition</td>
</tr>
<tr>
<td>AS 2706</td>
<td>Numerical values – Rounding and interpretation of limiting values</td>
</tr>
<tr>
<td>AS 2758.1</td>
<td>Aggregates and rock for engineering purposes – Concrete aggregates</td>
</tr>
</tbody>
</table>