

RTA QA SPECIFICATION R81

NO FINES CONCRETE SUBBASE

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RTA QA SPECIFICATION R81
NO FINES CONCRETE SUBBASE
REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 0				

GUIDE NOTES
(Not Part of Contract Document)

Using RTA R81

R81 is a QA specification and the use of QA specifications requires the implementation of a quality system by the Contractor that meets the quality system requirements specified in RTA Q. To comply with the intention of government policy as well as R81, No Fines Concrete Subbase works constructed using R81 requires adequate surveillance and audit by the Principal.

General

Edition 1 is based on the same format as R82 Lean-Mix Concrete Subbase where the no fines concrete mix is designed by the Contractor to meet the specified end product limits.

This Specification is intended for the construction of new pavements at sites where there is a high moisture content or the water table is near the top of the formation. The use of edge and intra-pavement drains to ensure moisture is collected and drained away from the pavement is to be considered in conjunction with a no fines concrete subbase layer.

The no fines concrete subbase may form part of a rigid or composite pavement as shown in Figure 1 and is typically 200 mm in thickness.

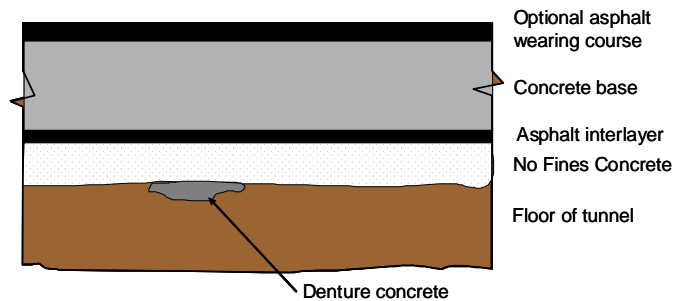


Figure 1 Typical configuration of no fines concrete subbase, asphalt interlayer and CRCP base layer for a road tunnel.



QA SPECIFICATION R81

NO FINES CONCRETE SUBBASE

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RNIC-QA-R81

VERSION FOR: DRAFT DATE:

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FOREWORD

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REVISIONS TO EDITION 1

This document is based on RTA Specification R81 Edition 1 Revision 0 – xxxx.

All revisions to RTA R81 Ed 1 / Rev 0 (other than minor editorial and project specific changes) have been indicated by a vertical line in the margin as shown here.

PROJECT SPECIFIC CHANGES

Project specific changes to the base document have been 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~~.

RTA QA SPECIFICATION R81

NO FINES CONCRETE SUBBASE

1 GENERAL

1.1 SCOPE

This Specification sets out the requirements for the supply and construction of no fines concrete subbase (NCS), including:

- (a) concrete materials.
- (b) concrete mix design requirements.
- (c) process control and manufacture of no fines concrete.
- (d) end product criteria for NCS.
- (e) quality systems, minimum process standards, plant requirements, and sampling and testing requirements.
- (f) the optional application of thin asphalt interlayer placed onto the subbase after curing and minimum strength requirements are met.

Limiting values are interpreted in accordance with the Rounding Method in AS 2706.

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 R81/A.

1.2.2 Measurement and Payment

The method of measurement and payment must comply with Annexure R81/B.

1.2.3 Schedules of HOLD POINTS, WITNESS POINTS and Identified Records

Annexure R81/C lists the Hold Points and Witness Points that must be observed. The records listed in Annexure R81/C are Identified Records for the purposes of RTA Q Annexure Q/E.

1.2.4 Referenced Documents

Unless otherwise specified the applicable issue of a referenced document, other than an RTA 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 2350). For convenience, the full titles are given in Annexure R81/M.

1.3 DEFINITIONS

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 batch mixer’.
Anchor slab	The base slab which lies over an anchor
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 RTA 3211 and this Specification.
Cement	Material complying with RTA 3211.
Concrete	A thoroughly mixed combination of cement, 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	<p>(a) For a stationary batch mixer discharging into a storage bin or tipper truck, this will be the time at which the batch is discharged from the mixer.</p> <p>(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.</p> <p>(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.</p> <p>(d) For a continuous mixer discharging into a tipper truck, this will be the time at which discharge commences into the truck.</p> <p>(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.</p>
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, kerb concrete or no-fines concrete).
Fixed-form paving	Also referred to as ‘manual’ and ‘hand’ paving. Paving between fixed formwork and using manually operated equipment such as internal vibrators and vibrating bull-floats.
Fly ash	Material complying with RTA 3211 and this Specification.
Formed joint	All joints except for induced joints. This includes paved and fixed-formed joints and edges.

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).
Haul Time	The elapsed time measured between the completion of batching and the completion of discharge of the mix.
Joint	A planned discontinuity in the concrete, other than an edge, and which conforms with Clause 4.5.
Load	A single truckload of concrete comprising one or more batches.
Lot	As defined in RTA Q, refer to RTA R81 Clause 5.3.3.3.
Mixers	Mixer types as per AS 1379 Clause 4.2.
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.
Monolithic	Constituting a single uniform homogeneous element of concrete between planned joints and/or edges; a section of concrete of uniform composition and properties which will act as a single structural element.
No Fines Concrete	Concrete material with interconnecting voids and no fine aggregates to allow water to penetrate the material.
Paving machine	A self propelled machine used to lay material on a pavement to close longitudinal and transverse level tolerances. The paver screed gives compaction of the material by means of vertical tamping.
Retemper	The addition of water to a batch after completion of batching to restore consistency, followed by remixing of the concrete before placement. See also Temper.
Smooth (surface)	The surface condition such that deviations under a 150 mm straight-edge, laid in any direction at any position, do not exceed 1 mm
Supplementary cementitious material (SCM)	Material complying with RTA 3211 and this Specification.
Temper	The addition of water and mixing of concrete (or mortar) to bring it initially to the required consistency. 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/sublot (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	Hand vibrated concrete which is cast with otherwise machine paved concrete, such as transverse construction joints in machine paved work.
Transition point	The point at which vibration on a paving machine commences or ceases effective compaction.
Yielded cubic metre	As per the determination of mass per unit volume in accordance with AS 1012.5

1.4 ABBREVIATIONS

ATIC	Australian Technical Infrastructure Committee (formerly Cement and Concrete User Review Group - CCURG)
CMRS	Cementitious Materials Registration Scheme
CRCP	Continuously reinforced concrete pavement (base)
NATA	National Association of Testing Authorities, Australia
NCS	No fines concrete subbase
PCP	Plain concrete pavement (base)
RTA	Roads and Traffic Authority, New South Wales
SMZ	Selected Material Zone

1.5 SYMBOLS

Symbol ⁽¹⁾	Definition
F_{28Min}	The specified minimum 28-day (cylinder) compressive strength in the trial mix
F_{28Max}	The specified maximum 28-day (cylinder) compressive strength in the trial mix
f_{cMin}	The specified minimum 42-day (core) compressive strength in the Work
Note:	
(1) The leading uppercase “F” refers to results in the trial mix. The leading lowercase “f” refers to results in the work.	

2 MATERIALS**2.1 COARSE AGGREGATE**

Coarse aggregates for no fines concrete must consist of clean, durable materials sourced from natural gravel, crushed stone, air-cooled iron blast furnace slag and sand. Steel-plant slag is 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 Clause 2.1 and AS 2758.1, except that alkali-reactivity testing is to conform to the requirements in this Clause. The properties of the coarse aggregate must also comply with Table R81.1. If two or more coarse aggregates are to be blended, that from each source must comply with these requirements.

Table R81.1 - Coarse Aggregate Properties

Property	Requirement	Test Method
Bulk Density ⁽¹⁾	Minimum 1200 kg/m ³	AS 1141.4
Particle Density	Minimum 2100 kg/m ³	AS 1141.6
Water Absorption	Maximum 2.5%	AS 1141.6
Particle Size Distribution	Table R81.2	AS 1141.11
Particle shape: 2:1 ratio 3:1 ratio	Maximum 35% Maximum 10%	AS 1141.14
Wet Strength ⁽²⁾	Minimum 150 kN	RTA T215
Fractured Faces: two or more ⁽³⁾	Minimum 80%	RTA T239 ⁽⁴⁾
Wet/Dry variation	Maximum 35%	RTA T215
Notes:		
⁽¹⁾ 'Bulk density' in AS 2758.1 means the same as 'unit mass' in AS 1141.4.		
⁽²⁾ When tested in accordance with RTA T215 the wet strength must be a minimum of 150 kN and the wet/dry strength variation must not exceed 35%. The fraction to be tested is the particle size distribution interval in Table 1 of RTA T215 which represents at least 50% of the aggregate by mass.		
⁽³⁾ The area of each fractured face must be a significant proportion of the total surface area of the particle. Testing is required on aggregate derived from gravels and metasediments, including conglomerates. Testing is not required on aggregate derived from igneous rock.		
⁽⁴⁾ RTA T239 Clauses 6.1, 6.2, 6.3, and 7(b) to (d) may be ignored.		

The aggregate particle size distribution in no fines concrete must comply with the requirements of Table R81.2 when tested in accordance with RTA T201.

Table R81.2 – No Fines Concrete Particle Size Distribution for Coarse Aggregate

Australian Standard Sieve Size (mm)	Percent Passing by Mass (%)
26.50	100
19.00	95 – 100
9.50	0 – 5

Assess all aggregate for potential alkali-aggregate reaction (AAR) in accordance with Annexure R81/E within 12 months before the date of closing of tenders.

Take action for AAR potential as follows according to the results from Test Method RTA 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 RTA T364.

Do not use aggregates that are classified as reactive by Test Method RTA 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 with Specification RTA 3211.

All aggregate must be assessed for soluble salt content within 12 months prior to the date of closing of tenders.

Determine chloride and sulfate ion contents by one of the methods in Annexure R81/E. Aggregates may only be used if the chloride and sulfate contents indicated for the concrete are not greater than 0.8 kg/m³ and 5 per cent respectively.

2.2 CEMENT AND FLY ASH

Cement and fly ash must comply with RTA 3211, unless otherwise approved by the Principal.

2.3 ADMIXTURES

Chemical admixtures and their use must comply with AS 1478, but they must not contain calcium chloride, calcium formate, triethanolamine or any other accelerator, unless approved in writing by the Principal. The following conditions also apply:

- (a) For combinations of two or more admixtures, their compatibility must be certified in writing by the manufacturers.
- (b) The PROJECT QUALITY PLAN must provide details of the criteria for initiating changes in admixture type with season. During the warm season, a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or WR Re) must be used to control slump. If a retarder is used during the cool season, it must be a lignin Type WR Re containing not more than 6 per cent reducing sugars.
- (c) Superplasticisers and high range water reducers Type HR WR Re may also be used.

2.4 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 2.7 and Table 2.2, "Limits for Impurities in Mixing Water", except for the following:

- (a) chloride ion: maximum 500 parts per million determined by AS 1478 Appendix D
- (b) sulfate ion: maximum 400 parts per million determined by AS 1289.4.1.2.

Refer to Annexure R81/E Clause A2.1.2 for testing requirements.

2.5 CURING MEMBRANE

Curing membrane must consist of 0.3 mm thick polyethylene opaque plastic sheets at a minimum width of 1.2 m.

2.6 DENTURE CONCRETE

Denture concrete may be either:

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

unless specified in Annexure R81/A.

2.7 ASPHALT

When specified in Annexure R81/A, the asphalt interlayer placed above the no fines concrete must be AC10 complying with RTA R116.

3 DESIGN

3.1 GENERAL

The Principal may alter the subbase and/or base thickness and levels by up to 30 mm before the commencement of each section of work. Such variations in the scope of work will be covered by the schedule rate, and you will not be entitled to any additional payment.

3.2 SURVEY AT THE TOP OF THE UNDERLYING LAYER

3.2.1 Survey Prior to Placing Subbase

Carry out a survey in accordance with RTA G71 to determine the subbase invert levels prior to setting out levels and commencing placement of subbase. 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.

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

Survey the levels using a flat based staff of base area between 300 and 4000 mm², at a spacing of 10.0 m longitudinally and at the cross-section offsets shown in Figure R81.1, with a tolerance of 0.5 m. Report the levels to the nearest millimetre.

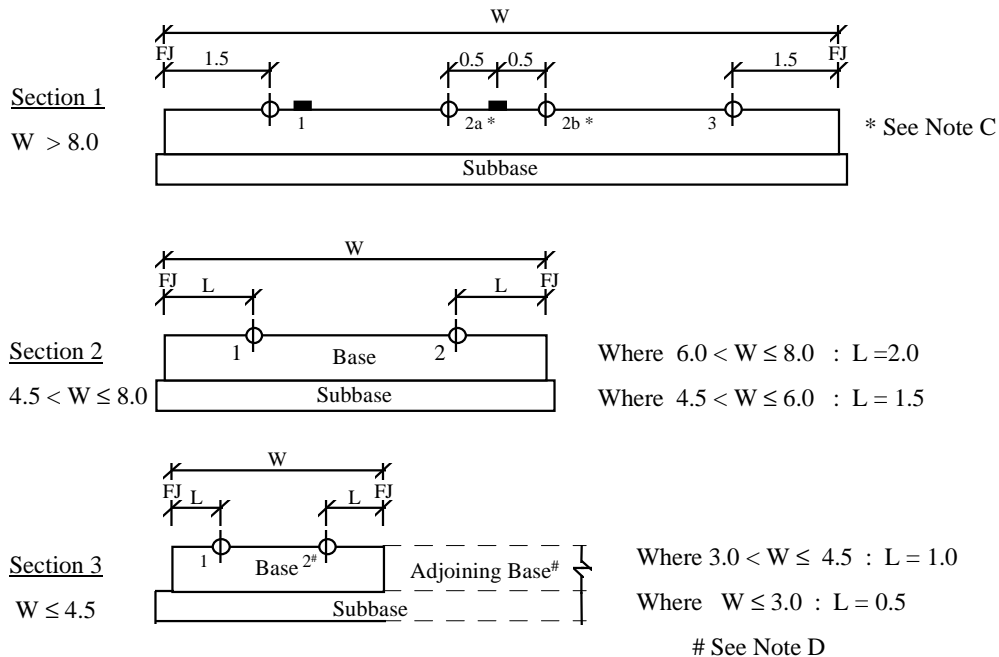


Figure R81.1 - Survey Locations
 (not to scale)

Notes:

- All dimensions are in metres (m).
- Induced longitudinal joints should be ignored for the purpose of locating survey points and are not shown in Figure R81.1.
- In Section 1, you must nominate to take survey either at point 2a or 2b.
- In Section 3, delete survey point 2 adjoining previously placed base.
- 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.
- Key: FJ Formed joint or edge
 W Paving width between formed joints or edges
 ■ Lane lines
 ϕ Survey points

3.2.2 Survey Reports Prior to Placing Subbase

Prior to subbase paving and upon completion of placing denture concrete, submit a Survey Report conforming with RTA G71, highlighting all locations where the actual level is higher than the design level.

3.2.3 Redesign of Pavement Levels

In the case of high nonconforming levels, you may locally redesign the pavement levels in accordance with the following criteria and submit the redesign to the Principal for approval. The Principal will then respond within four working days.

Review the approved design surface levels in accordance with the following criteria:

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

- (ii) the revised crossfall (or superelevation) at any location must not vary from the approved value by more than ± 0.3 per cent (when expressed as actual values; hence a specified crossfall of 3.0 per cent may be varied within the range 3.0 per cent ± 0.3 per cent).
- (iii) the revised design must transition to abutting structures and pavements.

The revised design must be such that:

- (iv) water will not pond on the carriageway.
- (v) the drainage design is not compromised in aspects including depth and rate of flow over the pavement, flow direction and capacity (both on the pavement and within the drainage network).
- (vi) the risks and associated consequences (in terms of drainage) are not increased at locations such as superelevation transitions when considered in terms of aspects such as the likely construction deviations (within the specified level tolerances) in the finished base.

Where the subbase and the underlying layer are constructed under the same contract, you will not be entitled to additional payment as a consequence of local redesign.

Apply a Hold Point to subbase paving if any high levels exist within the schedule of subbase invert levels.

HOLD POINT

Process Held:	Paving of subbase, if high invert levels exist.
Submission Details:	Schedule of subbase invert levels and relevant nonconformity report.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising release of the Hold Point.

3.2.4 Survey Prior to Placing Asphalt Interlayer

Prior to asphalt paving and upon completion of placing subbase concrete, submit a Survey Report conforming with RTA G71, highlighting all locations where the actual level is higher than the design level.

3.2.5 Survey Prior to Placing Base

Prior to base paving and upon completion of placing asphalt interlayer, submit a Survey Report conforming with RTA G71, highlighting all locations where the actual level is higher than the design level.

3.3 NOMINATED MIX

3.3.1 Binder content

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

3.3.2 Compressive strength

The requirements for compressive strength at 28 days are given in Table R81.3. To determine the compressive strength F_{28} for each trial batch, use a minimum of three specimens of subbase tested at age 28 days. F_{28} is the average of all individual results within 2.0 MPa of the median value.

Table R81.3 - Concrete Strengths

	Trial mix concrete	Pavement concrete
Test specimen size	Cylinder 100 mm diameter	Cores (refer to Clause 5.3)
Compressive Strength ⁽¹⁾	6 MPa min at 28 days (F_{28Min})	5 MPa min at 28 days (f_{cMin})
Test methods	RTA T376 for moulding AS 1012.9 for testing	AS 1012.14 (as amended by Clause 5.3)
Notes:		
⁽¹⁾ Each sample must have a minimum air void content of 20% for the concrete strength to be valid. The determination of air voids must be in accordance with RTA T378.		

3.3.3 Permeability

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

Test the permeability in accordance with Test Method RTA T377.

All permeability results must exceed 20 mm/sec unless otherwise specified in Annexure R81/A.

3.3.4 Submission of nominated mix

The following details are required for each nominated mix:

- (i) Material Constituents:
 - (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 soluble salt content, in accordance with Annexure R81/E.

- (ii) Mix Design:
- (A) Constituent quantities, per yielded cubic metre of concrete.
 - (B) Nominated particle size distribution of aggregates.
- (iii) Test results of a trial batch: for each nominated mix (Clauses 3.3 to 3.7) determined at your nominated maximum water cementitious ratio and showing conformity for:
- (A) cement content, fly ash content and content of cementitious material per yielded cubic metre of concrete.
 - (B) compressive strength and void content at age 28 days (F_{28}).
 - (C) permeability
- Mould all test specimens from the same homogeneous batch and use test methods in accordance with Clauses 3.5, 3.6 and 3.7.
- Test results must certify that the specimens were prepared in accordance with this Specification.

The date of testing of both the nominated mix and the aggregates must be within eighteen months before the nominated mix is proposed to be used. If sufficient production mix test results are available from within this period, the Principal may reduce the scope of the trial nominated mix.

Submit a new nominated mix if any changes occur to the source or proportions of materials or methods of production.

HOLD POINT

Process Held:	Delivery of no fines concrete.
Submission Details:	At least five working days before proposed date of delivery, submit the following: <ul style="list-style-type: none">(a) All test results and certificates together with a statement that the Nominated Mix complies with all the requirements of this Specification.(b) Details of the mixing plant and delivery vehicles in accordance with Clause 5.2.
Release of Hold Point:	The Principal will consider the submitted documents before authorising the release of the Hold Point.

3.3.5 Variations to Nominated Mixes

You may vary the nominated mix without resubmitting a new nominated mix, the allowable variations being:

- (a) Cement up to 10 kilograms per cubic metre, other cementitious material up to 20 kilograms per cubic metre, providing the requirements of Clause 3.4 are still met.
- (b) 5 per cent by mass of each other constituent except admixtures and water.
- (c) Admixture dosages in accordance with Clause 2.5.
- (d) Water, unspecified.

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

If you want 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 compliance with Clause 3.3.4.

Tolerances on the particle size distribution of aggregates are specified under Clause 4.2.1.

3.4 SLAB GEOMETRY

Construct joints in locations to satisfy the criteria listed in Clause 4.6. The minimum slab width is 0.6 m.

4 PROCESS CONTROL

4.1 (NOT USED)

4.2 PRODUCTION AND TRANSPORT OF CONCRETE

The production and transport of concrete must be such as to:

- (a) prevent segregation or loss of materials.
- (b) supply a homogeneous product.
- (c) result in concrete workability, at the time of incorporation, which is compatible with the capacity of the paving equipment to achieve the required compaction and surface finish and requiring only nominal manual finishing.

For mechanical paving, the mixing, agitation and transport equipment must have an operational capacity which allows continuous paving at the target paving speed. In no case must the capacity be less than that required to maintain a continuous paving speed with adequate allowance for mixer efficiency and control testing.

4.2.1 Production Mixes

Table R81.4 shows the allowable tolerances on the combined aggregate and binder content for the mix.

Notwithstanding these tolerances, the binder content must comply with Clause 3.3.1.

Table R81.4 - Production Tolerances

Description	Tolerance (% by mass)
Particle Size Distribution:	
26.50 mm sieve	± 2
19.00 mm sieve	± 10
9.5 mm sieve	± 2
Each binder:	± 3.0

4.2.2 Mixing, Transport, Consistence and Forming Time

Aggregates which have become intermixed or contaminated with foreign matter must not be used in the Works.

Cementitious materials must be weighed separately.

Volumetric batching of water must employ a measuring device calibrated in one litre increments.

Liquid metering equipment for admixtures must measure the volume, or mass, of liquid to an accuracy of ± 5 per cent of the value shown on the indicating device except that, for water metering equipment, the accuracy must be ± 2 per cent.

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.

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 of charging must be consistent with the recommendations of the suppliers of mix additives.

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 and Appendix A, Annexure R81/E Clause A4.2.2 and the following conditions:

4.2.2.1 Mixing time

- (a) Determine the minimum mixing time from mixer uniformity testing in accordance with Annexure R81/E, and the following:
 - (i) for stationary batch mixers, the mixing time must not be less than 54 seconds plus six seconds for each cubic metre (or part thereof).
 - (ii) for mobile batch mixers, the full period of mixing must be provided at either the testing station or the point of placement. Ignore all other mixing and agitation for the purpose of assessing the actual mixing time for a specific batch.

The minimum mixing time for mixers which do not have a certified compliance plate is 3.5 minutes.

- (b) The maximum mixing time is five minutes for split drum mixers, or 10 minutes otherwise.

HOLD POINT

Process Held:	Paving of 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, prior to authorising the release of the Hold Point within two working days of receipt of the results.

4.2.2.2 Admixture addition

Admixtures must be separately and thoroughly diluted in the mixing water prior to their introduction to other materials. They must then be mixed 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 to comply with this requirement.

4.2.2.3 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.

Subsequent addition of water (retempering) in accordance with Clauses 4.2.2.4 and 4.2.2.5 is deemed to have taken place after completion of batching.

4.2.2.4 Retempering

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

Concrete which is delivered by other than a mobile batch mixer must not have water or any other ingredient added to the mixed batch.

Concrete which is delivered by mobile batch mixer may be retempered prior to the completion of discharge of the batch in accordance with the following conditions:

- (a) Immediately after retempering, the mixing mechanism must be operated at the designated mixing speed for not less than the time determined under Clause 4.2.2.1(a), or for such additional time as may be necessary to re-establish uniformity of the mix.
- (b) The retempering and the quantity of water added (accurate to one litre) must be recorded on the identification certificate for that batch. If water is added after the commencement of discharge, the remaining quantity of concrete at that time must also be recorded.
- (c)
- (d) If a maximum water-to-cement ratio has been specified, the quantity of water added must be such that the specified ratio is not exceeded.

- (e) Retempering is permitted only within the following times as measured from the completion of batching and as appropriate for the temperature of the concrete:
 - (i) 40 minutes for temperature less than or equal to 25°C
 - (ii) 30 minutes for temperature greater than 25°C.

Measure the concrete temperature at the commencement of discharge of a batch at intervals not exceeding 60 minutes throughout the paving operation. The latest value applies.

- (f) Retempering must only take place in the presence of your representative previously nominated to the Principal for this purpose and only at either the batch plant, the testing station, or the point of placement.

Nonconforming concrete must not be used in the Works.

4.2.2.5 Forming time

Determine a maximum forming time (as defined in Clause 1.3) for each nominated mix in order to achieve the requirements of Clauses 4.2(c) and 4.2.2 and with consideration of the prevailing weather conditions and concrete temperature. Include the procedure to determine the maximum forming time in the PROJECT QUALITY PLAN.

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

- (a) 90 minutes for air temperatures less than 30°C
- (b) 45 minutes for air temperatures greater than or equal to 30°C.

Conformity of such a batch is conditional on the conformity for compressive strength of cores from that specific batch.

4.2.2.6 Transport of Mixes for Manual Paving

Agitator vehicles must be used to deliver concrete which will be placed manually. However, subject to the approval of the Principal, tipper trucks may be used where haul lengths are such that segregation does not occur and compaction and finishing of the mix is not compromised.

4.3 PAVING CONCRETE IN SUBBASE

4.3.1 General

Paving must be carried out by mechanical self-propelled paver, except in areas where mechanical placement is impractical, where hand (fixed form) placement may be employed.

4.3.2 Mechanical Paving

Detail in the PROJECT QUALITY PLAN the equipment and methods to be used for placing, spreading and finishing the concrete subbase including the parameters nominated in Clause 4.3.4 for each of the proposed paving configurations.

The paver used must be a self-propelled machine capable of paving at a speed of one metre per minute or less as required to enable the continuous operation of the paver and obtain the required degree of compaction. It 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) The concrete is to be compacted with a tamping device as part of the paver and compaction rollers are not permitted.
- (d) Capability of paving in the widths and depths shown on the Drawings.

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

4.3.3 Manual (Fixed-Form) Paving

Detail in the PROJECT QUALITY PLAN the equipment and methods to be used for placing, spreading and finishing the concrete subbase, including the parameters nominated in Clause 4.3.3.

Design and construct formwork so that it is braced in a substantial and unyielding manner and can be removed without damaging the concrete. Formwork must be mortar tight and debonded to ensure non-adhesion of concrete to the formwork. It must be set to tolerances equivalent to those specified for the finished subbase surface.

Deposit and spread the concrete uniformly in the formwork without segregation and by means other than vibration. 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. Establish and detail in the PROJECT QUALITY PLAN suitable operating parameters for the specific site conditions in order to yield a homogeneous slab with uniform compaction.

4.3.4 Placing and Paving Operations

Place, pave and finish the concrete so as to:

- (a) avoid segregation or loss of materials.
- (b) avoid premature stiffening.
- (c) produce a homogeneous product throughout the pavement.
- (d) produce interconnecting voids to allow water to drain through the no fines concrete.
- (e) provide the specified thickness.

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

Provide staff training in compaction and general paving techniques in accordance with Clause 6.2 of ISO 9001. Include details of this training as part of the PROJECT QUALITY PLAN.

Nominate in PROJECT QUALITY PLAN the following parameters for each of the proposed mechanical paving configurations:

- (a) maximum paving speed (that is, instantaneous, not average).
- (b) target (optimum) paving speed.
- (c) compaction device frequency and amplitude, and ranges thereof.

- (d) gross operating mass per lineal metre of paving width.

Provide the following information for transition zones:

- (a) the proposed technique for paving at transverse construction joints, for both paver and fixed form phases, at both the start and finish of paving runs.
- (b) the distance between the transverse construction joint and the point of effective paver vibration, at both the start and finish of paving runs (the length of start transitions may be different to the finish transitions, depending on the paving techniques employed).
- (c) the details of vibratory screed devices.
- (d) the method of side forming to prevent edge slump.
- (e) proposals to ensure suitable workability for manual placement of the mix within the transition zone.

Maintain records that identify the location of each batch/load of concrete in the finished work in accordance with the provisions for traceability in RTA Q. The method of traceability must be sufficiently accurate to enable subsequent identification of specific batches/loads for examination and/or testing. Submit details of the method of traceability as part of the PROJECT QUALITY PLAN.

4.3.4 Temperature

Measure and record the concrete temperature at the point of placement and the air temperature in the shade. Measure the air temperature at a location away from artificial influences such as machinery.

Concrete must not be placed in the Works when the air temperature in the shade is below 5°C or above 36°C.

Concrete must not be placed in the Works if its temperature at the point of discharge from transport vehicles is less than 10°C or more than 32°C.

4.3.5 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 are not permitted to restrict the evaporation of water.

4.3.6 Surface Finish

The subbase surface after paving must have a uniform finish.

4.3.7 Curing

Cure the subbase by the application of a plastic membrane applied immediately after finishing. A minimum of 200 mm overlap must occur at edges of the membrane.

4.4 PROTECTION OF WORK

4.4.1 Temperature

Detail as part of the PROJECT QUALITY PLAN the procedures and equipment proposed for the protection of concrete from low air temperatures. Failure to protect the no fines concrete when the ambient temperature is at or below 5°C constitutes a nonconformity under the Contract.

4.4.2 Rain or Tunnel Leakage

Concrete must not be placed in the Works:

- (a) during rain or when rain appears imminent,
- (b) when water is continually leaking in drops or streams from the roof of the tunnel onto the paved area.

Protect the concrete from water damage. Detail as part of the PROJECT QUALITY PLAN the procedures and equipment proposed to protect the concrete from water damage. Keep the protective equipment on site ready for use at short notice by experienced personnel.

Concrete will be deemed nonconforming if it is exposed to water within the period from tipping to application of curing membrane (or suitable alternative protection such as covering). Beyond this time, water-exposed surfaces must be assessed under the finished surface criteria of this Specification.

4.4.3 Trafficking of the Subbase

Subbase must not be trafficked by either personnel or construction equipment, other than those associated with essential inspection and testing, until the insitu strength of the subbase has reached at least 4.0 MPa. Thereafter, access to vehicles with a gross mass less than 1.5 tonnes and construction equipment necessary for the following operations will be permitted to traffic the subbase:

- (a) surface survey measurements.
- (b) repair, removal or replacement of the curing membrane.
- (c) construction equipment required to place the asphalt interlayer (refer to Clause 4.7.1).

In addition to the above, rectify any damage caused to the subbase resulting from your operations to produce a homogeneous subbase with the specified surface finish. The cost of rectifying such damage to the subbase will be borne by you.

HOLD POINT

Process Held: Trafficking of subbase.

Submission Details: Insitu strength test results of the subbase.

Release of Hold Point: The Principal will consider the submitted results within two working days of receipt of the results prior to authorising the release of the Hold Point.

4.5 CONCRETE PAVING TRIAL

Prior to normal concrete subbase paving, construct a trial section of concrete subbase using the nominated materials, approved concrete mix, equipment and methods. Conduct concrete strength testing for the trial in accordance with Clause 5.3.

Give the Principal seven days written notice of your intention to commence:

- (a) the trial paving.
- (b) construction of the concrete subbase on any section of work.

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 per cent of the maximum width proposed, the Principal may call for a new trial section prior to full-width paving.

HOLD POINT

Process Held:	Subbase paving subject to the paving trial.
Submission Details:	Submission of checklists and test results (excluding results for compressive strength), and concrete pavement training records in accordance with Clause 26.8 of RTA G2.
Release of Hold Point:	The Principal will inspect the trial and consider the submitted documents prior to authorising the release of the Hold Point.

The trial section will be accepted as part of the Work if it conforms with 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 work if:

- (a) significant changes are made in the equipment, materials, plant or rate of paving,
- (b) the concrete subbase fails substantially to comply with this Specification.

4.6 JOINTS AND EDGES

Deal with detritus from sawcutting operations in accordance with the RTA Specification for ENVIRONMENTAL PROTECTION.

4.6.1 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 20 mm from a 3 m straight edge nor by more than 10mm from a 0.3 m straight edge.
- (c) at the top surface of the joint not deviate by more than 3 mm from a 0.3 m straight edge placed along the joint.
- (d) be constructed at $90^\circ \pm 5^\circ$ to the longitudinal joints with a butt joint face which is square ($\pm 5^\circ$) to the finished top surface of the subbase.
- (e) The first-placed face must be compacted and must be free of gaps of no fines concrete and re-entrant angles.
- (f) if initially nonconforming or damaged, be reinstated or repaired prior to the placement of the adjacent concrete.

4.6.2 Longitudinal Construction Joints

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

- (A) Under concrete bases: within the zone 0.25 ± 0.15 m offset from a 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 subbase must be constructed within 0.10 m of the plan location of the longitudinal joint in the base, unless otherwise shown on the Drawings.
- (B) Under flexible bases: within the zone 0.20 m offset from a lane line. The joint must not be located within the heavy vehicle lane unless otherwise approved by the Principal.

Subbase longitudinal joints:

- (a) need not be scabbled unless otherwise shown on the Drawings. They must not be corrugated.
- (b) must comply with the following geometric tolerances:
 - (i) must 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, you must advise its nominated location.
 - (ii) must not deviate by more than 20 mm from a 3 m straight edge placed along the joint, after due allowances for any planned curvature, nor by more than 10 mm from a 0.3 m straight edge.
 - (iii) must be square to the finished top surface of the subbase with a tolerance of $\pm 5^\circ$.
 - (iv) at the top surface of longitudinal construction joints must not deviate by more than 3 mm from a 0.3 m straight edge placed along the joint.
 - (v) not produce slab widths less than 0.6 m (as measured orthogonal to the control line).
 - (vi) not produce slab lengths less than 1.5 m (as measured parallel to the control line).
 - (vii) not produce corner angles more acute than 70° .

- (c) the first-placed face must be compacted and must be free of gaps in no fines concrete and re-entrant angles.
- (d) must be reinstated or repaired where a joint is nonconforming or the edge is damaged in accordance with Clause 4.10.3. Reinstatement must be completed prior to the placement of the adjacent slab and repair material must not be placed integrally with the adjacent concrete.

4.6.3 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 proposed base is cement concrete;
 - (ii) 25 mm for other base types,with tolerances of ± 25 mm.
- (b) be square to the finished top surface of the subbase with a tolerance of $\pm 10^\circ$
- (c) be compacted and must be free of gaps in no fines concrete and re-entrant angles.

Test 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 test per 10 m of edge, until five conforming results are recorded; and thereafter
- (ii) one test per 50 m of edge.

The testing frequency reverts to (i) if nonconformity is detected.

Where the paved edge of is to form a longitudinal construction joint with adjoining subbase concrete, the horizontal alignment tolerances must comply with Clause 4.5.4.

4.6.4 Inspection

Each joint and edge must be inspected within 24 hours of its construction, and again prior to paving of abutting concrete. If nonconformity is detected in relation to geometric tolerances, Corrective Action must be implemented immediately.

4.7 ASPHALT INTERLAYER

4.7.1 General

A 30 mm asphalt interlayer must be applied to the top surface of the subbase in accordance with RTA 116. This treatment is not considered a curing treatment.

The asphalt interlayer is not to be placed until:

- (a) the subbase has achieved a strength of 4.0 MPa (Clause 6.3)
- (b) the submission of subbase level schedules and the completion of any disposition for nonconformance (Clause 3.2 refers).

The tolerance on the thickness of placing the asphalt interlayer is ± 5 mm.

Apply a Hold Point to asphalt interlayer if any high levels exist within the schedule.

HOLD POINT

Process Held:	Subbase asphalt interlayer, if high invert levels exist.
Submission Details:	Schedule of subbase surface levels and relevant nonconformity report.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising release of the Hold Point.

4.7.2 Surface Preparation and Repair Treatment

Clean the surface of all loose, foreign and deleterious material before applying the asphalt interlayer.

Spalled areas that are not deeper than 50 mm not greater than 150 mm by 150 mm, must be infilled with asphalt prior to placing the asphalt interlayer. Spalled areas deeper than 50 mm or greater than 150 mm by 150 mm must be squared up and infilled with no fines concrete.

A light surface spray of bitumen may be applied uniformly over the top of the NFS immediately prior to paving the asphalt.

You will detail as part of the PROJECT QUALITY PLAN the methods used to ensure loose, foreign and deleterious material does not get carried onto the NFS by the equipment wheels supplying asphalt to the paver.

5 END PRODUCT CRITERIA

5.1 CONCRETE CRACKING

Detail in the PROJECT QUALITY PLAN the inspection schedule for cracking in subbase.

5.1.1 Typical Subbase Cracking

No Fines concrete subbase will typically form full-depth transverse cracks continuous for the full width of the paving run at approximately 3 m to 15 m centres. In subbase placed in a single pass more than 6 m wide, longitudinal full-depth cracks might also typically occur at a spacing of approximately 4 m and in continuous lengths exceeding 4 m. Cracking of this type and extent will not be deemed to be nonconforming unless subsequent deterioration occurs prior to its being covered with base pavement.

5.1.2 Additional Longitudinal and Transverse Cracks

Subbase cracking other than typical cracking as described in Clauses 5.1.1 is nonconforming if the cumulative length of cracking in any 25 m² area of subbase exceeds 2 m. You must immediately implement Corrective Action.

5.2 NOT USED

5.3 CONCRETE COMPRESSIVE STRENGTH

5.3.1 Lot Definition

A lot is defined as a continuous pour of area:

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

5.3.2 Cylinder Strength Testing (in the Trial Mix)

In the Trial Mix, determine the moulded 28-day compressive strength of concrete using test cylinders of 100 mm nominal diameter complying with Clause 3.5 and with compaction.

The following provisions also apply:

- (a) All specimens of a set must be moulded from the same sample of concrete.
- (b) Sampling must comply with AS 1012.1.
- (c) All cylinders tested for strength must be measured for void content.
- (d) Cylinders with a void content less than 20% must not be used for strength testing.

If the age of the test specimens is greater than 28 days at the time of compressive testing, adjust the test results for age in accordance with Clause 5.3.5.

The compressive strength (F_c) of concrete represented by a pair of cylinders for Trial Mix is the average test value, except that the higher value will apply if the difference in the values exceeds 10 per cent of the average.

Cylinder strength testing is not required in the Works.

5.3.3 Core Strength Testing

Adjust compressive strengths for shape in accordance with Clause 5.3.5. Age correction factors do not apply to cores.

5.3.3.1 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 4.5 MPa, 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 void content of the cores must be determined using RTA Test Method 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.

5.3.3.2 Test Specimens

Specimens must be in the form of cores of hardened concrete, which must be secured, 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 $23 \pm 5^{\circ}\text{C}$ 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) and age in accordance with Clause 5.3.5.
- (e) Clauses 9(k), 9(i) *should this be 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.”

Bitumen seal where found on the core must be trimmed from the cores prior to testing.

5.3.3.3 Frequency and Location of Core Groups

Select the location for coring at random in accordance with RTA 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 (or other distance as nominated under Clause 4.3.3) constitute Transition Zones and must form separate sublots for the purpose of core strength acceptance testing.

One Test Group of cores must be taken from:

- (a) each lot of mechanically paved concrete.
- (b) each lot of manually paved concrete.
- (c) in Transition Zones, commencing with the trial section, the minimum frequency of coring is as follows:
 - (i) one group from each subplot until three consecutive conforming sublots are obtained; and then
 - (ii) one group from each third subplot, which must be selected on the basis of time sequence, until four consecutive sublots conform; and then
 - (iii) one group from each fifth subplot, which must be selected on the basis of time sequence.

If a nonconforming result is obtained, the frequency of testing, commencing from the nonconforming lot, reverts to that specified in sub-clause (i).

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

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

5.3.3.4 Restoration of Core Holes

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

Restoration must be completed prior to the application of the asphalt interlayer and the finished surface must be flush with the adjoining surface.

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

5.3.4 Conformity for Core Compressive Strength

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

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

5.3.5 Correction Factors for Age and Shape

Correction factors, AF for age and SF for shape, are given in Table R81.5 and Table R81.6 respectively. For intermediate ages, factor AF must be determined on a pro-rata basis rounded to the nearest second decimal place.

Adjust the test strength by factors as follows:

- (a) For Trial Mix cylinders: divide the test strength by factor AF to derive the equivalent 28-day strength;
- (b) For cores: multiply the test strength by factor SF and divide by factor AF to derive the “factored core strength”. The correction factors are applied to the unrounded core strength.

Table R81.5 - Age Correction Factors

Age of specimen at time of test (days)	Correction Factor AF					
	Cylinders			Cores		
	Fly ash content (%) ⁽¹⁾					
	< 10	10 - 25	> 25	< 10	10 - 25	> 25
28	1.00	1.00	1.00	1.00	1.00	1.00
35	1.02	1.03	1.07	1.00	1.00	1.00
42	1.04	1.06	1.19	1.00	1.00	1.00
49	1.06	1.09	1.28	1.02	1.03	1.09
56	1.08	1.12	1.36	1.04	1.06	1.17
70	1.10	1.15	1.52	1.06	1.09	1.35
84	1.12	1.18	1.66	1.07	1.11	1.54
112	1.14	1.21	1.90	1.10	1.14	1.75
140	1.16	1.24	2.09	1.11	1.16	1.95
168	1.18	1.27	2.25	1.13	1.18	2.04
196	1.20	1.30	2.38	1.14	1.20	2.14
224	1.22	1.33	2.42	1.14	1.21	2.17
308	1.24	1.36	2.56	1.15	1.22	2.21
365 or greater	1.25	1.38	2.66	1.15	1.23	2.23

Note:
(1) Relative to the total cementitious binder content.

Table R81.6 - Shape Correction Factors

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

5.4 GEOMETRY AND THICKNESS

5.4.1 Alignment Tolerances

Within four days of placing an area of concrete subbase, survey the alignment and inspect each joint for conformity. Tolerances on horizontal alignment are given in Clause 4.6 for the outer edges of the subbase and for joints.

5.4.2 Level Survey

Within four days of placing an area of concrete subbase, carry out a survey of the subbase finished surface levels in accordance with RTA G71 to determine conformity of the subbase surface and thickness.

Take levels with a flat based staff of base area between 300 m² and 4000 m² at the following locations. Report the levels to the nearest millimetre:

- (a) (i) at cross-section offsets shown in Figure R81.1;
- (ii) at the same longitudinal plan locations as those surveyed for the invert levels under Clause 3.2,
both with a tolerance of 0.5 m.
- (b) randomly selected at a minimum frequency of at least half the frequency required to comply with (a) above.

The schedules of measured levels must show actual and design levels (after applying the approved design adjustment, refer to Clause 3.2.3) 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 differences and actual levels that are below design levels as negative differences. The mean of differences is the algebraic sum of the differences excluding locations specially surveyed for apparent nonconformity.

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

- (i) Lots with levels below the level shown on the Drawings after allowing for the specified tolerance: submit a nonconformity report and attach the survey report and the relevant assessment of thicknesses.
- (ii) Lots with levels above the level shown on the Drawings after allowing for the specified tolerance high areas must be ground, then finished and debonded by methods detailed in relevant specification clauses to provide a surface consistent with the adjacent concrete and which complies with specified level requirements. Revise and resubmit the survey report.

Alternatively, for areas which are high by 20 mm or less, you may propose a redesign of finished levels.

Rectification of nonconformity must comply with Clause 5.6.

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

A lot is nonconforming if it contains any individual nonconforming levels and must be assessed in accordance with Annexure **R81/E**.

HOLD POINT

Process Held:	Asphalt interlayer of the area surveyed.
Submission Details:	At least seven days before commencing surface asphalt interlayer, 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.

5.4.3 Thickness Assessment

Assess the thickness of concrete subbase within lots which correspond to those established under Clause 5.3.3.3 except that each Transition Zone must be combined with the adjacent lot. Calculate the subbase thickness at individual survey points selected in accordance with Annexure R81/E Clause A5.4.2.1 as the difference between the finished subbase surface level and the subbase invert level surveyed in accordance with Clause 3.2.

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 subbase thickness on the cores taken for strength testing. Adjust the measured thickness in accordance with Clause A3.2.1 to remove the contribution of the sprayed seal on top of the underlying layer. Wherever a core result is 5 mm or more thinner than a survey result located within 1.5 m of the core, or 10 mm or more thinner in the range 1.5 m to 2.5 m of the core, the core result must be accepted and the survey result culled from the assessment. If the frequency of such occurrences is higher than three in any group of 10 consecutive comparisons, the surveys are deemed to be nonconforming.

In areas where the subbase thickness calculated from survey results is nonconforming and no representative cores are available for comparison, the Principal may authorise the drilling of 40 mm diameter cores. Additional cores for the purpose of thickness assessment must not be taken 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 mean to the nearest 5 mm.

For the purpose of assessing thickness conformity, individual deficiency results must then be rounded to the nearest 5 mm.

5.4.4 Conformity for Thickness

A lot will conform for thickness if:

- (a) the mean thickness is not less than the specified thickness, and
- (b) no individual result is 15 mm or more below the specified thickness.

Lots whose mean thickness is 20 mm or less below the specified subbase thickness may be accepted subject to a deduction to the schedule rate for supply and place concrete in subbase, as specified in Table R81.7

Table R81.7 – Deduction for Subbase Thickness Deficiency

Deficiency in Mean Thickness (mm)	Deduction (%)
5	0
10	12
15	24
20	50

Where the Contract includes the construction of a concrete base and you construct the base thicker than the specified base thickness, the increased base thickness may be applied as compensation for the reduced subbase thickness, with deductions to the schedule rate for supply and place concrete in subbase as specified in Table R81.8 in lieu of Table R81.7.

Table R81.8 - Increased Base Thickness as Compensation for Subbase Thickness Deficiency

Increase to specified base thickness (mm)	Deficiency in Mean Subbase Thickness (mm)		
	10	15	20
	Deduction (%)		
5	0	12	24
10	0	0	12
15 and over	0	0	0

Where the Contract includes the construction of an asphalt base and you construct the base thicker than the specified base thickness, the increased base thickness may be applied as compensation for the reduced subbase thickness, with deductions to the schedule rate for supply

5.5 SURFACE PROFILE

5.5.1 Straight-edge

Deviations under a 3 m straight-edge laid in any direction must not exceed 5 mm. Where the straight-edge is placed on convex sections, the cantilever length must not exceed 0.75 m.

Conformity with straight edge criteria must be tested at random locations, commencing with trial paving and at a frequency not less than the following for each of the longitudinal and transverse alignments:

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

Upon detection of nonconformity, testing frequency reverts to (a).

5.5.2 Inspection

Carry out the survey of the alignment and surface levels for conformity and the above requirements within four days of placing an area of subbase or as otherwise agreed with the Principal.

5.6 REMOVAL AND REPLACEMENT OF CONCRETE SUBBASE

5.6.1 General

Deal with detritus from saw cutting operations in accordance with the RTA Specification for ENVIRONMENTAL PROTECTION.

HOLD POINT

Process Held:	Removal and replacement of 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.

5.6.2 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 subbase depth.

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

Over-sawing is not permitted on any additional internal saw cuts which are made to aid the removal of the subbase.

5.6.3 Longitudinal Edges

Remove the concrete at each longitudinal edge of the nonconforming subbase:

- (a) in such a way that the exposed face complies with the criteria for longitudinal construction joints as defined in this Specification, and
- (b) either to an existing longitudinal joint or edge, or to a newly sawn longitudinal joint, except that,
 - (i) the location of the new sawn joint must comply with Clause 4.5.4.
 - (ii) both the width of replacement and the width of residual slab (that is, remaining after the removal) must not be less than 0.6 m (1.0 ?) (as measured orthogonal to the control line). (more under flexible ?)
 - (iii) both the length of replacement and the length of residual slab (that is, remaining after the removal) must not be less than 1.5 m (as measured parallel to the control line).
 - (iv) corner angles produced by the removal and replacement must not be more acute than 60°.

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

Over-sawing is not permitted on any additional internal sawcuts which are made to aid the removal of the subbase.

ANNEXURE R81/A – DETAILS OF WORK

Location Details

Site Number	Location		Permeability (m/s)[#]	Asphalt Interlayer#
	From:	To:		

Value to be nominated by Principal (Clauses 2.1).

If no permeability or asphalt interlayer values are specified in the table, the default values are:

- (a) 20 mm/s for permeability
- (b) 30 mm of AC10

ANNEXURE R81/B – MEASUREMENT AND PAYMENT

Payment will be made for all activities associated with completing the work detailed in this Specification, including Annexure R81/E, in accordance with the following Pay Items. A lump sum price for any of these items must 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 4.5.7). No account will be taken of the allowable tolerances.

The subbase thickness is the thickness as specified on the Drawings.

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

Pay Item R81P2 – Supply and Place Denture 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 4.5.7). 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 4.5.7). No account will be taken of the allowable tolerances.

The schedule rate includes all associated activities such as supply and spreading of aggregate, where applicable.

Pay Item R81P5 – Deductions

Pay Items R81P5.1 to R81P5.2 apply to nonconforming work where there is a specified disposition for acceptance that includes deductions. The value is negative.

Pay Item R81P5.1 – Thickness

This includes deductions for nonconforming works defined in Clause 5.4.

ANNEXURE R81/C – SCHEDULES OF HOLD POINTS, WITNESS POINTS AND IDENTIFIED RECORDS

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

Clause	Type	Description
3.2	Hold	High subbase invert levels
3.2 & RTA G71	Hold	Survey Report verifying subbase invert conformity
3.3.4	Hold	Submission of nominated mix
3.3.4	Witness	Trial mix
4.2.2.1	Hold	Paving of subbase (including the Paving Trial).
4.4.3	Hold	Trafficking of subbase
4.5	Hold	Subbase paving subject to paving trial
4.7.1 & RTA G71	Hold	Survey Report verifying subbase levels conformity
5.6.1	Hold	Removal and replacement of nonconforming concrete subbase

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of RTA G2 Clause 19.

Clause	Description of the Identified Record
3.2.1	Schedule of subbase invert levels and relevant nonconformity report.
3.2.4	Schedule of asphalt interlayer invert levels and relevant nonconformity report.
3.2.5	Schedule of base invert levels and relevant nonconformity report.
3.8.1	Statement and attachments referred to in Clause 3 regarding the nominated mix
3.3.4	Details of variations to a nominated mix before commencing production with the varied quantities
4.3.8.4	In situ strength test results of the subbase
4.4	Submission of checklists and test results, excluding results for compressive strength for subbase paving trial
5.4.2	Schedule of measured levels before commencing surface debonding treatment
5.6.1	Nonconformity report for each location of concrete subbase to be removed

ANNEXURE R81/D – QUALITY SYSTEM

You must supply certain information, as specified in the following clauses:

- a) Control of cement and fly ash; Clause 2.2
- b) Admixture selection; Clause 2.3
- c) Certification for water; Clause 2.4
- d) Certification for curing membrane (both nominated and delivered); Clause 2.5
- e) Subbase invert level survey; Clause 3.2
- f) Consistence; Clause 3.6
- g) Concrete mix design and constituent details; Clause 3.3.1
- h) Materials handling, batching and mixing proposals; Clause 4.2.2
- i) Admixture incorporation method; Clause 4.2.2(c)
- j) Control of batching time under Clause 4.2.2(d) and retempering under Clause 4.2.2(f) and nomination of Contractor's representative under Clause 4.2.2(f)(G)
- k) Determination of maximum forming time; Clause 4.2.2(h)
- l) Equipment and methods for spreading and paving; Clauses 4.3.1, 4.3.2
- m) Details of staff training; Clause 4.3.3
- n) Monitoring location of batches/loads of concrete placed; Clause 4.3.3
- o) Meteorological data and measures to restrict evaporation; Clause 4.3.5
- p) Protection of work from low temperatures (Clause 4.3.8.1) and rain (4.3.8.2)
- q) Notice of trial paving and subsequent paving; Clause 4.4
- r) Crack inspection schedule; Clause 5.1
- s) Method of calculating adjusted thickness from survey; Clause 5.4.3

ANNEXURE R81/E – TECHNICAL PROCEDURES

This Annexure details supplementary requirements for construction of concrete subbase.

The clause numbers in this Annexure, after the prefix “A”, correspond with the relevant clause number in the concrete subbase Specification.

A2.1 AGGREGATE - GENERAL

A2.1.2 Soluble Salts

The two methods for testing chloride and sulphate ion contents are as follows. Testing is required by only one method.

(a) Test Method for concrete constituents.

(i) Conduct chloride testing in accordance with:

- AS 1012 Part 20 for aggregates;
 - AS 1478 Appendix D for water and admixtures dissolved in water;
- then calculate the total content and percentage.

(ii) Conduct sulphate testing in accordance with:

- AS 1012 Part 20 for aggregates;
 - AS 1289.4.1.2 for water and admixtures dissolved in water;
 - AS 2350.2 for cementitious materials;
- then calculate the total content and percentage.

(iii) Notes:

- (A) For admixtures, the soluble salt contents may be taken as the values certified in writing by the manufacturer.
- (B) For water, the source proposed for the Works must be tested.

(b) Test Method for hardened concrete:

Conduct chloride and sulphate testing in accordance with AS 1012 Part 20. The water used in the concrete must be from the source proposed for the Works.

A4.2 PRODUCTION AND TRANSPORT OF CONCRETE

A4.2.2 Mixing, Transport, Consistence and Forming Time

Mixing, transport and consistence must comply with AS 1379, Sections 3 and 4 and Appendix A, subject to the following provisions:

(a) Mixer uniformity testing – general

For the purpose of conducting the mixer uniformity test, charge the mixer in accordance with the manufacturer's instructions and to the maximum volume (or throughput) proposed to be used in the Works. Thereafter, the volume (or throughput) at test must not be exceeded unless a further uniformity test is conducted.

Concrete from the mixer uniformity test may be incorporated into associated works as directed by the Principal.

(b) Uniformity testing of central mixers

Where concrete is to be produced and mixed by a central mixer, conduct mixer uniformity tests before production paving is commenced with that mix, and thereafter upon production of each 30,000 m³ of concrete from that mixer, or as otherwise required in accordance with AS 1379 Clause 3.4.2.

Conduct tests on three consecutive batches or runs of the same mix which conform to all of the requirements of this Specification. A run (from a continuous mixer) must comprise not less than 5 m³ of mix.

Report mixing speed and mixing time or, for continuous mixers, the throughput rate.

The whole of a single batch (or run) must be discharged and sampled by one of the following procedures:

- (i) By discharge into a moving vehicle whose tray length is not less than 8m. Sampling must be from the truck prior to tipping. Obtain the samples using a shovel or scoop but exclude the top 100 mm of concrete.
- (ii) By discharge into a transport vehicle typical of that to be used in the work, 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. Sampling must be from ground in accordance with AS 1012.1.

In each case, sample the batch (or run) at three points approximately 15 per cent, 50 per cent and 85 per cent along the discharged length of the mix. Take a sample of approximately 50 litres from each point. Samples must be individuals (that is, not composites); AS 1012.1 Clause 3 refers.

(c) Uniformity testing of mobile batch mixers

All mobile batch mixers must display an identification plate (or equivalent certification) in accordance with AS 1379 to certify compliance with mixer uniformity criteria. All mixers must have been tested within the past 24 months for slump, air content and mass per unit volume, and the results must have complied with the limits given in AS 1379 Appendix A. The date of latest test must be shown on the identification plate.

Further tests must be carried out in accordance with AS 1379 Clause 3.4.1(c):

- (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 per cent longer than the typical time for other trucks using the same mix.

Because of the retempering provisions of this Specification, these criteria apply even where mobile mixers are used to transport centrally-mixed concrete.

All samples for uniformity testing must be individuals (that is, not composites); AS 1012.1 Clause 3 refers.

(d) Uniformity testing of continuous mixers

Continuous mixers must be assessed in accordance with AS 1379 except that three individual samples must be taken (instead of two), each separated by an interval equivalent to at least 2 m³ of throughput.

(e) Compliance for uniformity

- (i) Central batch mixers and continuous mixers:

The mixer will be deemed to have passed the uniformity test if the difference between the highest value and the lowest value for the corresponding properties of the three samples does not exceed the limiting values given in AS 1379 Table A1 for any of the three consecutive batches. Additionally, no slump value must lie outside the specified range.

- (ii) Mobile batch mixers:

Assessment must be in accordance with AS 1379.

ANNEXURES R81/F TO R81/K – NOT USED

ANNEXURE R81/L – MINIMUM FREQUENCY OF TESTING

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
Supply of Concrete for Subbase			
2.1	- Bulk density	AS 1141.4,	In the trial mix
2.3	- Water absorption	AS 1141.6	Once within 12 months prior ⁽³⁾
2.3	- Material < 75 micrometre	AS 1141.12	One per 5000 tonnes
2.3	- Wet strength	T215	One per 2000 tonnes ⁽¹⁾
2.3	- Wet/dry strength variation	T215	One per 2000 tonnes ⁽¹⁾
2.1	Soluble salts	See Clause 2.1	Once per 30,000 m ³ of concrete
2.4	Cement & fly ash	???	As per Contractor's QP ?
4.2.1	Particle size distribution of combined aggregate - deviation from nominated:	AS 1141.11	
	- by calculation	By calculation	One per 800 tonnes of aggregate
	- by wet-sieving ⁽²⁾	T329 ⁽²⁾	One per 2000 m ³ of concrete
4.2.2	Mixer Uniformity	AS 1379 and Clause 2.4.4	As per Clause 4.2.2
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) Only the +1.18 mm fraction need be tested; Clause 4.2.1(b) refers.			
(3) Within 12 months prior to the date of closing of tenders, or else in conjunction with the trial mix.			
Placing Concrete in Subbase			
4.5.1	Geometric tolerance on transverse joints		Two tests per joint
4.5.3	Geometric tolerance on longitudinal joints		Initially and also after each nonconformity: One per 10 lin m of joint until 5 conforming results are recorded, then one per 25 lin m.
4.3.8.4	Insitu compressive strength (for trafficking purposes)	Cores as per Clause 4.3.8.4	As per Clause 4.3.8.4
5.3.3	Core compressive strength of concrete at maximum 42 days		As per Clause 5.3.3
5.4	Surface level and alignment	Various	As per Clause 5.4
5.4.3	Thickness	Survey and Core length	As per Clause 5.4.3
5.5	Surface profile	See Clause 5.5	As per Clause 5.5

ANNEXURE R81/M – REFERENCED DOCUMENTS

Refer to RTA R81 Clause 1.2.4.

Australian Standards

AS 1012	Concrete Testing
AS 1141	Aggregate Testing
AS 1289	Soil Testing
AS 1379	Concrete Manufacture
AS 1478	Concrete Admixtures
AS 2350	Method of Testing Portland and Blended Cements
AS 2703	Numerical values – Rounding and interpretation of limiting values
AS 2758.1	Concrete Aggregates
AS 3799	Liquid membrane-forming curing compounds for concrete
AS 3942	Quality Control Guide
AS/NZS 4671	Steel reinforcing materials
AS/NZS 4680	Hot-dip galvanized (zinc) coatings
AS 4940	Control Chart Methods
AS/NZS ISO 9001	Quality management systems - Requirements

RTA Specifications

RTA Q	Quality Management System
RTA G2	General Requirements
RTA G35	Environmental Protection (Management Plan)
RTA G36	Environmental Protection (Management System)
RTA G71	Construction Surveys
RTA R53	Concrete (for General Use) Mortar and Grout
RTA R82	Lean-Mix Concrete Subbase
RTA R106	Sprayed Bituminous Surfacing
RTA R116	Asphalt (Dense Graded and Open Graded)
RTA 3151	Cover Aggregate for Sprayed Bituminous Surfacing
RTA 3211	Portland and Blended Cements
RTA 3253	Bitumen for Pavements
RTA 3254	Bitumen Emulsion

The specification for ENVIRONMENTAL PROTECTION means RTA G35 or RTA G36, as incorporated into the contract documents.

RTA Test Methods

RTA T192	Texture depth using TRL Meter
RTA T201	Sieve Analysis of Aggregates
RTA T215	Ten percent fines
RTA T235	Aggregate least dimension
RTA T239	Aggregate fractured faces
RTA T240	Surface texture depth
RTA T278	Aggregate Shape by the Ratio of Greatest to Least Dimension
RTA T304	Moulding of concrete specimens
RTA T321	Drying Shrinkage of 100x100x280 mm Concrete Prisms
RTA T363	Accelerated AAR assessment
RTA T368	Dressing of voids and adjustment for steel
RTA T862	Stability of Wax Emulsion
RTA T865	Non-volatile content of concrete admixtures and curing compounds
RTA T1005	Infrared spectrophotometer