RMS QA SPECIFICATION R83

CONCRETE PAVEMENT BASE

NOTICE

"This document is a copy of one of the Authority's QA Specifications.

The QA Specifications are policy documents within the meaning of the Freedom of Information Act 1989 (NSW)("FOI Act") and this document is accordingly made available to you pursuant to Section 15(1) of the FOI Act.

The QA Specifications were developed by the Authority for use with roadworks and bridgeworks contracts let by the Authority or local councils. The Authority only uses the QA Specifications in conjunction with its other standard form documents and under the supervision of professional civil engineers who are trained and experienced in roadworks and bridgeworks. The Authority does not use the QA Specifications for any other purpose and does not consider them suitable for use for any other purpose.

Consistent with the FOI Act, the purposes for which this document has been made available for inspection or purchase by you are:

- to satisfy the Authority's obligation under Section 15(1) of the FOI Act to make its policy documents available for inspection and purchase by members of the public
- to ensure that you, as a member of the public who may be affected by the operation of this document, have access to the document.

The price which you have paid for this document only covers the Authority's costs of printing and handling the document.

If you use this document for any purpose which is not consistent with the above (including, without limitation, for carrying out any construction, engineering, maintenance or other work), you do so at your own risk.

This document is current as at the date of this notice. However, you should be aware that the Authority regularly reviews and updates its QA Specifications. You will not be notified of any update.

Your comments and suggestions to improve any of the RMS QA specifications may be sent to: Infrastructure Contracts Branch, RMS, Locked Bag 928, North Sydney, NSW 2059 (Fax 02-8588 4171).

No advisory or support services will be provided by the Agency.

Copyright in this document belongs to Roads and Maritime Services New South Wales."

Electronic copies of only Annexure A of specifications in MS Word format may be provided to organisations carrying out privately funded work that will be handed over to RMS. Electronic copies of specifications are not to be supplied in MS Word format outside the RMS unless loaned, by the appropriate RMS Project Manager, to professional services contractors or Councils for preparing tender documents for RMS funded projects. In which cases, the contractors and Councils are required to return them to the RMS Project Manager.

Electronic copies of specifications may be provided to other State Road or NSW Government Authorities by Infrastructure Contracts Branch for use on Government funded projects only

RMS does not permit the possession or use of electronic copies of specifications or guides to specifications by non-RMS organisations or persons other than as stated above.

RMS QA SPECIFICATION R83

CONCRETE PAVEMENT BASE

REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 2/Rev 0		Completely revised. Some requirements transferred to Annexure R83/3.	GM, RNIC (W Ho)	30.01.98
Ed 2/Rev 1	Various	Minor editorial changes	GM, RNIC	15.04.98
	2.2	Natural sand content 75%		
	3.6	Vebe to be ≤ 3 secs in trial mix		
	5.3, 5.4	Rearranged under new clause headings		
	Annexure R83/3	Subclause numbers changed for: A2.1, A2.6, A3.2, A4.1, A4.2.1, A4.3.6, A4.5.2, A4.5.4, A5.2.1, A5.4.2		
	A1.2	Incorporated into Cl 1.2		
	A2.1.1	Table A3.2 & A3.3 renumbered		
	A4.2.1.5, A5.3.4	Age correction factors added for flexural strength		
	A5.3	Paragraphs rearranged.		
	Annexure R83/3	Cl 5.3.3 Subclause numbers added		
Ed 2/Rev 2	5.5.3.2	Table R83.14 deductions changed for PRC 5	GM, RNIC (J Woodward)	28.09.98
Ed 2/Rev 3	1.2, 2.8	AS 1650 replaced by AS/NZS 4680	GM, RNIC	13.08.99
	2.2	Quartz-chert content changed for base below asphalt		
	2.6, 4.3.8.4, 4.5.3, 4.5.5, A4.2.1.2, A5.3.2,	Minor changes. 5.2.1, 5.3.2, A2.1.2, A4.2.1.1 A4.2.1.3, A4.5.2.5, A5.2.1.1		
	2.9	Reference to AS 1379 changed		
	3.8.1(iii)	Results format specified		
	4.1.1	Clearance to joints changed.		
	4.1.3	Additional dowel requirements		
	4.3.7(g)	Curing required until 30MPa		
	5.4.3	Thickness assessment changed		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 2/Rev 3	6	Sub items required for P1, P7		
(Cont.)	A2.1.1	Test methods changed		
	A4.1.1.2	Fabric splicing changed		
	A4.5.2	Sawcutting required		
	A4.5.2.1	Single cut permitted generally		
	Annex R83/7	New annexure listing Identified Records		
Ed 2/Rev 4	1.2, 2.4, 3.3, 5.4.2, Annx R83/4:	3.8.1, 4.2.1, 4.5.2, 4.5.5, 5.2.2, Annx R83/2, A4.5.1, A4.5.4.1, A5.2.1.2 Minor changes	GM, RNIC	31.08.00
	2.2	Natural sand content 50%		
		Organic impurities requirement changed		
	2.5	Alkali contribution for fly ash mixes changed		
	2.6	Curing compound types changed		
	3.5	Flexural strength omitted for non-pavement mixes		
	3.6	Slump range changed		
	4.1.3	Additional dowel requirements		
	4.2.1	Control chart requirements for combined aggregate grading changed		
	4.2.2	Forming time recording changed Mixing time for mobile mixer added		
	4.3.4	Concrete temperature range changed		
	4.6	Isolated joints required at pits		
	5.1.4	12% deductions added		
	5.5.1	Longitudinal joint test added		
	5.5.3.2	Assessment of cores changed		
	6	Pay Item R83P1 changed		
	Annex R83/3 - A4.1.2.2	Voids above tiebars to be filled		
	- A..4.2.1.2	Minimum frequency for testing flexural specimens changed		
	- A4.2.2	Continuous mixers included		
	- A5.2.3	Assessment of cores changed		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 2/Rev 4	- A5.3.3	Cores must be wet conditioned		
(Cont'd)	- A5.4.2	Survey model included		
	Annex R83/4	Particle size distribution testing requirements changed		
Ed 2/Rev 5		Title changed from Plain Concrete Base to Jointed Concrete Base	GM, RNIC	21.08.03
	1.2	Various revisions to Table R83.1		
	3.7, 4.3.4, 4.3.6, 4.4, A4.2.2,	Minor editorial changes. 5.2.1, 5.4.2, A3.8.1, A4.1.2.2 A5.2.1.1, A5.2.4, A5.3.2		
	1.1	Steel fibre reinforcement added		
	1.2, 2.8, Pay Item R83P4	AS/NZS 4671 replaces AS 1302 AS 1303 and AS 1304		
	1.2, 2.4	RMS 3211 replaces detailed cement requirements. RMS requires a cement sample. AS 2349 added.		
	2.4	Flyash requirements changed		
	2.6	Amendments to curing compounds		
	2.7	RMS T1193 and T1192 added to table		
	3.3	40% replaced by 38%; Table R83.5 4.75 mm AS sieve, 36 replaced by 38		
	3.8.1(iii)	Test methods specified		
	4.1.2	Plain tiebar length added		
	4.1.3(a)	As 4680 added		
	4.1.4, 4.1.5, 4.1.6, 4.1.7, 4.1.8, 4.1.9, 4.1.10	New clauses		
	4.2.1, A4.2.1.5	General revision of the use of control charts		
	4.2.2	Headings added and general revision		
	4.3.2	Vibrator requirements added		
	4.3.3	Details required in PQP		
	4.3.8.2	Rain damage to be assessed		
	4.3.6, 4.4	Reference panel deleted		
	4.5	Management of detritus from sawcutting added		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 2/Rev 5	4.5.1	New clause		
Continued	4.5.3	Item (e) added		
	4.5.5	Item (c) (iii) added		
	4.5.8	Test edge alignment		
	4.6, 4.8	Concrete requirements revised		
	4.8	Slump and compaction requirements changed for slab anchors		
	5.2.1	(i) and (ii) Treatment of Lots in Transition Zones; (a) conformity of Lots; (C) nonconformity of Lots		
	5.4.2	First paragraph revised		
	5.4.4	General revision		
	5.5.2	Incentive payments applicable at minor grinding (iii) clause deleted		
	5.6	Management of detritus from sawcutting added		
	Annexure R83/2	k) batching time added n) general revision and 4.3.3 added o) Training details required		
	A2.6	Viscosity added		
	A4.1.1.1	General revision of paragraphs three and five		
	A4.1.1.2	Grade 500 added		
	A4.1.2.2 (ii) (B)	500 replaced by 400; "All voids … filled." paragraph revised		
	A4.2.1	Paragraph referring to SFRC added		
	A4.2.1.1	General revision		
	A4.2.1.2	Note added to table		
	A4.2.1.3	Reference to SFRC added; Tolerance on flexural strength changed from 0.3 to 0.5; AS1012.12 amendment changed; (ii) general revision		
	A4.2.1.5	General revision		
	A4.2.2	Paragraph five revised for conforming retempering		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 2/Rev 5	A4.2.2 (c)	General revision		
Continued	A4.2.2 (f)	(i) mixing time to be determined under Clause 4.2.2(a); (v) 30 replaced by 40 and 20 replaced by 30		
	A4.3.3	Compaction and training requirements added		
	A4.3.7	Hand lances permitted to 4.5 m		
	A4.4	Second paragraph, reference to Clause A5.2.1.1 added		
	A4.5.1	New clause		
	A4.5.3.5	Second paragraph, 10 replaced by 14; Fourth paragraph, backer rod described; Eighth paragraph, reference to manufacturer's recommendations added		
	A5.2.1.1	General revision		
	A5.2.1.3	Use of Lots redefined		
	A5.2.3	General revision		
	A5.2.4	First paragraph, deleted; Second paragraph, clarification; Third paragraph, added		
	A5.3.2	Last paragraph, less than changed to greater than		
	Annex R83/4	Clause 3.3, 800 replaced by 1500; AS 1141.12 added; Clause 4.3.6 (a) and (b) amended; Clause 4.5.1 added		
	Annex R83/5	New definitions and symbols added		
	Annex R83/8	New annexure		

Ed 2/Rev 6	2.4	RTA Laboratory details updated	GM, IC	23.03.07
	4.4	Requirement for Concrete Paving Crew Training records added to Hold Point.		
	Annex R83/3, A4.3.3	Training requirements amended to include reference to Concrete Paving Crew Training		
Ed 2/Rev 7	Table R83.1	Reference documents updated.	GM, IC	03.09.10
	2.8	ACRS certification replaced NATA certification.		
	3.2, A3.2.1, A5.4.2.1, Annex R83/6	Reference for survey requirements changed from “RTA Q” to “RTA G71”.		
	Annex R83/5	Abbreviation for ACRS added.		
	Annex R83/7	ACRS endorsed test certificate for steel reinforcement inserted in Schedule of Identified Records.		
Ed 2/Rev 8	2.8	Steel reinforcement requirements clarified.	GM, IC	11.10.10
	Annex R84/7	Certification requirement for steel reinforcement amended.		

CONCRETE PAVEMENT BASE

Copyright—Roads and Traffic Authority of New South Wales, 2007
RNIC-QA-R83

VERSION FOR: **DRAFT REVIEW**
DATE: **Tracked Revisions since 6 Jan 2013**

CONTENTS

CLAUSE PAGE

FOREWORD

RMS COPYRIGHT AND USE OF THIS DOCUMENT

When this document forms part of a contract

This document must be read with all the documents forming the Contract.

When this document does not form part of a contract

This copy is not a controlled document. Observe the Notice that appears on the first page of the copy controlled by RMS. A full copy of the latest version of the document is available on the RMS Internet website: www.rms.nsw.gov.au/doingbusinesswithus/specifications

REVISIONS TO EDITION 3

This document is based on of RMS Specification R83 Edition 3 Revision 0 –** 2013.

All revisions to RMS R83 Ed 3 / 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~~.

SPECIFICATION USER GUIDE

A User Guide CR083 is available for this document. It is intended for use by the Principal's staff and has no contractual status. Web access is available as follows:

www.rms.nsw.gov.au
"Partners & suppliers"
"Engineering Contract Docs"
"Specification guides"

RMS QA SPECIFICATION R83

CONCRETE PAVEMENT BASE

1 GENERAL

1.1 SCOPE

This Specification is for the supply of concrete and construction of the base (upper) layer of the following formats:

(a) plain concrete pavement (PCP)

(b) continuously reinforced concrete pavement (CRCP)

(c) jointed reinforced concrete pavement (JRCP)

(d) steel fibre reinforced concrete pavement (SFCP), for which the provisions of Clause 6 apply.

It includes the following items:

(i) concrete materials;

(ii) concrete mix design requirements;

(iii) process control and manufacture of base;

(iv) end product criteria for base;

(v) quality systems, minimum process standards, plant requirements, and sampling and testing requirements.

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.

1.2.1 Details of Work

Details of work are shown in Annexure R83/A.

1.2.2 Measurement and Payment

The method of measurement and payment must comply with Annexure R83/B.

1.2.3 Schedules of HOLD POINTS, WITNESS POINTS and Identified Records

Annexure R83/C lists the Hold Points and Witness Points that must be observed. The records listed in Annexure R83/C are Identified Records for the purposes of RMS Q Annexure Q/E.

1.2.4 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 2350). For convenience, the full titles are given in Annexure R83/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.
AF	Age correction factor; see Cl 5.3.5
AGD	Average Greatest Dimension (of aggregate); see Cl 2.3.
ALD	Average Least Dimension (of aggregate); see Cl 2.3.
Anchor slab	The base slab which lies over an anchor. See also "slab anchor".
Approach sections	Pavement which is located within 30 m of bridges (or other structures) where the concrete base is discontinuous, or within 30 m of contract limits.
Batch	A quantity of concrete containing a fixed amount of ingredients and produced in a discrete operation. See also "load".
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 RMS 3211 and this Specification. See also *Cement*.
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	Cements and supplementary cementitious materials as defined by RMS 3211:
Charging	~of a mixer; the introduction of ingredients at the plant, but excluding water which is added at the slump stand in order to establish the desired slump.
Coefficient of variation	Ratio of the standard deviation of the test values to the mean of test values *100. For 28-day flexural strength the coefficient of variation is calculated as the ratio of the 5-point rolling standard deviation to the 5-point rolling mean (*100).
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	(a) For a stationary batch mixer discharging into a storage bin or tipper truck, this will be the time at which discharge commences from the mixer. (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 commences into the truck. (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.
Curing Classes 1, 2 & 3	see Clause 4.3.7.1
Debond/Debonding	The application of a material to a surface to prevent the formation of bond.
Dowel	or dowel bar; a round steel bar intended to allow joint opening but to minimise relative shear displacements across the joint.
Drill-tie	A tiebar which is fixed by drilling into existing concrete.
Edge, free	This term is used in the context of limiting all restraint against the free movement of joints which intersect that edge or joint. A free edge is provided by an isolation joint or by an outer edge. Untied butt joints and dowelled expansion joints do not constitute free edges.
Edge, outer (base)	An edge against which material other than base concrete or kerb concrete is to be placed (such as granular backfill or no-fines concrete).
Edge, relief	See "relief edge"
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 screeds.
Fly ash	A 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.
Haul Time	The elapsed time measured between the completion of batching and the completion of discharge of the mix from the delivery vehicle.
Joint	A planned discontinuity in the concrete, other than an edge, and which complies with Clause 4.5.
Joint, mismatched	A joint which terminates at a junction with an adjoining slab. Tied joints may mismatch without restriction. Untied joints are subject to restrictions in accordance with Clause 4.5.7
Jointed base	A grouping of PCP, PCP-R, JRCP, SFCP and SFCP-R. In other words, all base formats covered by this document except for CRCP.
Lap (in reinforcement)	A splice in which the bars are in contact over the full lapped length, with sufficient ties to ensure contact in the hardened concrete.
Load	A single truckload of concrete comprising one or more batches; see also Clause 4.2.2.

Lot	A Lot is defined as a continuous pour of volume: (a) up to 50 m³ for slipformed base. (b) up to 30 m³ for hand-paved base. If you choose to define a Lot by a method that is different to (a) and (b), detail the method in the PROJECT QUALITY PLAN in accordance with Clause 7.5.3 of RMS Q. The details must include how the method incorporates the requirements of (a) and (b). See also *Transition Lot*.
MBV	Methylene Blue Adsorption Value
MBV75 value	The multipleproduct of the MBV and the passing 75u fraction
Microfines	The fraction of aggregate which passes the 300 µm sieve but is retained on the 75 µm sieve.
Mixers	Mixer types as per AS 1379 Clause 4.2.
Mixing Time	Applicable to batch mixers only. Comprises only that mixing carried out at the specified mixing rate (ie, excluding agitation), measured from the time all the ingredients (including all water) are in the mixing drum until mixing ceases, or after specified revolutions. Note that this is different to the requirements of Standard AS1379.
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.
Process mean	$\overline{\overline{X}}$; see Clause 1.5 – Symbols
Ramp gore areas	See Figure R83.6
Range	In the context of Clause 4.2.1, range is defined as the difference between the highest and lowest values within a five-point group.
Re-entrant angle	An angle, formed by joints and/or edges, which point inwards, towards the concrete slab (for example, at a drainage pit).
Relative compaction	The percentage ratio of the core unit mass of the Lot to the rolling cylinder unit mass (RCUM) for the Lot. In the case of SFCP, it is the percentage ratio of the core unit mass of the Lot to the rolling beam unit mass (RBUM) for the Lot.
Relief edge	An edge or joint which relieves contraction stresses in joints and/or sections which are aligned approximately parallel with the joint (or section) under design. A relief edge is provided by an untied joint or by a free edge or by an expansion or isolation joint.
Relief-edge distance (RED)	The distance measured from the joint (or section) under design to the nearest relief edge which is aligned in such a way that it will limit the design stress. The value for RED must take into account all stress contributors such as connected kerbs and barriers. Allowance may also need to be made for likely future widenings.
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. The addition of an admixture (such as high range water reducers) is not considered to constitute retempering. Clauses 4.2.2.3 and 4.2.2.7 refer.

Rolling cylinder unit mass (RCUM)	The rolling mean for five consecutive pairs of 28-day cylinders prior to and including the relevant Lot, or for fewer than five pairs, the mean value of the pairs available.
Rolling statistical results	Calculated using groups of consecutive results, with progression in single increments.
SCM	Supplementary cementitious materials include fly ash, ground granulated iron blast furnace slag and amorphous silica, as defined by RMS 3211.
SF	Shape correction factor; see Cl 5.3.5
Skew, Road	Applicable at locations such as bridge abutments, it is the complement of the Bridge Skew (ie 90° minus the Bridge Skew).
Slab	A portion of concrete bounded by joints and/or edges.
Slab, odd-shaped	(a) Slab containing a blockout (for example, for a drainage structure). (b) A trafficked slab having a corner angle less than 84°, or the ratio of its longer to shorter dimension exceeding 1.25. (c) An untrafficked slab having a corner angle less than 80°, or the ratio of its longer to shorter dimension exceeding 3.0. If dimensions, measured normal and parallel to longitudinal joints, are variable within a slab, the greatest value of the ratio applies.
Slab anchor	A restraining beam cast in the ground, on which a base slab is later cast.
Slab anchor, terminal	A slab anchor where the overlying base slab is a terminal slab.
Slab anchor, intermediate	A slab anchor where the overlying base slab is not a terminal slab.
Slipform paving	Also referred to as mechanical and machine paving. Paving by a purpose-built machine with the capacity to spread, compact, screed and finish the concrete in accordance with Clause 4.3.1 and without fixed formwork. (Note that for specialised applications, a slipformer can be used over fixed forms, which work is deemed to comply with this definition.)
Squared standard deviation	s^2; see Clause 1.5 – Symbols
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 (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.
Tie barTiebar	A deformed reinforcing bar intended to hold joints closed whilst allowing hinge movement.see *tiebar*
Trafficked slab	A slab (bounded by longitudinal joints and/or edges) which lies either totally or in part within the trafficked carriageway as defined by lane lines.
Transition Lot	A Lot which falls within a transition zone (as defined).
Transition zone	Hand vibrated concrete which is cast with otherwise machine-paved concrete, such as at transverse construction joints in machine-paved work. Clause 5.3 refers.

Transition point	The point at which vibration on a paving machine commences or ceases effective compaction. Examples include: (a) Transition zones; (b) the boundary of a zone where a vibrator becomes faulty or irregular; (c) the boundary of a zone where the operation of the 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.
Vebe test	A flow test on a vibrating table, used as a measure of workability in stiff mixes.
Wet curing	Curing in which the concrete surface is maintained in a wet condition. For test specimens, this can be achieved by placing in a fog room/chamber with a relative humidity exceeding 98 per cent.
Yielded cubic metre	As per the determination of mass per unit volume in accordance with AS 1012.5

1.4 ABBREVIATIONS

ACRS	Australian Certification Authority for Reinforcing Steels
ATIC	Australian Technical Infrastructure Committee (formerly Cement and Concrete User Review Group - CCURG)
CMRS	Cementitious Materials Registration Scheme
CSIRO	Commonwealth Scientific and Industrial Research Organisation, Australia
GGBFS	Ground Granulated Iron Blast-Furnace Slag
MBV	Methylene Blue Adsorption Value
NATA	National Association of Testing Authorities, Australia
RTA	Roads and Traffic Authority, New South Wales
RMS	Roads and Maritime Services, New South Wales
SMZ	Selected Material Zone
LCS	Lean-mix concrete subbase
PCP	Plain concrete pavement (base)
PCP-R	Discrete reinforced slabs within PCP (base)
CRCP	Continuously reinforced concrete pavement (base)
JRCP	Jointed reinforced concrete pavement (base) - dowelled
SFCP	Steel fibre reinforced concrete pavement (base)
SFCP-R	Discrete mesh-reinforced slabs of steel fibre reinforced concrete pavement (base)

1.5 SYMBOLS

Symbol [1]	Definition
F_{28Min}	The specified minimum 28-day (cylinder) compressive strength in the trial mix
F_{28}	The actual 28-day (cylinder) compressive strength in the trial mix
F_7	The actual 7-day (cylinder) compressive strength in the trial mix
F_{f28Min}	The specified minimum 28-day flexural strength in the trial mix
F_{f7}, F_{f28}	The actual 7-day & 28-day flexural strengths in the trial mix
F_{t28}	The actual 28-day indirect tensile strength in the trial mix
f_{cMin}	The specified minimum 28-day (cylinder) compressive strength in the Work
f_c	The actual 28-day (cylinder) compressive strength in the Work
f_{c7}	The actual 7-day (cylinder) compressive strength in the Work
f_{fMin}	The specified minimum 28-day flexural strength in the Work
f_f	The actual 28-day flexural strength in the Work
F_{sf}	Fibre factor for steel fibre reinforcement
K_f	Steel fibre bond coefficient
MT_{min}	Minimum mixing time determined in accordance with Cl 4.2.2.1
S	Standard deviation
$\overline{\overline{X}}$	Process mean calculated on a rolling basis using 100 values (,ie k=100). Prior to 100 values becoming available, all available values must be used.
s_{100}	See Clause 4.2.1. Process standard deviation calculated on a rolling basis using 100 values (ie, k=100). Prior to 100 values becoming available, all available values must be used.
s_{30}	See Clause 4.2.1.1. Process standard deviation calculated on a rolling basis using 30 values (ie k=30). Prior to 30 values becoming available, a value of $f_{cMin}/10$ must be used.
s^2	Squared standard deviation calculated on a rolling basis using 100 values (ie k=100). Prior to 100 values becoming available, all available values shall be used.
s_5	Five-point rolling standard deviation.
V_f	Steel fibre content (per cent volume) of a mix

Notes

1. In relation to concrete strengths, 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 AGGREGATE - GENERAL

Aggregates for base 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.

Aggregate must be sourced from:

(a) stockpiles which have been formed and tested at site, or;

(b) certified stockpiles.

Do not exceed a Lot size of 4000 tonnes.

Stockpiles must be formed on clear, even, well-drained, firm ground or constructed floor, and must be constructed separate from each other in such a way as to prevent cross-contamination and segregation.

The materials must be stockpiled such that:

(i) each stockpile represents only one Lot, or;

(ii) the stockpile of a single material is built incrementally in such a way that a new Lot of material is added, tested and found conforming or is removed from the stockpile before any further Lot of material is added.

Stockpiles must be clearly and uniquely identified by signposting which indicates the type and quantity of material.

Industry comment sought *regarding stockpile identification requirements.*

Assess each aggregate individually for potential alkali-aggregate reactivity in accordance with Clause 2.5.1.

Further requirements for the total combined aggregates are located in Clause 2.2.

Further requirements for fine aggregates are located in Clause 2.3.

Further requirements for coarse aggregates are located in Clause 2.4.

2.2 COMBINED AGGREGATES

Ensure that the particle size distribution of combined aggregates complies with Table R83.1.

The specified particle size distributions are based on materials of equal particle densities in a saturated surface dry condition. Where particle densities are unequal, adjust the specified combined particle size distribution accordingly.

The Principal may approve an alternative combined aggregate particle size distribution where:

(a) the variations are limited to the fractions retained on the 300 μm sieve and above, and;

(b) the proposal is in accordance with guidelines for alternative designs as detailed in User Guide CR83.

Provide the aggregate particle size distribution with the nominated mix submission.

Table R83.1 - Combined Aggregate Particle Size Distribution

AS sieve (mm/ μm)	Percent passing by mass
19.00	95 - 100
13.20	75 - 90
9.50	55 - 75
6.70	(45 - 62) (1)
4.75	38 - 50
2.36	30 - 42
1.18	22 - 34
600 μm	16 - 30
300 μm	5 - 15
150 μm	0 - 7
75 μm (2)	0 - 7 (3)
2 μm (3)	0 - 1.0 (3)

Notes:
1. Values in brackets are for guidance only. Provide actual values for research purposes but do not apply them for acceptance purposes.
2. Determined in accordance with AS 1141.12 (by washing).
3. Assess acceptance in accordance with Clause 2.3.

2.3 FINE AGGREGATE

Fine aggregate must have a size less than AS 4.75 mm sieve and comply with AS 2758.1 except as qualified hereunder:

(a) Table 3 is waived;

(b) Clause 8.2.1 is replaced by criteria in Table R83.2;

(c) Clause 8.2.2 is replaced by criteria in Table R83.2.

Determine the properties listed in Table R83.2.

Table R83.2 - Fine Aggregate Properties

Property	Test - individual or combined fine	Requirement	Test Method
Material finer than 75 μm	total combined (1)	Assess in accordance with Fig R83.1	AS 1141.112 (2)
Material finer than 2 μm	total combined (1)	Assess in accordance with Fig R83.1	AS 1141.13
Dominant clay type; < 2 μm fraction	total combined (1)	Assess in accordance with Fig R83.1	X-Ray Diffraction
Methylene Blue Adsorption Value (MBV)	composite	Assess in accordance with Fig R83.1	RMS T659
MBV75 (3) value	composite	Assess in accordance with Fig R83.1	NA
Bulk Density (compacted)	individual	1200 kg/m^3 minimum	AS 1141.4 Procedure 7.2
Water Absorption	individual	5.0% maximum	AS 1141.5
Soundness (sodium sulfate)	individual	5.0% max weighted average loss	AS 1141.24
Organic impurities	combined	Pass/Fail (AS1141) and 0.5% maximum (AS1289) (4)	AS 1141.34 and AS 1289.4.1.1(1)
Sugar content	combined	less than 1 part in 10,000	AS 1141.35
Micro-Deval loss	combined	15% maximum	ASTM D7428
Flow Cone time (5)	combined	27 seconds maximum	RMS T279
Hardness	combined microfines(6)	1000 kg/mm^2 minimum	Vickers Hardness Tester
Glass content	combined	30% maximum (7)	

Notes:

1. Test the fine component of the total combined aggregates (coarse and fine).
2. Determined in accordance with AS 1141.112 (by washing).
3. MBV75: the multipleproduct of the MBV and the passing 75 μm value.
4. Test initially under AS 1141. If the presence of organic impurities is indicated, test under AS 1289.
5. Flow Cone testing is not mandatory if the manufactured fine aggregate content is less than 20% by mass of the total fine aggregate.
6. Microfines are defined as the component passing the 300 μm and retained on the 75 μm sieve.
7. As a proportion of the total fine aggregate component.

Assess the fine fraction of the total combined aggregates in accordance with Figure R83.1.

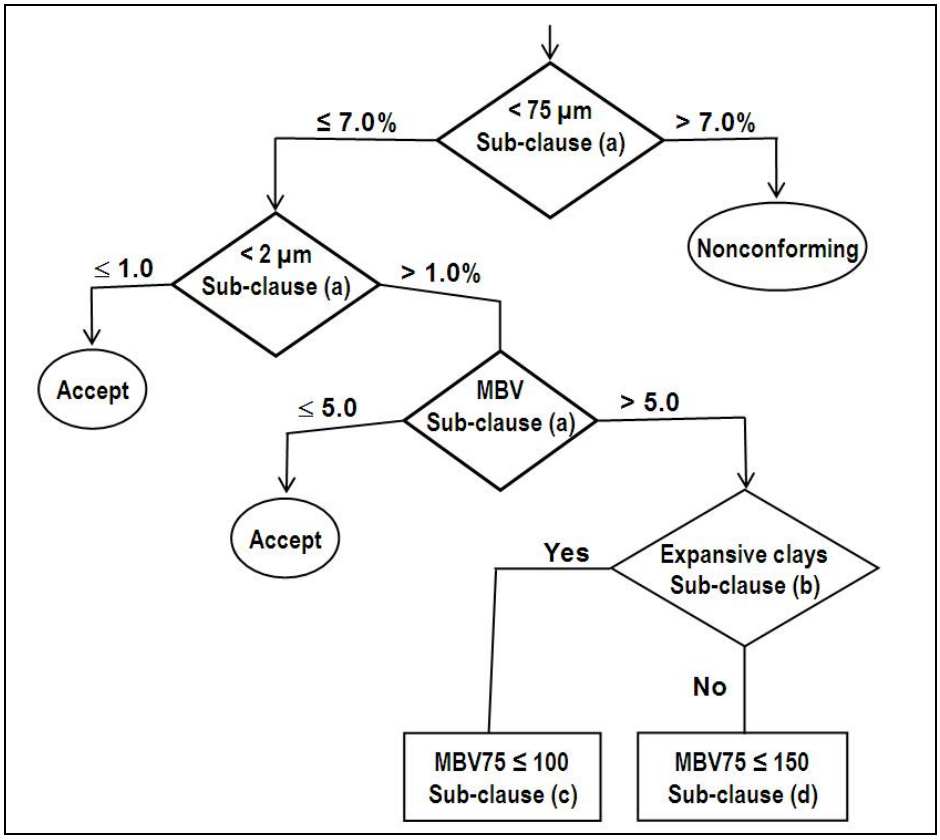


Figure R83.1 - Fine aggregate testing

(a) Test in accordance with Table R83.32.

(b) Assess the mineralogy of the clay fraction in accordance with Clause 2.5.2.

(c) If the clay fraction is deemed expansive, limit the MBV75 value to 100 maximum, otherwise;

(d) If the clay fraction is deemed not to be expansive, limit the MBV75 value to 150 maximum.

2.4 COARSE AGGREGATE

Coarse aggregate must comply with AS 2758.1 except as qualified hereunder:

(a) Table 1: waived;

(b) Clause 8.2.1: replace with the criteria in R83 Clause 2.2;

(c) Clause 8.2.2: replace with the criteria in R83.Clause 2.2.

The properties of the coarse aggregate must also comply with Table R83.3.

Table R83.3 - Coarse Aggregate Properties

Property	Test - individual or combined coarse	Requirement	Test Method
Bulk Density	individual	minimum 1200 kg/m^3	AS 1141.4
Particle Density	individual	minimum 2100 kg/m^3	AS 1141.6
Water Absorption	individual	2.5% maximum	AS 1141.6
For material > 9.50 mm: Particle shape, 2:1 and 3:1 ratios	individual	maximum 25% and 10%	AS 1141.14
For material ≤ 9.50 mm: The ratio AGD/ALD(3) for all fractions 2 mm to 9 mm. (4)	individual	*Maximum 2.25*	RMS T275 and T278
Wet Strength	combined	minimum 80 kN	RMS T215
Wet/Dry variation	combined	maximum 35%	RMS T215
Weak particles	combined	maximum 0.3%	AS 1141.32
Light particles	combined	maximum 1.0%	AS 1141.31
Fractured faces (2 or more) (1)	individual	minimum 80%	RMS T239
Alkali reactivity	individual	see Clause 2.5.1	RMS T363
Polished Aggregate Friction Value (PAFV)	individual	minimum 48	RMS T233
Foreign materials content	individual(5)	maximum 0.1%(5)	RMS T276
Coefficient of Thermal Expansion (CTE)(6)	individual	Report only(6)	AASHTO T336

Notes:

1. Testing can be waived for aggregate which has been extracted from igneous rock quarries by drilling and blasting.
2. RMS T239 Clauses 6.1, 6.2, 6.3, and 7(b) to (d) may be ignored.
3. Ratio of Average Greatest Dimension to Average Least Dimension.
4. In accordance with T278, carry out the test only where the number of aggregate particles in the group is ≥ 15% of the minimum 100 particle sample used to determine ALD.
5. Required only for a recycled aggregate component. The 0.1% limit relates to the proportion of the mass of that recycled aggregate component.
6. This value is for research purposes only and is not an acceptance criterion.

2.5 AGGREGATE TESTS

2.5.1 Alkali-Aggregate Reactivity (AAR)

Assess each aggregate individually for potential alkali-aggregate reactivity within 12 months prior to the date of closing of tenders.

AssessClassification for AAR potential using the accelerated mortar bar test RMS T363.

Determine the weighted AAR contribution of all aggregates in the mix on the basis of mass proportions. The total aggregate AAR potential is deemed to be twice the weighted AAR contribution.

Take action according to the total aggregate AAR potential in accordance with the classification shown in RMS T363 Table T363/A as follows:

(a) Non-reactive: no action is required;

(b) Slowly reactive:
- comply with 'Reactive AAR Class SCM' limits in accordance with RMS QA 3211/C, or;
- limit total alkalis in the mix to 2.1 kg/m^3.

(c) Reactive:
- comply with 'Reactive AAR Class SCM' limits in accordance with RMS QA 3211/C, or;
- demonstrate that the mix is 'Non-Reactive' when tested in accordance with RMS T364 using the nominated materials at the nominated proportions.

2.5.2 Assessment of the mineralogy of clays

Assess the mineralogy of the total clay fraction using X-Ray diffraction. Carry out the assessment using a laboratory which is quality accredited under ISO-9001.

Test as follows:

(a) sub-sample sufficient material to yield 50g of material less than 2 μm in size;

(b) disperse the quartered sample in water with the aid of deflocculants;

(c) allow the solution to settle to produce the <2 μm fraction by the pipette method;

(d) using the resulting dispersion, prepare oriented clay preparations on ceramic plates;

(e) air-dry the samples and treat with glycerol to confirm the presence of smectite;

(f) carry out an analysis by an X-Ray diffractometer trace and use the peak areas of the first order basal diffraction peaks of kaolinite, mica and glyceroled smectite and the second order basal diffraction peak of chlorite and their corrected areas summed to 100%.

Report the relative percentages of the following minerals/groups:

(i) smectite

(ii) mica (illite)

(iii) chorite

(iv) kaolinite

A clay is deemed to be expansive if it contains more than the nominated proportion of any one of the following components:

(A) 40% smectite;

(B) 50% mica;

(C) 60% chlorite;

(D) 70% kaolinite.

2.6 CEMENTITIOUS MATERIALS

Comply with RMS 3211.

2.7 ADMIXTURES

Chemical admixtures and their use must comply with AS 1478 but they must not contain calcium chloride. The following conditions also apply:

(a) For combinations of two or more admixtures, their compatibility must be certified in writing by the manufacturers.

(b) For mixes with less than 50 kg/m^3 fly ash, the total alkali contribution (measured as Na_2O equivalent) from all admixtures used in any mix must not exceed 0.20 kg/m^3.

(b) Provide details in the PROJECT QUALITY PLAN of the criteria for initiating changes in admixture type with season or ambient temperature. If the same admixture is proposed across seasons, provide dose rate charts for temperature change in the project Quality Plan. Additional trial mixes are not required if admixture dose rate changes are based solely on ambient temperature.

(c) Superplasticisers and high range water reducers Type HWRRe may be used in non-pavement applications such as anchors and subgrade beams.

Air entraining agents are mandatory in slipform paving mixes[1] and must ensure the concrete complies with Clause 3.7.

Industry comment sought

on justification for omitting the mandatory use of AEA.

1 Entrainment is not mandatory in non-pavement components such as anchors and subgrade beams, nor in fixed-form mixes.

2.8 CURING COMPOUND

See also Clause 4.3.7 regarding curing operations.

Comply with Table R83.4.

Table R83.4 – Curing Compound Properties

Description	Comply with AS 3799 class	Carbon Number[3]	Limitations
Hydrocarbon resin based	Class B with minimum 30% NV content [2]	C_5	Do not use aromatic hydrocarbon additions. May not give a suitable bondRequires a specialised primer if used under bitumen seal or asphalt. Do not use aromatic hydrocarbon additions.
Water-borne hydrocarbon resin	Class Z with minimum 30% NV content [2]	C_5	Requires a specialised primer if usedMay not give a suitable bond under bitumen seal or asphalt.
SBR (styrene butadiene resin)	Class Z	Not applicable	Requires a specialised primer if usedMay not give a suitable bond under bitumen seal or asphalt.
Bitumen emulsion	RMS 3254	Not applicable	
Blended bitumen and water-borne hydrocarbon	Class Z	C_5 (Hydro-carbon component)	To be compatible with the prime that will be applied later.
Wax emulsion [1]	Class A with minimum 30% NV content [2]	Not applicable	Do not use on the top surface. Use only for debonding of joints. Comply with RMS R82.

Notes:

1. Do not use on the top surface of the Base. Use only for debonding of joints.
2. Non-volatile content, when tested in accordance with AS 1580 Method 301.1

The following conditions also apply:

(a) incorporate a fugitive light-colored reflective dye for summer paving;

(b) if pigment or dye is added at site, incorporate and agitate it in accordance with the manufacturers recommended guidelines. Include the details as part of the Quality Plan;

(c) do not use permanent pigments on the finished surface.

Industry comment sought on

(i) possible challenges associated with mandating fugitive dyes in summer. For example, summer paving of CRCP which will have an AC surfacing; is a light-colored reflective compound feasible ?

(ii) It has been suggested that Column 1 in the above table should refer to paving temperature rather than months, but this would seem to increase the difficulty of remaining in conformity if the temperatures are fluctuating;

(iii) the suitability of C5, C7 & C9 compounds for different conditions.

For each nominated curing compound, certify by written report that the compound complies with this Specification and submit NATA endorsed test results with the report.

For compounds that are proposed to be used with pigments or fugitive dyes, also provide NATA test results to show that the compound meets the water retention requirements without the pigments or dyes.

A sample must be available for acceptance testing which is covered by the certification. This reference sample may be used on more than one project.

Attention is drawn to RMS R141 Clause 3.1 regarding adhesion of line marking.

2.8.1 Reference Sample

Test the reference sample for the following properties. Testing must be in accordance with AS 3799 and the results must comply with the tolerances specified therein.

(i) non-volatile content

(ii) the efficiency index

(iii) density

(iv) drying time

(v) viscosity

(vi) the infrared spectrum as determined in accordance with RMS T1005.

On the basis of these results, provide written certification (accompanied by the test results) that the reference sample complies with this Specification.

2.8.2 Initial Delivery

From the first delivery to the project, test a random sample for the following properties. Testing must be in accordance with AS 3799 and the results must comply with the tolerances specified therein.

(i) non-volatile content

(ii) density

(iii) drying time

(iv) viscosity

(v) the infrared spectrum as determined in accordance with RMS T1005.

On the basis of these results, provide written certification (accompanied by the test results) that the delivered batch has the same formulation as that of the reference sample.

2.8.3 Subsequent Deliveries

For all subsequent deliveries, provide written certification that each delivered batch has the same formulation as that of the initial delivery. The certification must be made on the basis of the manufacturer's Certificate of Analysis for uniformity of the following properties, with testing in accordance with AS 3799:

(i) non-volatile content

(ii) density

(iii) viscosity.

2.9 JOINT SEALANT

Joint sealant must be silicone sealant for casting insitu, complying with the requirements of Table R83.5.

You must:

(a) certify that the proposed sealant complies with this Specification;

(b) provide all relevant test results endorsed by an ISO 9001 certified laboratory whose Quality Management System is certified by a conformity assessment body [2] or by JAS-ANZ, except that JAN-ANZ certification is not required for RMS Test Methods T1192 and T1193.

(c) provide a full technical description (as part of the PROJECT QUALITY PLAN), including the method of installation recommended by the manufacturer.

Table R83.5 - Silicone Joint Sealants

Test Method	Attribute	Requirements
ASTM-D792 (Method A)	Specific gravity	1.1 - 1.55
ASTM-D2240 (Standard Curing)	Durometer hardness	10 - 25
ASTM-C603	Extrusion rate	90 - 250 g/minute
ASTM-C679	Tack free time	30 - 70 minutes
ASTM-C793	Accelerated weathering	No chalking, cracking, or bond loss at 5000 hours.
ASTM-C794	Adhesion to concrete	Minimum 35 N average peel strength.
RMS T1193	Accelerated Ageing	
RMS T1192	Adhesion to concrete	Pre-treatment as per RMS T1193. Extension to 70%, compression to 50%. Not more than 10% failure over the cross-sectional area.
(Not applicable)	Colour	Grey, compatible with pavement concrete.

2 ~ as defined in ISO 17000.

2.10 STEEL REINFORCEMENT

The reinforcement material supplier must be certified by the Australian Certification Authority for Reinforcing Steels (ACRS) for the supply of reinforcement material.

The reinforcement fabricator must be certified by the Australian Certification Authority for Reinforcing Steels for fabricating reinforcement and must implement and maintain a quality management system in accordance with AS/NZS ISO 9001 as a means of ensuring that the product complies with this Specification.

Steel reinforcement must comply with AS/NZS 4671. Reinforcement must be readily identified as to its grade and origin.

When galvanised bars are specified, the bars must be hot dipped in accordance with AS/NZS 4680.

2.11 WATER

Water used in the production of concrete must be free from materials harmful to concrete and reinforcement, and be neither salty nor brackish. The water must comply with AS 1379 Clause 2.7 and Table 2.2, Limits for Impurities in Mixing Water, with the addition of the following:

a) chloride ion: maximum 500 parts per million determined by AS 1478.1 Appendix C.

b) sulfate ion: maximum 400 parts per million determined by AS 1289.4.1.2.

Mixing water which is drawn solely from a reticulated drinking water supply, is deemed to comply.

If the mixing water contains a component from a source other than a reticulated drinking water supply, test all sources. Ensure that the combined mixing water complies with the above criteria.

Refer to Clause 3.7 for testing requirements.

Limits on total soluble salt content for the concrete mix are detailed in Clause 3.7.

3 DESIGN

3.1 GENERAL

Construct the Works in accordance with the Drawings:

In plain concrete pavement (PCP), steel reinforcement is only used in special slabs, in anchors and in joints (as tiebars and dowels). Typically in NSW, longitudinal joints are tied and transverse joints are not dowelled.

In jointed reinforced concrete pavement (JRCP), steel reinforcement is used in all slabs, in anchors and in joints (as tiebars and dowels). Typically, longitudinal joints are tied and transverse joints are dowelled.

In steel-fibre reinforced concrete pavement (SFCP), mesh reinforcement is only used in special slabs, in anchors and in joints (as tiebars and dowels). All slabs contain steel fibre reinforcement, longitudinal joints are typically tied and transverse joints are not dowelled. Refer to Annexure R83/F for additional SFCP requirements.

The Principal may alter the 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 are not entitled to any additional payment over and above payment at the scheduled rate.

3.2 SURVEY AT THE TOP OF THE UNDERLYING LAYER

3.2.1 Survey Prior to Placing Base

The base invert level is the level at the top of the subbase including the thickness of any debonding treatment. Determine the base invert level as follows:

(i) for LCS where the base and subbase are constructed under the same contract:
- in accordance with RMS R82;

(ii) for LCS which was constructed by others:
- by survey jointly between you and the Principal, in accordance with RMS G71;

(iii) for subbases other than LCS:
- in a manner consistent with criteria contained in R82.

Where you choose to undertake additional survey testing on the subbase, this need not be repeated on the base.

Survey the levels using a flat based staff of base area between 300 mm^2 and 4000 mm^2, at a spacing of 10.0 m longitudinally and at the cross-section offsets shown in Figure R83.2, with a tolerance of 0.5 m. Report the levels to the nearest millimetre.

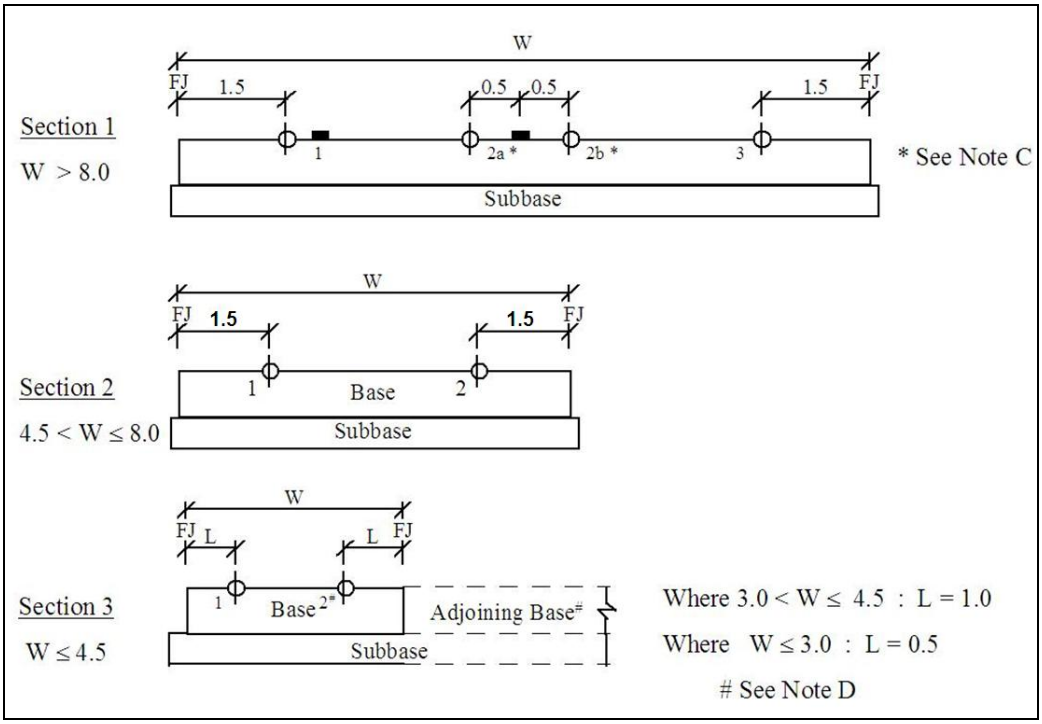


Figure R83.2 - Survey locations
(not to scale)

Notes:

A) All dimensions are in metres (m).

B) Induced longitudinal joints should be ignored for the purpose of locating survey points and are not shown in Figure R83.2.

C) In Section 1, you must nominate to take survey either at point 2a or 2b.
D) In Section 3, delete survey point 2 adjoining previously placed base.
E) 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.
F) Key: FJ - Formed joint or edge
W - Paving width between formed joints or edges
■ - Lane lines
ϕ - Survey points

3.2.2 Survey Report Prior to Placing Base

Prior to base paving, submit a Survey Report complying with RMS G71 and highlighting all locations where the actual level is higher than the contract level.

3.2.3 Thickness of the Surface Debonding Treatment

For the purpose of determining survey levels, the initial curing compound is deemed to have nil thickness.

Where the surface debonding treatment comprises additional application(s) of curing compound without aggregate, the treatment is deemed to have nil thickness for the purpose of determining survey levels.

Where the surface debonding treatment over LCS comprises a sprayed bituminous seal, the thickness of the treatment is taken as the Average Least Dimension (ALD) of the cover aggregate, determined in accordance with RMS R106. Add this thickness to the levels determined at the top of LCS. The resultant levels are regarded as the bottom level of the base for the purpose of determining its thickness.

Where the subbase is other than LCS, determine the bottom level of the base by survey using a flat based staff of base area between 300 mm^2 and 4000 mm^2 on the surface over which base will be paved.

3.2.4 Redesign of Pavement Levels

In the case of low nonconforming levels, redesign to lower levels will not be allowed.

In the case of nonconforming levels which are high, you may locally redesign the pavement levels in accordance with the following criteria and submit the redesign to the Principal for approval.

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

(i) The rate of level change on any longitudinal profile string, calculated relative to the approved contract 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 2.0 per cent may be varied within the range 2.0 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 base and subbase are constructed under the same contract, you are not entitled to additional payment as a consequence of local redesign.

Apply a Hold Point to base paving if any high levels exist within the schedule.

HOLD POINT	
Process Held:	Paving of base, if high invert levels exist.
Submission Details:	Schedule of base 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.

3.3 MIX PARTICLE SIZE DISTRIBUTION

Comply with Clauses 2.1 to 2.5.

3.4 CEMENTITIOUS CONTENT

Comply with RMS 3211 Annexure D.

3.5 STRENGTH

Table R83.6 lists the minimum requirements for compressive and flexural strength at 28 days, together with qualifying requirements for moulding and testing.

For CRCP mixes, the flexural strength in the Trial Mix must not exceed 6.5 MPa.

Table R83.6 - Minimum Concrete Strengths

Description		Compressive Strength	Flexural Strength [2]
Non-SCM Mixes[3]	**In the Trial Mix**	45.0 MPa (F_{28Min})	5.0 MPa (F_{f28Min})
	In the Works	40.0 MPa (f_{cMin})	4.8 MPa (f_{fMin}) [1]
SCM Mixes[3]	**In the Trial Mix**	40.0 MPa (F_{28Min})	4.8 MPa (F_{f28Min})
	In the Works	35.0 MPa (f_{cMin})	4.5 MPa (f_{fMin}) [1]
Test specimen size		cylinder 100 mm diameter	beam 100 × 100 × 350 mm
Test methods		AS 1012.8 except: RMS T304 for moulding. AS 1012.9 for testing	AS 1012.8 except: RMS T304 for moulding. AS 1012.11 for testing

Notes:

1. Specified only for process control, not specified for Lot acceptance. For SFCP, refer to Clause 6.6.
2. Applicable to base pavement mixes only. Not applicable to non-pavement mixes such as anchors and kerbs.
3. SCM: Mixes containing supplementary cementitious material(s). See RMS 3211 Annexure 3211/D.

3.6 CONSISTENCE

Determine the consistence of the concrete by measuring the slump in accordance with AS 1012.3 Method 1.

Nominate a slump for each concrete mix that best suits the equipment to be used and within the ranges as follows:

(a) for fixed-form (manual) (fixed-formed) paving: 50 - 70 mm;

(b) for slipform paving, except as provided under (c): 15 - 50 mm;

(c) for paving in transition zones: 15 - 70 mm.

The nominated slump must be within ± 5 mm of the slump as measured in the trial mix batch under Clause 3.8.1.

The slump adopted must allow the production of a dense, non-segregated base with minimal bleeding. Bleed water must not form in sufficient quantity to flow over the slab edge.

For slipform concrete mixes, the Vebe reading must not exceed three seconds in the trial mix in accordance with AS 1012.3 Method 3.

Industry comment sought *regarding Vebe limit*

3.7 OTHER ATTRIBUTES

3.7.1 Shrinkage

Prepare and test concrete specimens in the Trial Mix in accordance with AS 1012.13.

Shrinkage of the concrete specimen after either of the 3 or 8 weeks' drying periods must conform to Table R83.7. Conformance is required at only one age. If the result at 3 weeks is nonconforming, the test may be extended to 8 weeks.

Table R83.7 - Maximum Shrinkage Strain

Mix type	Maximum shrinkage strain (microstrain με)[1]	
	Drying period	
	3 Weeks	8 Weeks
GGBFS mixes[2]	580	680
Other mixes	450	580

Notes

1. To be tested only in the trial mixes.
2. For the purpose of this clause, a GGBFS mix is defined as having a minimum of 40% GGBFS (by mass).

3.7.2 Other

Limits on other concrete attributes apply in accordance with Table R83.8.

Total contents for chloride and sulfate ions in the combined mix must be determined by one of the methods in Clause 3.7.3.

Limits on mixing water are detailed in Clause 2.11.

Table R83.8 - Other Concrete Attributes

Attribute	Test Method	Requirement
Compaction	Clause 5.2	Relative compaction 98.0% minimum
Chloride ion content	Clause 3.7.3	0.8 kg/m^3 maximum per cubic metre of concrete
Sulfate ion content	Clause 3.7.3	5% maximum relative to cement mass (5)
Air content of fresh concrete (3)	AS 1012.4.2, with compaction by internal vibration (2)	4.5 ± 1.5 %
Bleeding (1)	AS 1012.6, with compaction by internal vibration	3% maximum
Coefficient of Thermal Expansion (CTE) (1)	AASHTO T336: Standard Method for the Coefficient of Thermal Expansion of Hydraulic Cement Concrete	Report only (4)

Note:

1. To be tested only in the trial mixes.
2. Use the same vibration pattern and durations as for cylinders in accordance with RMS T304.
3. Entrainment is not mandatory in non-pavement applications such as anchors and subgrade beams. Testing is only required on entrained mixes.
4. This value is for research purposes only and is not an acceptance criterion.
5. Calculate the sulfate ion content relative to the cement mass, ie excluding supplementary cementitious materials such as fly ash and slag.

3.7.3 Chloride and sulfate content testing

The two methods for testing chloride and sulfate 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 1478.1 Appendix C for water and admixtures dissolved in water;

then calculate the total content.

(ii) Conduct sulfate 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, 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.

(b) Test Method for hardened concrete:

Conduct chloride and sulfate testing in accordance with AS 1012 Part 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 to 0.02 N. Use the Volhard method calibrated using a concrete with known chloride content for the test.

3.8 NOMINATED CONCRETE MIXES

3.8.1 Submission of Nominated Mixes

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

(a) conduct trial mixes[3] to demonstrate that the proposed mix designs comply with this Specification;

(b) certify that each nominated mix and its constituents meet the requirements of this Specification;

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

(d) submit a copy of a verification checklist covering items listed below;

(e) specify the nominated slump for each mix within a tolerance of ± 5 mm of the trial mix value.

Trial mixing must comply strictly with your proposals under Clause 4.2 for batching and mixing, including the dilution and incorporation of admixtures, and the sequence of addition of materials.

The date of testing of both the trial mix and the aggregates must be within eighteen months prior to paving work. If sufficient production mix results are available from within this period, the Principal may reduce the scope of the trial mix.

To determine the compressive strengths F_7 and F_{28} for each trial batch, test a minimum of three specimens at age seven days and a minimum of three specimens at age 28 days. Specimens must comply with Clause 3.5, with compaction by internal electric vibration. F_7 and F_{28} are the average of all individual results not more than 2.0 MPa from the median value at each age.

To determine the flexural strength for each trial batch, test a minimum of three specimens at age 28 days and a minimum of three specimens at age seven days. Specimens must comply with Clause 3.5, with compaction by either internal electric or table vibration. The flexural strengths F_{f28} and F_{f7} are the average of all individual results not more than 0.5 MPa from the median value at each age.

To determine the indirect tensile strength for each trial batch of base, test a minimum of three specimens at age 28 days. Notwithstanding the requirement of AS 1012.8 Clause 1.5.2(b)(iii), specimens must be 100 mm diameter cylinders which comply with the requirements for compressive

3 Where a higher slump mix is proposed under Clause 3.6(c) for use in transition zones, it may be considered to be covered by the slipform trial mix.

strength specimens under Clause 3.5, with compaction by internal electric vibration. The indirect tensile strength F_{t28} is the average of all individual results not more than 0.5 MPa from the median value. The indirect tensile strength will not be used for conformity purposes.

HOLD POINT

Process Held:	Production of each concrete mix.
Submission Details:	Submit the statement and attachments referred to in Clause 3.8.1 at least five working days before commencing production.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising release of the Hold Point.

WITNESS POINT

Process Witnessed:	Trial mix.
Submission Details:	Submission of notice of time and location of mixing at least two working days before mixing.

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 alkali-reactive materials in accordance with Clause 2.5.1, and soluble salt content in accordance with Clause 3.7.3.

(ii) Mix Design:

- (A) Constituent quantities, per yielded cubic metre of concrete.
- (B) Nominated particle size distribution of aggregates, including fine, coarse and combined particle size distributions.

(iii) Test Results for a laboratory trial batch (or batches): for each nominated mix (Clauses 3.3 to 3.7), determined at the nominated a slump with a trial mix tolerance of ± 10 mm which complies with Clause 3.6. and showing Results must demonstrate conformity for:

- (A) cement content and fly ash content per yielded cubic metre of concrete;
- (B) compressive strength at age seven days (F_7);
- (C) compressive strength at age twenty eight days (F_{28});
- (D) flexural strength at age seven days (F_{f7});

(E) flexural strength at age twenty eight days (F_{f28});

(F) indirect tensile strength at age twenty eight days (F_{t28});

(G) drying shrinkage at an age in accordance with Clause 3.7.1;

(H) Vebe reading;

(I) air content;

(J) bleeding;

(K) Factors AF in accordance with Clause 5.3.5. Derivation of AF is optional but, where adopted, it must be notified as part of the trial mix submission. For ages beyond 28 days, report the results progressively as they become available.

Mould all test specimens using test methods in accordance with Clauses 3.5, 3.6 and 3.7.

Where it is impractical to mould all specimens from a single batch, prepare two batches of the trial mix, and mould the test specimens as follows:

Batch No	Specimen grouping from item sub-clauses above
1	(A) to (G) inclusive
2	(H) to (K) inclusive, and (C)(1)
Notes. 1. Repeat item (C) in order to demonstrate between-batch consistency.	

Report the unit mass for all specimens tested under items (B), (C), (D), (E) and (F), using test methods specified in Clauses 4.2.1 and 5.2.1.

Test results must certify that the specimens were prepared specifically in accordance with this Specification and using vibration as stipulated above.

3.8.2 Variations to Authorised Nominated Mixes

You may vary the authorised nominated mix without submitting a new 'nominated mix', unless the proposed variations exceed the following amounts:

(a) Cement and other cementitious material: 10 kilograms per cubic metre for each material, providing the requirements of Clause 3.4 are still met.

(b) Five per cent by mass of each other constituent except admixtures and water.

(c) Admixture dosages in accordance with Clause 2.7.

(d) Water, unspecified.

Notify the Principal of such variations to an authorised nominated mix before commencing production with the varied quantities. A new variation to an authorised mix will automatically cancel all previous variations.

If you wish 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 3.8.1.

4 PROCESS CONTROL

4.1 PLACING STEEL REINFORCEMENT

4.1.1 General

In CRCP, place reinforcement as shown on the Drawings. Longitudinal steel must be placed on top of transverse steel.

In other Base formats, reinforce the concrete as shown on the Drawings, including special slabs (Clause 4.7). Reinforced PCP slabs are designated as PCP-R. Unless shown otherwise on the Drawings, place steel mesh reinforcement as follows:

(a) within 80 mm ± 20 mm of the finished top surface of the base slab

(b) clear of all joints and edges by 80 mm ± 20 mm.

Support the reinforcement in position using concrete, plastic or wire chairs. Do not use timber or pieces of aggregate to support reinforcement. Do not use a support chair which is likely to impede compaction of the enveloping concrete. Ensure that any enclosed perimeter of the bar chair side elevation has at least 25% voids, with a minimum gap in the chair below the reinforcement of 1.5 times the maximum nominal size aggregate in the concrete mix.

The arrangement and spacing of chairs must be such that the reinforcement is supported in its proper position with permanent deflection or displacement of the reinforcement of no more than 2 mm during placing and compaction of the concrete. The chairs must also have sufficient bearing at their base to prevent overturning. Chairs must be capable of supporting a 200 kg mass without permanent distortion in excess of 2 mm.

The mass of reinforcing steel supported by any one chair must not exceed 10 kg. In CRCP, place the support chairs under the transverse steel using a systematic pattern such that the spacing between any two adjacent chairs does not exceed 0.90 m in either the longitudinal or transverse direction.

HOLD POINT

Process Held:	Placement of concrete around steel reinforcement.
Submission Details:	A certificate of compliance signed by you covering the installation of reinforcement and embedments.
Release of Hold Point:	The Principal will consider the submitted documents and may inspect the work prior to authorising release of the Hold Point.

4.1.2 Tiebars [4]

Tiebars must be a minimum length of 1.0 m. Drill-ties must be a minimum length of 750 mm.

The method of insertion of tiebars must provide for:

(a) no disturbance to the finished concrete surface;

(b) full reinstatement of the structural integrity of the affected slab;

4 Also referred to in some documents as "tie bars".

(c) in fixed-form paving, vibration of all tiebars in their final position by either internal vibration or by vibrating screed board;

(d) an anchorage strength of at least 85 per cent of the bar's yield strength;

In longitudinal tied joints, place tiebars:

(i) within the central third of the slab depth but with a minimum vertical clearance of 30 mm to any crack inducer or sawcut;

(ii) not closer than 300 mm to a transverse untied joint (contraction or isolation joint);

(iii) not closer than 200 mm to a transverse tied joint;

(iv) at spacings as shown on the Drawings, with a tolerance of ± 20% on the spacing of individual bars, subject to the provision of the specified number of tiebars per slab.

In transverse tied joints of jointed bases, place tiebars not closer than 200 mm to a longitudinal joint or slab edge.

Conduct testing for tiebar location, anchorage and concrete compaction, as follows:

4.1.2.1 Pull-out Testing

For tiebars which have been inserted (in lieu of pre-placement) into a formed slab edge (either slipformed or fixed-formed[5]), test for anchorage strength.

Undertake testing within 30 days of paving.

Tiebars must be capable of withstanding a tensile pull-out stress equal to 85 per cent of their yield stress. Terminate the testing at the 85 per cent level.

Undertake pull-out testing at the following minimum frequency for each inserter[6], independent of transverse construction joints, and commencing 5 m from the project start of base paving:

(i) One test per 20 m of joint until four consecutive conformities are achieved, and thereafter

(ii) at a rate of 1 per 50 m of joint until a further four consecutive conformities are achieved, and thereafter

(iii) at a rate of 1 per 100 m of joint.

Test a minimum of five bars in any paving trial.

If a nonconformity is encountered at any stage of the test, consecutive bars must be tested alternately each side of the failed bar until four consecutive tests are performed without failure. Testing then reverts to frequency (i).

Replace nonconforming bars by using a suitable epoxy or polyester setting system to develop an anchorage strength of at least 85 per cent of the yield strength of the bar. Bar replacement must not disturb the concrete surface. Test the replaced bars at a minimum frequency of 1 in 2.

---

5 Pull-out testing is not required in fixed-form paving if the tiebars are pre-placed and are subjected to internal vibration.

6 If tiebars are inserted on both sides of a paving run, test each side at the specified frequency.

4.1.2.2 Location and Compaction Testing at induced joints

For tiebars which have been inserted (instead of pre-placement) at induced joints, test for location conformity using a metal detector and take cores to ensure that the method of placement provides full compaction of concrete around and above the bars:

(i) For location:

(A) In the paving trial: every bar, and thereafter;

(B) at a minimum frequency equal to that for anchorage testing as detailed above.

(ii) For compaction:

(A) In the paving trial: one core per 40 m of joint, or part thereof.

(B) Elsewhere: one core per 400 m of joint.

Where two or more inserters are used, the frequencies under (i) and (ii) apply to each inserter.

Cores must be located to intersect a tiebar but must be offset from the longitudinal joint by 250 mm ± 100 mm and must not be closer than 1.5 m to a transverse contraction joint nor 3.0 m to a transverse construction joint.

Compaction must be tested and assessed in accordance with Clause 5.2, except that Clause 2 of Test T368 is replaced by the following requirement:

"All voids which exceed 5.0 mm in any direction must be fully filled."

Include the results in the assessment of Lot conformity under Clause 5.2.

4.1.3 Dowels

Dowels must be installed ahead of paving and must:

(a) comply with AS 3679.1 and be galvanised in accordance with AS/NZS 4680.

(b) be straight and free of irregularities, including burrs and protrusions, which could hinder their movement in accordance with this Specification.

(c) be coated at one end with a tough, durable debonding agent of thickness 0.75 mm ± 0.25 mm over a minimum length of 275 mm. At formed joints, the debonding must be within the second-placed slab.

(d) when tested in accordance with RMS T366, have an average bond stress not more than 0.15 MPa.

(e) at expansion joints, have the debonded end capped to provide a clearance for movement equal to the width of the joint plus 15 mm (± 5 mm).

(f) unless otherwise shown on the Drawings, be placed at mid-depth ± 20 mm, parallel to the pavement surface and normal to the line of the joint with tolerances as given below.

(g) be supported so that no part of the assembly, except the dowel, crosses the joint. Submit details of the proposed dowel support system and the method of debonding as part of the PROJECT QUALITY PLAN.

(h) be 450 mm long and be aligned parallel with the line joining the centroids of the adjacent slabs, unless otherwise shown in the Drawings.

(i) be equally positioned about the line of the intended joint within a tolerance of ± 25mm.

(j) be placed not closer than 150 mm to a longitudinal joint or slab corner.

Prior to placing concrete, the alignment tolerance of individual dowels at any location as measured in the dowel assembly is ± 2 mm for two thirds of the dowels within a joint.

The alignment tolerance on dowel location in the finished slab is ± 3 mm.

4.1.4 Testing general

Confirm the location of reinforcement and dowels within the finished pavement using a metal detector. Do not take cores for this purpose except as required under Clause 4.1.2.2 or unless approved by the Principal.

Where testing frequencies have not been specified, nominate your proposed testing frequency in accordance with Q6 Clause 8.1.2.

4.1.54 Protective Coatings

Do not use protective coated reinforcement unless otherwise specified in the contract documents.

4.1.65 Bending

Bend the reinforcement in accordance with Clause 17.2.3.1 of AS3600. Bend without impact or damage to the bar either by cold bending around pins or by applying uniform heat not exceeding 450°C to, and beyond, the portion to be bent. Heated bars must not be cooled by quenching.

Reinforcement already bent and straightened or bent in reverse must not be bent again within 20 bar diameters of the previous bend.

Reinforcement partially embedded in concrete may be field bent provided that the bending complies with the above requirements and the bond of the embedded portion is not impaired as a result of bending.

The nominal internal diameter of a reinforcement bend or hook is taken as the external diameter of the pin around which the reinforcement is bent. The diameter of the pin must be not less than the value determined from Table R83.9.

Submit details as part of the PROJECT QUALITY PLAN any proposal to bend anchor stirrups to facilitate slipform paving.

Table R83.9 - Internal Diameter of Bend and Hooks

Type of bar	Minimum internal diameter of bend
(a) Normal bends	
Fitments: bar grade 250 and wire grade 450	$3d_b$
Fitments: bar grade 500	$4d_b$
Bars other than in (b) and (c) below	$5d_b$
(b) Bends designed to be straightened or re-bent subsequently	
$d_b \leq 16$ mm	$4d_b$
$d_b = 20, 24$ mm	$5d_b$
$d_b \geq 28$ mm	$6d_b$
(c) Bends in reinforcement epoxy coated or galvanised either before or after bending	
$d_b \leq 16$ mm	$5d_b$
$d_b \geq 20$ mm	$8d_b$
Notes.	
1. d_b is the nominal diameter of a bar or wire	

4.1.76 Welding

All welding must comply with the requirements of RMS B204. For Grade 500 bars the welding procedure must comply with the bar manufacturer's recommendations for control of heat input. In welded splices, bars may only be welded by an electrical method. The welded splice must meet requirements of tensile and bend tests specified for the parent metal.

4.1.87 Lapped Splices

The minimum length of lapped splices is in accordance with Clause 13.2 of AS 3600, unless shown otherwise on the Drawings:

Lapped bars splices not shown in the Drawings must have lengths not less than the values listed in Table R83.10.

Table R83.10 - Splice Lengths

Bar type	**Bar diameter** (mm)	**Splice length** (mm)
Deformed	12	450
	16	600
	20	750
	24	900
	28	1050
	32 & 36	1200
Plain (fitment)	d_b < 13 mm	50 d_b or 300 mm whichever is the greater
Notes 1. Where db is the nominal diameter of a bar or wire.		

Splices in reinforcing fabric must comply with Clause 13.2.3 of AS 3600 such that the two outermost transverse wires of one sheet overlap the two outermost transverse wires of the lapping sheet. The orientation of the sheets must be such that they mechanically engage each other (that is, the bottom sheet has transverse wires uppermost and the top sheet has them underneath).

The ends of bars forming a lapped splice must be welded or securely wired together in at least two places.

4.1.98 Mechanical Splices

Mechanical splices must be of the type specified or an approved equivalent and used only at the locations shown in the Drawings. Install the splices in accordance with the manufacturer's recommendations.

When tested in tension or compression, mechanical bar splices must develop at least the nominal ultimate tensile or compressive strength of the smaller of the bars being tested.

4.1.109 Storage

Support reinforcement above the surface of the ground and protect it from damage and deterioration due to exposure.

4.1.110 Surface Condition

At the time concrete is placed, the steel must be free from loose or thick rust, grease, tar, paint, oil, mud, mortar or any other coating, but must not be brought to a smooth polished condition. Its surface condition must not impair its bond to the concrete or its performance in the member.

4.2 PRODUCTION AND TRANSPORT OF CONCRETE

The production and transport of concrete must:

(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 specified compaction and surface finish requiring only nominal manual finishing.

For slipform 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 of one metre per minute with adequate allowance for mixer efficiency and control testing.

4.2.1 Production Mixes

For producing a concrete mix, always target the nominated mix. Table R83.11 shows the allowable tolerances on individual loads.

The mean content of each cementitious material within a Lot must be not less than that of the authorised nominated mix (after compliant variations in accordance with Clause 3.8.2).

Maintain and monitor a Batching Record which records the actual masses of each ingredient in every batch, together with departures beyond the allowable tolerances. Do not incorporate nonconforming batches or loads into the Works.

Determine the combined aggregate particle size distribution by the following methods:

(a) Test Method A - by calculation:

Determine a separate particle size distribution for each constituent aggregate, and calculate the combined particle size distribution from the nominated mix proportions.

(b) Test Method B - by wet-sieving:

Determine the combined particle size distribution by wet-sieving of the production mix for the fractions coarser than the 1.18 mm sieve.

For the fraction passing the 1.18 mm sieve, adopt the most recent result obtained using Method A.

ref frequencies

Table R83.11 - Production Tolerances

Description	Tolerance (% by mass)
Aggregate Particle Size Distribution: (AS sieve)	
19.00 mm	± 2
13.20 mm	± 5
9.50 mm	± 5
4.75 mm	± 3
2.36 mm	± 5
1.18 mm	± 5
600 μm	± 5
300 μm	± 5
150 μm	± 2
75 μm	± 0.5%
Cementitious material (of each type):	± 3.0 (1)
Admixtures:	unspecified
Water:	unspecified
Notes 1. Subject to compliance of the mean for the Lot, as specified above.	

For the purpose of this clause, concrete delivered by agitators is considered to be of a different mix to that delivered by tippers.

Clauses 4.2.1.2, 4.2.1.3 and 4.2.1.5 do not apply to SFRC. For SFRC, refer to Clause 6.6.

4.2.1.1 7-Day Compressive Strength

Undertake 7-day compressive strength testing at the same frequency as specified for 28-day compressive testing in accordance with Clause 5.3.

Whenever the 7-day compressive strength requirements are not met, submit the results to the Principal with an assessment report and an assignable cause within two working days of testing.

The 7-day compressive strength requirements will be met if the five point rolling mean compressive strength is not less than the following lower warning limit (LWL):

$$\text{LWL} = \frac{F_7}{F_{28}} \times f_{cMin} + s_{30} \qquad \text{MPa}$$

where:

F_7 is the 7-day compressive strength in the trial mix (reference Clause 3.8.1)

F_{28} is the 28-day compressive strength in the trial mix

f_{cMin} is as specified in Clause 3.5.

s_{30} is the standard deviation.

When production results become available for f_c and f_{c7}, replace the factor F_7/F_{28} by f_{c7}/f_c . This must be done initially on receipt of 30 test values and thereafter at your discretion, but no less frequently than with each group of 30 new values.

Prior to 30 test values becoming available, adopt a value of $f_{cMin}/10$ for s_{30}. Thereafter, calculate s_{30} as the rolling standard deviation for 7-day strength of not fewer than 30 test values.

Your target value must not be less than $2s_{30}$ above the lower warning limit.

4.2.1.2 Frequency of Moulding of Flexural Test Specimens

For SFRC, refer to Clause 6.6.

Flexural strength requirements apply to base pavement mixes, including shoulders. They do not apply to non-pavement mixes for applications such as anchors and kerbs.

Mould flexural test specimens in sets of three. Mould all specimens within a set from the same sample of concrete, and mould flexure specimens from batches[7] of concrete from which cylinders are moulded for 28-day compressive strength under Clause 5.3.2.

In the paving trial, mould the 7-day and 28-day flexure sets from the same batch[7].

Specimens must be moulded for each concrete mix at the minimum frequencies listed in Table R83.12 and procedures must be in accordance with Table R83.6.

7 This will require care in sampling if a load comprises more than one batch.

Table R83.12 - Minimum Frequency of Flexural Test Specimens

	Minimum Frequency (Sets)	
		28-day testing
Paving Trial	As per Clause 4.4	
and thereafter		
from the first three Lots using that mix (1)		1 per Lot
and thereafter		
for daily outputs ≤ 200 m^3		1
for daily outputs > 200 m^3		1 per 400 m^3
Note: 1. The Lots are those determined in accordance with Clause 1.3.		

4.2.1.3 Flexural Test Specimens

For SFRC, refer to Clause6.6.

The flexural strength (f_f) of the concrete represented by a set of specimens moulded from one sample is the mean of individual results not more than 0.5 MPa from the median value.

Sampling must be in accordance with AS 1012.1. For agitator delivered concrete, sampling must take place at the point of discharge after all retempering.

Test specimens for determining the flexural strength of concrete must be standard beams of nominal size 100 × 100 × 350 mm complying with Clause 3.5.

Mould all specimens within a set from the same sample of concrete, with compaction by internal or table vibration.

Specimens must be moulded in accordance with Table R83.6 and inspected, conditioned and tested in accordance with AS 1012.11.

Determine the unit mass of all 28-day flexure test specimens at age not less than 7 days in accordance with AS 1012.12 Method 2, amended as follows:(i) Mass testing must be in the saturated-surface-dry condition and without dressing of voids; (reference RMS T368).

(ii) The unit mass for a set of beams is the average of results not more than 20 kg/m^3 from the median value. Round the average to the nearest 10 kg/m^3.

Report unit mass results for flexure specimens regularly to the Principal but do not use the results in the calculation of the RCUM.

4.2.1.4 Assessment of 28-day Flexural Strength

For SFRC, refer to Clause 6.6.

Make a statistical check of the flexural strength of each nominated pavement mix using consecutive 28-day test results.

Should any specimen be tested more than 28 days after moulding, the equivalent 28-day flexural strength is the flexural strength divided by the relevant factor AF applicable to the age of the specimen at the time of test as specified in Clause 5.3.5.

Calculate the five point rolling mean for flexural strength and standard deviation for each group.

Assess the results in accordance with Table R83.13. Take action as follows if the rolling mean flexural strength falls below f_{fMin} or the rolling standard deviation exceeds 0.5 MPa:

(i) 0.95 f_{fMin} less than or equal to 28-day rolling mean flexural strength less than f_{fMin}:

Promptly implement corrective action to ensure conformity as specified.

(ii) 28-day rolling mean flexural strength less than 0.95 f_{fMin}:

Observe the Hold Point specified.

(iii) 28-day rolling coefficient of variation greater than 11.0%:

Industry comment sought regarding the proposed 11.0% limit.

*Comment from wkshp: outliers need to be removed prior to analysis.

Promptly implement corrective action to ensure conformity as specified.

Submit test results to the Principal within two working days of testing.

4.2.1.5 Process Control Charts

Develop process control charts in accordance with AS 3940 and AS 3942 for the parameters listed in Table R83.13 for each nominated pavement mix in use (excluding non-pavement mixes such as anchors and kerbs).

For the purpose of charting under this clause, the process mean $\overline{\overline{X}}$ is defined in Clause 1.5.

Analysis is to be generally in accordance with AS 3942 Section 5, except that the decision rules shown in the above table must be followed for the identification of assignable causes that require corrective action.

Take corrective action also regarding your system if:

(a) tests are not carried out at the required frequency, or

(b) the results are not recorded and/or reported within the specified time.

A Hold Point applies on the use of the relevant concrete mix if:

(c) the rolling mean 28-day compressive strength falls below the specified minimum, or

(d) the rolling mean 28-day flexural strength falls below the specified minimum, or

(e) corrective action is not promptly implemented.

HOLD POINT	(Where specified above)
Process Held:	Use of a concrete mix in pavement base.

Submission Details:	Results for compressive and flexural strength, relative compaction and thickness for the same Lot. The proposal for corrective action to achieve conformity.
Release of Hold Point:	The Principal will consider the submitted documents and will release the Hold Point when appropriate Corrective Action has been implemented.

Following release of the Hold Point, monitor the 7-day strength and submit the results to the Principal with an assessment report within two working days of testing.

Table R83.13 - Control Charts

Parameter	Control chart requirements		
	Chart types and controls	Specifications and criteria	Decision rules [2]
7-day compressive strength	(a) Mean chart, showing:	As per AS 3942 Clause 4.3.2.	
	- target value	See Note 5.	
	- Lower warning limit	As per Clause 4.2.1.1.	
	- 5-point rolling mean	As per Clause 4.2.1.1.	A
28-day flexural strength [8]	(a) Mean chart, showing:	As per AS 3942 Clause 4.3.2.	
	- target value	See Note 5.	
	- Lower warning limit	As per AS 3942 Clause 4.3.2 and Note 7.	
	- specified limits	As per Clause 4.2.1.4.	
	- 5-point rolling mean	As per Clause 4.2.1.4.	B
	(b) Coefficient of variation chart, showing:		
	- Upper warning limit	9.0%	
	- specified limit	As per Clause 4.2.1.4	
	- 5-point rolling coefficient of variation	As per Clause 4.2.1.4.	B
Cylinder unit mass	(a) Mean chart, showing:	As per AS 3942 Clause 4.3.2.	
	- Lower warning limit	LWL = RCUM in the paving trial, less 30 kg/m^3.	
	- RCUM for the paving trial(s)		A
	(b) Standard deviation chart, showing:	As per AS 3942 Clause 4.3.4.	
	- 10-point rolling standard deviation		
	- process standard deviation s_{100}	UWL = 15 kg/m^3 See Note 4.	E

Fraction passing 75 µm sieve[6]	(a) Sample chart, showing:	Based on the calculated combined grading for all possible stockpile combinations.	
	- specified upper limit	Upper limit = *7.0% (Clause 2.3.).	D
	- individual results		C

Notes:

1. Abbreviations:
   UCL: upper control limit UWL: upper warning limit
   LCL: lower control limit LWL: lower warning limit
2. Key to decision rules
   A: Any value below the lower warning limit (LWL).
   B: In accordance with Clause 4.2.1.4.
   C: Five consecutive increasing values.
   D: Any value above the upper control limit (UCL).
   E: Any value above the upper warning limit (UWL).
3. The individual values to be charted are those calculated to represent the Lot after averaging of pair/group test results in accordance with the relevant clause of this Specification.
4. The process mean ($\overline{\overline{X}}$) and standard deviation (s_{100}) must be calculated in accordance with Clause 1.5 on a rolling basis using 100 values (that is, k=100).
5. At the start of production of a nominated mix, base the target value on the results of the trial mixes. When 25 test values are available, the target value may be revised at the contractor's discretion and conditional on the results having been conforming. A further revision may be conducted when 100 test values are available. At all times, the target value must be at least three standard deviations above the minimum specified value.
6. The specified limit applies to all concrete mixes but control charting of this parameter is only required where manufactured or unwashed natural sand is used.
7. The lower warning limit for 28-day flexural strength must be at least one process standard deviation above the minimum specification limit.
8. This parameter is not applicable to SFRC.

4.2.2 Mixing, Transport, Consistence and Air Content

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, all as modified by the following requirements (within Clause 4.2.2).

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

Weigh cementitious materials separately.

Use a measuring device calibrated in one litre increments for volumetric batching of water to an accuracy of ± 2 per cent of the value shown on the indicating device.

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.

See Clause 1.3 for definitions of terms "batch" and "load". Additionally:

(a) For mobile batch mixers: a "batch" is deemed to be the same as a "load". A load must not comprise more than a single batch.

After the completion of batching, discharge the entire batch of concrete from the mixer before any further charging takes place, with the exception of conforming retempering.

(b) For continuous mixers: a "batch" is deemed to be a "load" produced in a single discrete operation.

(c) For central batch mixers discharging into tipper trucks: a "load" might comprise more than one "batch".

Detail in the PROJECT QUALITY PLAN the proposed methods of handling, storage and batching of 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.

4.2.2.1 Mixing time

Mixing time is defined in Clause 1.3.

Mixing time is measured from the time all ingredients, including all water, are in the mixing drum.

Industry comment sought regarding the request to relax the requirement regarding "including all water". What controls are proposed to ensure that late water additions are given adequate mixing time ?

(a) Determine the minimum mixing time MT_{min} from mixer uniformity testing in accordance with Clause 4.2.2.2, and the following:

(i) for twin-shaft mixers, the mixing time after full 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 full charging must not be less than 54 seconds plus six seconds for each cubic metre (or part thereof);

(iii) 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.

For mobile mixers which do not have a certified compliance plate, the minimum mixing time is 3.5 minutes.

For steel-fibre reinforced mixes, Clause 6.3.7 also applies.

(b) The maximum mixing time is five minutes for split drum and twin-shaft mixers, or ten minutes otherwise.

4.2.2.2 Mixer uniformity testing

(a) Mixer uniformity testing - general

For the purpose of conducting the mixer uniformity test, charge the mixer:

(i) in accordance with the manufacturer's instructions, and;

(ii) in the sequence proposed to be used in the Works, and;

(iii) to the maximum volume (or throughput) proposed to be used in the Works.

Thereafter, the same charging sequence must be used, and 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 the base or into associated works such as anchors, kerbs, subgrade beams or drainage structures on the condition that all concrete from the test complies with 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 subclause (e) hereunder.

(b) Uniformity testing of continuous mixers

Continuous mixers must be assessed in accordance with sub-clause (c) below, with each sample being separated by an interval equivalent to at least 2 m^3 of throughput.

(c) Uniformity testing of central batch 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 m^3 of concrete from that mixer, or as otherwise required in accordance with AS 1379 Clause 3.4.2. Include mixes of all types (including subbase, base and kerbs) and to all clients in the above volumetric total.

Carry out tests on each base mix to be placed in the Works. Alternatively, tests may be carried out on the base 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 base mixes.

Conduct tests on three consecutive batches[8] or runs of the same mix which comply with all of the requirements of this Specification. A run (from a continuous mixer) must comprise not less than 5 m^3 of mix.

Assess and report:

(i) mixing speed;

(ii) batch (or run) volume;

(iii) mixing time or, for continuous mixers, the throughput rate;

(iv) duration of charging from addition of first ingredients to last addition of mix water.

Discharge and sample the whole of a single batch (or run) by one of the following procedures:

(A) By discharge into a moving vehicle whose tray length is not less than 8 m. Sampling must be from the truck prior to tipping. Obtain the samples by using a shovel or scoop but exclude the top 100 mm of concrete.

(B) 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 but not closer to

8 as distinct from "loads"

either end than 10% of the length. Take a sample of approximately 50 litres from each point.

Samples must be individuals (not composites) in accordance with AS 1012.1 Clause 7.2.2.

Additionally, cast a minimum of 24 cylinder samples in accordance with RMS T304 from grab samples taken linearly throughout the batch. Obtain sufficient material to cast one cylinder only. Do not mix sub-samples.

Test each sample at 7 days as follows:

(1) Mass Per Unit Volume (MPUV) in accordance with with AS 1012.12.2

(2) Compressive Strength AS 1012.9.

Determine the Coefficient of Variation of both result sets as follows:

$$CoV_C = \frac{\sigma_{compressive}}{\mu_{compressive}} \times 100$$ where:

$\sigma_{compressive}$ = Standard Deviation of Compressive Strength, to the nearest 0.1 MPa

$\mu_{compressive}$ = Mean of Compressive Strength, to the nearest 0.1 MPa

CoV_C = Compressive Strength Coefficient of Variation, reported to the nearest 0.1 %.

$$CoV_{MPUV} = \frac{\sigma_{MPUV}}{\mu_{MPUV}} \times 100$$ where:

σ_{MPUV} = Standard Deviation of MPUV to the nearest 0.1 MPa

μ_{MPUV} = Mean of Compressive Strength, to the nearest 0.1 MPa

CoV_{MPUV} = MPUV Coefficient of Variation, to the nearest 0.1 %.

(d) 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 be certified as belonging to a fleet which is operating under a mixer uniformity and compliance program as detailed below. Such program shall record the progressive maintenance regime for each mixer and the results of compliance by mixers which have been tested for mixer efficiency under a statistical sampling procedure. Such individual results must have complied with the limits given in AS 1379. Where a mixer is one of the test sample, the date of the latest test must be shown on its mixer compliance plate (or Certificate).

Further tests must be carried out:

(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 also apply where mobile mixers are used to transport centrally-mixed concrete.

All samples for uniformity testing must be individuals and not composites; AS 1012.1 Clause 3 refers.

To satisfy the mixer uniformity and compliance programme, 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.

Over a period of 24 months, randomly test the number of mixers shown in Table R83.14. The fleet will be deemed to comply if all selected mixers satisfy the requirements of Appendix A in AS 1379.

Table R83. 14 - Mobile mixer fleet testing

Population size	Sample size
< 16	All
16-25	17
26-50	22
51-90	24
91-150	26
151-280	28
281-500	32

This sampling programme is predicated on an 8% Limiting Quality Value, and where a mixer fails to satisfy a mixer uniformity test, the entire fleet is deemed to have failed, until:

(A) the producer immediately stands 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, and;

(B) you must immediately test another randomly selected mixer from the same fleet and that result will determine the continued compliance of the fleet, as follows.

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

(2) if it fails, proceed in accordance with sub-clause (Aa).

(e) Compliance for uniformity

(i) Central batch mixers and continuous mixers:

The mixer will be deemed to have passed the uniformity test if:

(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 for any of the three consecutive batches or runs, and;

(B) no slump value must lie outside the specified range, and;

(C) CoV_C is less than 4.0%, and;

(D) CoV_{MPUV} is less than 5.0%.

(ii) Mobile batch mixers:

Assessment must be in accordance with AS 1379.

HOLD POINT	
Process Held:	Paving of base (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.

4.2.2.3 Admixture addition

Detail in the PROJECT QUALITY PLAN how admixtures will be incorporated to comply with this requirement.

This clause does not cover the addition of water; see Cl 4.2.2.7.

(a) Incorporation during initial batching

Prior to their introduction to the other materials, admixtures must be separately and thoroughly diluted in the mixing water by one of the following methods:

(i) addition into the water weighhopper, or

(ii) direct introduction into the water feed line during water batching.

They must be incorporated in accordance with the manufacturer's instructions, and by a method which ensures that no adverse interaction occurs.

(b) Addition to a mobile mixer beyond Completion of Batching

Incorporate admixtures in accordance with the manufacturer's written recommendations.

Immediately after addition, the mixing mechanism must be operated at the designated mixing speed for not less than 30 revolutions or for such additional time as may be necessary to re-establish uniformity of the mix, except that if assurance is not available that the batch was initially mixed for 55 revolutions, the retempered batch must be re-mixed for a minimum of 55 revolutions.

4.2.2.4 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.

Any addition of water which occurs after the completion of batching (as defined) must be in accordance with Clause 4.2.2.7.

Any addition of admixture which occurs after the completion of batching (as defined) must be in accordance with Clause 4.2.2.3.

No other additions are allowed to a mixed batch prior to its complete discharge. Recycling of concrete is not permitted.

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

4.2.2.5 Transport capacity

For slipform paving, provide sufficient transport capacity to enable continuous paving.

4.2.2.6 Consistence (slump)

Test the consistence of concrete by the slump test.

Test within 40 minutes of the completion of batching (as defined).

Do not incorporate concrete into the Works which is nonconforming in relation to consistence.

Obtain test samples in accordance with AS 1012.1 and test the slump in accordance with AS 1012.3.1.

The slump must be within the following limits from the nominated slump:

(a) slipformed concrete: ± 10 mm

(b) fixed-formed concrete: ± 15 mm.

Record all slump test results, whether conforming or otherwise.

The minimum frequency of routine testing is as follows:

(1) For tipper delivery

(i) Initial daily slumping:

Test every load prior to discharge until eight consecutive conforming loads are tested. Calculate the standard deviation (SD) of these eight loads.

If SD is less than or equal to 8.0 mm, go to Process Slumping.

If SD is greater than 8.0 mm, continue slumping every load until any eight consecutive loads have a SD less than or equal to 8.0 mm.

(ii) Process Slumping:

Slump test every fourth load. Visually check every intermediate load prior to discharge, and test the slump for any load which appears, in the opinion of either party, to be nonconforming.

Allow visual assessment only by the testing staff, and only at the testing station.

Record visual checks as, for example, V_{30}, V_{40} for Visual 30 mm and 40 mm respectively.

If a nonconforming slump is measured, slump test all loads thereafter (prior to discharge) until the SD of six consecutive loads is less than or equal to 8 mm, at which time testing may revert to each fourth load.

Additionally, slump test every load from which samples are taken for other tests on the concrete or its constituents.

(2) For delivery by mobile mixer

(i) Initial daily slumping:

test every load prior to discharge until four consecutive conforming loads are tested, and thereafter;

(ii) test every alternate load.

Visually check every intermediate load during discharge, and test the slump for any load which appears, in the opinion of either party, to be nonconforming.

Allow visual assessment only by the testing staff, and only at the testing station.

Conduct additional slump testing as required in accordance with the provisions for retempering in Clause 4.2.2.7.

(3) General

Sampling must be as follows:

(A) For tipper delivery: obtain a composite test sample[9] in accordance with AS 1012.1 Clause 7.3. Take the sample prior to discharge from the truck using a shovel or scoop. Exclude the top 100 mm.

(B) For agitator delivery: the test sample must be an individual sample obtained in accordance with AS 1012.1 Clause 7.2.2.

For any sample, if the measured slump is not within the specified limits, immediately carry out one repeat test from another portion of the same sample. The concrete represented by the sample is accepted as conforming if the value obtained from the repeat test falls within the specified limits.

In the case of mobile mixers, if the slump value falls outside the specified limits, the load may be re-mixed and re-tested within the limit of 40 minutes from the completion of batching.

4.2.2.7 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 in accordance with the following conditions:

(a) Immediately after retempering with water, the mixing mechanism must be operated at the designated mixing speed for not less than 30 revolutions or for such additional time as may be necessary to re-establish uniformity of the mix, except that if assurance is not available regarding the original mixing for 55 revolutions, the retempered batch must be re-mixed for 55 revolutions.(b) The quantity of water added must be

9 ~ with the exception of Mixer Uniformity Testing where samples must be individuals; Clause 4.2.2.2(c) refers.

recorded on the identification certificate for that batch. If water is added after the commencement of discharge, the estimated remaining quantity of concrete at that time must also be recorded.

(c) Immediately after condition (a) has been satisfied, the slump must be checked for conformity.

(d) Retempering is permitted only within 40 minutes of the completion of batching.

(e) 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.

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

Nonconforming concrete must not be used in the Works.

4.2.2.8 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 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 load 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 load is conditional on the conformity for compaction and compressive strength of cores from that specific load.

4.2.2.9 Air content

Test the air content in accordance with this Clause for conformity with Clause 3.7.

Carry out daily testing at the following minimum frequency:

(a) one per load until three conforming results are obtained, and thereafter;

(b) one per 50 m^3 until four consecutive conforming results are obtained, and thereafter;

(c) one per 200 m^3 for the remainder of the day.

Testing under (b) and (c) must be on loads of concrete from which cylinders are moulded for 28-day compressive strength under Clause 5.3.

For any sample, if the measured air content is not within the limits specified, immediately carry out one repeat test from another portion of the same sample. The concrete represented by the sample is accepted as conforming if the value obtained from the repeat test falls within the specified limits.

The frequency reverts to (a) if a nonconforming result is obtained at any stage of testing.

Air entrained concrete with an air content higher than the specified range is nonconforming and must not be used in the Works, except that concrete batched for base may be used in anchors and subgrade beams subject to conformity with the relevant requirements.

Air entrained concrete with an air content of less than the specified range is nonconforming. However, such concrete may be used in the Works on condition of the conformity of the compressive strength of cores from that specific load which have been obtained and tested in accordance with this Specification. This testing is in addition to routine random sampling, unless that particular load has been chosen in the random selection process.

4.2.2.10 Transport of Mixes for Manual Paving

Use agitator vehicles to deliver concrete which will be placed manually. However, tipper trucks may be used in combination with a suitable Material Transfer Placer (MTP) and where slump and haul lengths are such that segregation does not occur and compaction and finishing of the mix is not compromised.

4.3 PAVING CONCRETE

Ensure that your workers who are engaged in paving operations have undergone the Concrete Paving Crew Training in accordance with RMS Specification G2-C2. Submit details of such training as part of the PROJECT QUALITY PLAN.

Paving of CRCP must precede paving of adjacent jointed base unless they are separated by an isolation joint. Where practicable, paving of travel lanes must precede paving of adjacent shoulder lanes.

4.3.1 Slipform (Mechanical) Paving

Where practicable, carry out paving by the slipform method, using equipment 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 base, including the parameters nominated in Clause 4.3.3 for each of the proposed slipform paving configurations.

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 vibrators and conforming plate without segregation of the components;

(c) internal vibrators capable of compacting the full depth of the concrete;

(d) capability of paving in the widths and depths shown on the Drawings.

Regularly inspect and service the paver to ensure that it is maintained at all times in full operating condition consistent with the manufacturer's specifications. Monitor key items such as vibrators and sensors throughout the paving process.

Implement a system to indicate the malfunction of each individual vibrator. Document the system in the PROJECT QUALITY PLAN.

Maintain the supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing trains in a smooth and firm condition.

Plan the work, and coordinate the delivery, spreading and paving activities to optimise the continuous and uniform progress of the paver and to minimise discontinuities in the work.

Record details of any interruptions to the progress of the paver, including the reason, location, and duration.

Form a transverse construction joint in accordance with Clause 4.5.1 if an interruption to paving occurs which is likely to result in a loss of integrity of the concrete mass.

Should subsequent testing at the location of an interruption indicate the presence of non-uniform or nonconforming concrete, remove and replace the affected section with conforming concrete in accordance with Clause 5.6.

The mechanical paver must spread, compact, screed and finish the freshly placed concrete so as to produce a dense and homogeneous slab with a smooth uniform finish requiring a minimum of hand finishing.

The edge produced must maintain its shape and must not sag or tear. If excessive bleed water occurs, such that it flows over the slab edge, cease paving until the consistence of the mix is adjusted to prevent such flow or until the mix is redesigned.

At locations where the paver is unable to fully compact and finish the concrete (such as, but not confined to, transition Lots), use supplementary manual vibration, both internal and surface, with operating parameters in accordance with Clause 4.3.2.

Program the slipform and manual paving operations to ensure that the ride quality of the finished pavement is in accordance with this Specification.

4.3.2 Manual (Fixed-Form) Paving

Detail in the PROJECT QUALITY PLAN the equipment and methods to be used for placing, spreading and finishing the concrete base, 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 is debonded so that it can be removed without damaging the concrete..

Limit gaps in formwork such that the specified systematic vibration and compaction can be achieved throughout the slab and such that the requirements of Clause 4.5.5.1 are met.

Formwork must be set to tolerances on the screeding surface equivalent to those specified for the finished base surface.

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

Establish and document suitable vibrator operating parameters for the specific site conditions in order to yield consistent conformity under Clause 5.2.

Prior to the demonstration of such conformity, adopt one of the three methods listed in Table R83.15 and use operating parameters which are no less thorough than the guidelines provided.

At all times, use internal vibrators with the following operating parameters:

(a) a minimum diameter of 50 mm;

(b) operating at a frequency of between 8,000 and 12,000 vibrations/minute (130 – 200 Hz);

(c) by regular and systematic insertions using one of the methods shown in Column 1 of Table R83.15.

The number of standby vibrators must be not less than one fourth of the number in use, with a minimum of one.

Following internal vibration, compact and finish the slab by at least two passes of a hand-guided vibratory screed with the following operating parameters:

(d) traverse the full width of the slab on each pass;

(e) the screed's length must be compatible with the width of the slab under construction;

(f) constructed of tubular steel trusses or rigid metal and/or timber;

(g) operating at a frequency of between 3000 and 6000 vibrations/minute (50 – 100 Hz) and a minimum amplitude of 0.3 mm;

(h) a concrete surcharge of between 20 mm and 50 mm height over its full length.

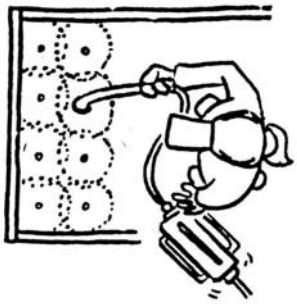
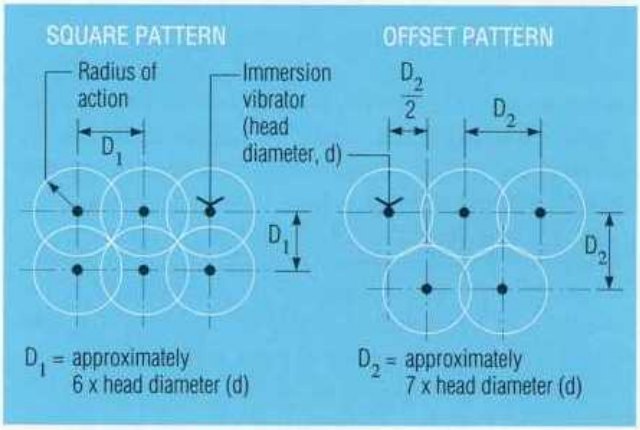
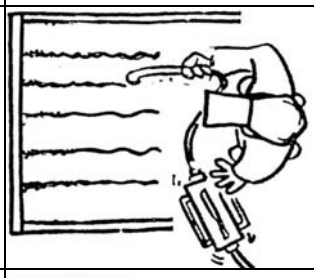
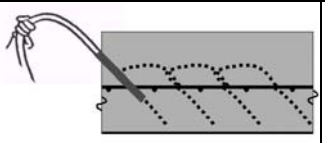
There must be at least two passes of the screed after any significant disturbance of the concrete surface, such as by walking in the mix.

Provide a dense and homogeneous slab with a surface finish which requires a minimum of hand finishing.

Do not use power trowelling on the surface.

Form a transverse construction joint in accordance with Clause 4.5.2 if an interruption to paving occurs which is likely to result in a loss of integrity in the concrete mass. If subsequent testing at the location of an interruption indicates the presence of non-uniform or nonconforming concrete, remove and replace the affected section with conforming concrete in accordance with Clause 5.6.

Table R83.15 – Internal vibration methods

Method	Diagram	Guideline Parameters (1)
1 Dip method		(a) the spacing D_1 is not greater than 300 mm, and D_2 is not greater than 350 mm; (b) insertion durations are 10 seconds minimum, and; (c) withdrawal speed does not exceed 1.5 m/minute.  Source: "Concrete Practice on Building Sites". SAA Handbook HB67 – 1995, jointly as Cement & Concrete Association publication C&CAA T43 (1995).
2 Drag method		(a) vibrator paths at spacings not greater than 350 mm, and; (b) travel speed not exceeding 1.5 m/minute.
3 Modified Drag method (for reinforced pavement)	 (Section view)	(a) vibrator paths at spacings not greater than 350 mm, and; (b) insertion spacings not greater than 350 mm, and; (c) nett horizontal travel speed not greater than 1.5 m/minute, and; (d) withdrawal speed not greater than 1.5 m/minute.

Notes:

1. The vibration intensity required to achieve compaction conformity will vary according to factors such as the workability of the concrete and the characteristics of the compaction equipment. The guideline parameters are specified as minimum levels only, and higher compaction levels may be required to produce conforming results.

4.3.3 Placing and Paving Operations

The subbase at the time of base paving must be clean and free of loose or foreign matter.

Where the subbase is lean concrete (LCS), it must be treated with debonding agent in accordance with RMS R82.

Where the subbase is asphaltic concrete (AC), its surface at the time of base paving must be in a condition which minimises the absorption of mortar and water from the base concrete.

Where the subbase is other than LCS or AC, it must be sealed with a sprayed bituminous or bitumen emulsion seal.

Place, pave and finish concrete so as to:

(a) prevent segregation or loss of materials;

(b) prevent premature stiffening;

(c) produce a uniform dense and homogeneous product throughout the pavement;

(d) expel entrapped air and closely surround all reinforcement and embedments;

(e) provide the specified thickness and surface finish.

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

Provide staff training in paving techniques in accordance with Clause 6.2 of ISO 9001RMS G2-C2. Include details of this training as part of the PROJECT QUALITY PLAN.

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

(i) maximum paving speed (instantaneous, not average);

(ii) target (optimum) paving speed;

(iii) vibrator spacing, frequency and amplitude, and ranges thereof;

(iv) gross operating mass per metre of paving width.

Nominate the following parameters for manual paving:

(v) the size and number of vibrators;

(vi) the pattern and spacing of vibrator insertions.

Provide the following information for transition zones:

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

(viii) the distance between the transverse construction joint and the point of effective slipform 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);

(ix) the size and number of manual vibrators;

(x) the spacing and duration of vibrator insertions;

(xi) the method of side forming to prevent edge slump;

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

(xiii) the equipment type and its method of use to provide surface vibration.

Maintain records showing the location of each 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 loads for examination and/or testing. Submit details of the method of traceability as part of the PROJECT QUALITY PLAN.

4.3.4 Temperature

(a) Concrete temperature

Measure and record the concrete temperature at the point of placement..

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, except that when the diurnal air temperature changes are greater than or equal to 20°C, the upper limit of temperature of concrete to be placed in the Works is 30°C.

(b) Air temperature

Measure and record the air temperature outdoors in the shade at the paving site but remote from artificial influences such as machinery.

Where air temperature greater than 35°C is forecast, monitor the air temperature at intervals not exceeding 30 minutes. Cease concrete batching when the air temperature reaches 32°C and is rising.

Concrete must not be placed in the Works when the air temperature is below 5°C or above 35°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. A guide for assessing the rate of evaporation is provided in Figure R83.3.

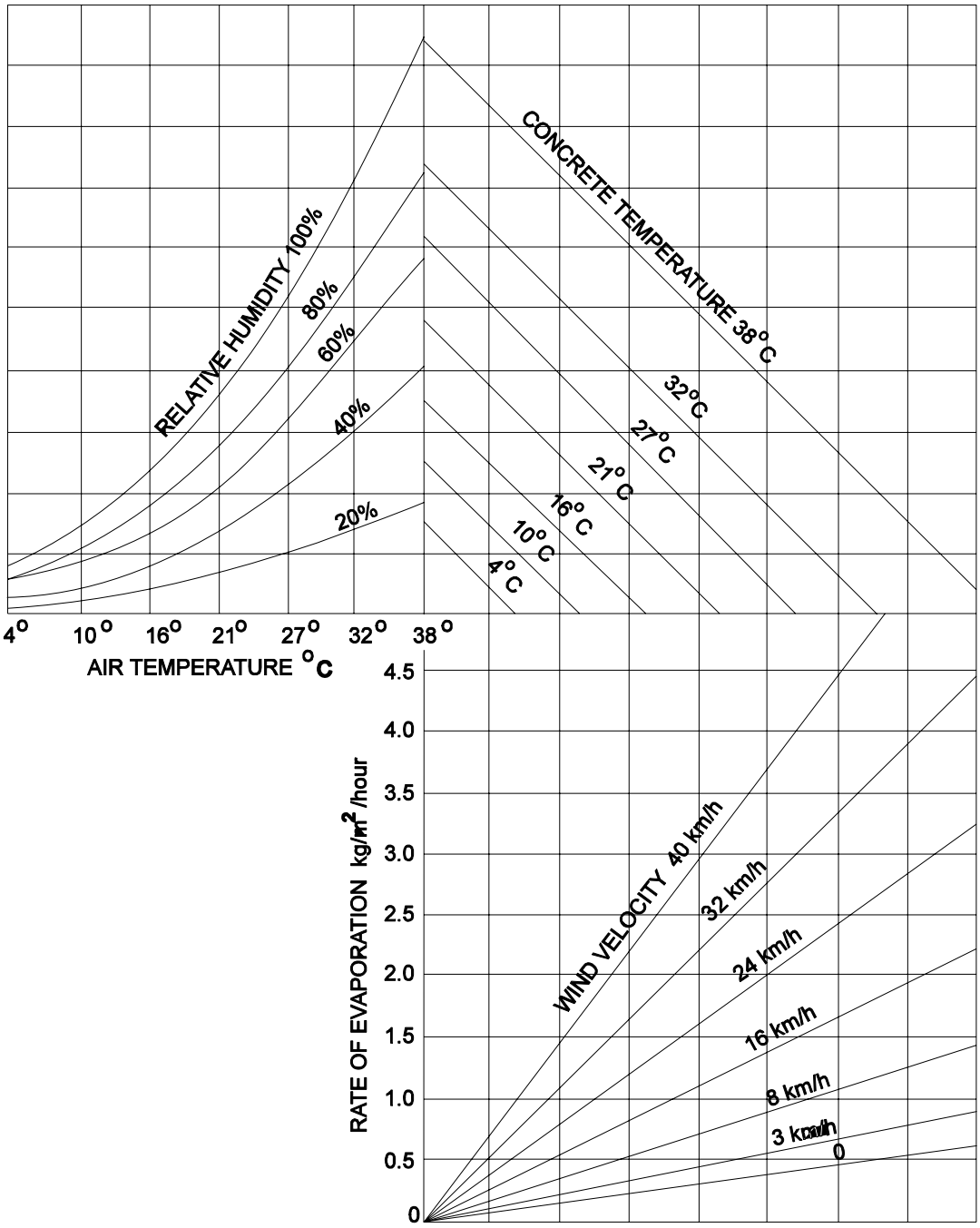


Figure R83.3 - Evaporation from Concrete Freshly Placed on Site

The graph shows the effects of air temperature, humidity, concrete temperature and wind velocity together on the rate of evaporation of water from freshly placed and unprotected concrete. An example follows:

With air temperature at 27°C, relative humidity at 40%, concrete temperature at 27°C, and a wind velocity of 26 km/h, the rate of evaporation would be 1.6 kg/m^2/hour. To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27°C), and move vertically to intersect the curve for relative humidity encountered (here 40%). From this point move horizontally to the respective line for concrete temperature (here 27°C). Move vertically down to the respective wind velocity curve (in this case interpolating for 26 km per hour) and then horizontally to the left to intersect the scale for the rate of evaporation.

Source: Gelber, S, 1984, "Predict evaporation rate and reduce plastic shrinkage crack", Concrete International (ACI) v5 n4, 19-22

If you choose to use an evaporation retarder to restrict the evaporation of water, apply it as a fine uniform spray. Carry out any subsequent finishing operations by meansin a way which does not incorporate the evaporation retarder into the surface mortar.

Regularly inspect the plastic concrete to monitor the effectiveness of the procedures adopted.

4.3.6 Texturing of Surface

Under revision to cater for longitudinal tining and grinding.

Unless specified otherwise in Annexure R83/A, texture the surface with both a hessian drag and tining longitudinally and transversely in accordance with Clauses 4.3.6.1, 4.3.6.2 and 4.3.6.3 to produce aAverage tTexture dDepths as given in Table R83.16.

Transverse texturingTining is not required beneath a bituminous or asphalt surfacing. but lLight brooming may be applied in lieu of a hessian drag.

Table R83.16 - Specified Average Texture Depths

DirectionType	Average Texture Depth	Test Method (1)
LongitudinalHessian drag only (2)	0.40 mm ± 0.05 mm (2) or alternatively, 0.55 mm ± 0.05 mm (2)	RMS T192 RMS T240
TransverseTining (3)	0.45 mm ± 0.05 mm or alternatively, 0.65 mm ± 0.15 mm	RMS T192 RMS T240

Notes:

1. Texture testing is exempt from the requirement in RMS Q for NATA registration.
2. Testing of longitudinalhessian-drag texture (alone) is required only where transverse texturingtining is not specified in Annexure R83/A.
3. The specified values for transversetining are for total texture including thatthe contribution from longitudinal texturinghessian drag or brooming (where iteither one has been specified).

Areas with less than the specified transverse texture must be saw-grooved to comply with this Specification.

Adjust the surface texturing process to account for the prevailing weather conditions and mix design to limit surface ravelling and to produce a uniform finish without rounding of the paved edges.

4.3.6.1 Longitudinal

Use a hessian-drag or equivalent to produce longitudinal texturing. Adjust the length of the drag to produce the specified texture. Replace the drag when it is worn or ineffective for producing a uniform consistent texture.

4.3.6.2 Transverse

As soon as possible after longitudinal texturing, transversely texture the surface of the freshly placed concrete by means of a mechanical device for grooving plastic concrete.

The transverse texturing equipment must have rectangular shaped tines of flat spring steel, approximately 0.6 mm thick, 3 mm wide and minimum free length of 200 mm. The tines must be randomly spaced between 10 mm and 21 mm, with a mean spacing between 13 mm and 14 mm. A typical random pattern is shown below:

10	14	16	11	10	13	15	16	11	10	21	13	10

The width of the texturing combs must be at least 750 mm.

Texturing combs must be used in one direction only, away from the tied tail at the connection.

For paving widths exceeding 4.5 m, carry out the texturing by means of a machine spanning the concrete slab. Make provision for downward adjustment to compensate for tine wear.

4.3.6.3 Texture testing

For testing with the Sand Patch method, prepare the surface for testing to remove concrete fins which are soon likely to abrade under early trafficking. Prepare an area at least 330 mm in diameter to minimise impedance to the 300 mm straightedge.

Use a circular carborundum stone with a minimum diameter of 50 mm and a minimum thickness of 20 mm. Grind the test area by hand in a circular motion such that each part of the target area receives between 15 and 20 passes. Apply a constant down force of approximately 20 kg.

The target condition is for the top surfaces of the landings to be free of fins while still retaining a coating of mortar. Sweep the test area prior to test to completely remove all loose material.

4.3.6.34 Sawcut Transverse Grooves

Sawcut grooves must:

(a) be 3 mm wide and 3 mm deep;

(b) be at a random pattern;

(c) have a spacing neither less than 10 mm nor more than 18 mm;

(d) have a mean spacing between 12 mm and 15 mm;

(e) be in the direction of the tining unless otherwise specified in Annexure R83/A or as directed by the Principal.

Grooving residue must be controlled and removed from the pavement and must not be allowed to flow into the drainage system or across lanes which are in public use.

4.3.7 Curing

Cure the base by the application of a sprayed curing compound applied soon after texturing.

In confined spaces (such as tunnels) where the use of curing compounds is deemed undesirable, cure the base for a minimum of 7 days using water or blanket techniques in accordance with Clause 4.3.7.3.

Cure all other structural concrete (including kerbs and gutters) either by application of a compound or by a method included in Clause 4.3.7.3.

Apply the compound in accordance with the following conditions:

(a) The curing compound must form a continuous and unbroken film, and be applied uniformly in two applications:

  (i) the first within 15 minutes of the surface reaching the low sheen bleed water condition;

  (ii) the second 10 to 30 minutes later or as recommended by the manufacturer.

(b) On fixed-formed surfaces, the first application must be within 30 minutes of stripping and the second must be 15 to 45 minutes after the first. At the time of the first application, ensure that the concrete is in a damp condition.

(c) Each application must be at a minimum rate as follows:

  (i) on tined texture: the higher of 0.30 L/m^2 or 50% more than the rate stated on the test certificate;

  (ii) on surfaces with only hessian-drag texture: the higher of 0.25 L/m^2 or 25% more than the rate stated on the test certificate;

  except as specified under sub-clauses (d) to (h).

(d) For areas sprayed by other than a mechanical sprayer, the application rate must be the higher of 0.30 L/m^2 or 50% more than the rate stated on the test certificate regardless of the texture type. These areas include the faces of formed joints and sections of slipformed edges which were supported by temporary forms at the time of initial spraying.

For bitumen emulsion, the total application (two passes) must be at a rate of not less than 0.50 L/m^2 residual bitumen.

(e) For the purpose of determining application rates, BE-HR is deemed to be hydrocarbon resin.

(f) Test the application rate in accordance with Clause 4.3.7.2. For any section on which the application does not comply, resprayed within six hours of testing, at an application rate not less than twice the deficiency in the original application. Test the respray as specified for the first application.

(g) Maintain the curing film intact in a continuous and unbroken membrane until an insitu concrete strength of 25 MPa is achieved. Make good any damage to the curing membrane by hand spraying the affected area. Assess the insitu strength by methods as stated in Clause 4.3.8.4.

Any hardened concrete of age less than seven days adjoining the commencement of each paving run (and notwithstanding that film damage may not be readily apparent) must be resprayed with a single application for a minimum distance of 7 m and extend to areas trafficked by persons during placement at the construction joint.

You will bear the cost of any respraying and of making good any damage to the curing membrane.

4.3.7.1 Curing Equipment

Fully operational spraying equipment is a pre-condition for paving to proceed.

Spray application methods are categorised as follows:

(a) Class 1: by hand lance, with either single or multiple nozzles;

Use this method (or Classes 2 or 3) for paving widths less than 2.5 m.

(b) Class 2: by spraybar or hand-lance fitted with a minimum of three nozzles spaced to give a uniform cover over a minimum width of 1.0 m in a single pass;

Use this method (or Class 3) for paving widths between 2.5 m and 4.5 m.

(c) Class 3: by a mechanical sprayer fitted with a spray bar with multiple nozzles spaced to give a uniform cover for the full paving width in a single pass;

Use this method for slipformed paving widths greater than 4.5 m.

Provide as part of the PROJECT QUALITY PLAN the following information:

(i) the supplier's recommended procedures for the incorporation of any material (such as dye) which will be added after delivery;

(ii) the supplier's recommended procedures for storage and agitation of compound (taking account of any added materials) under varying weather conditions in order to maintain uniformity.

For Class 3 curing, submit as part of the PROJECT QUALITY PLAN the procedures that are proposed for demonstration of the following:

(iii) uniformity of bulk output from each nozzle, including edge sprays (litres per minute per nozzle);

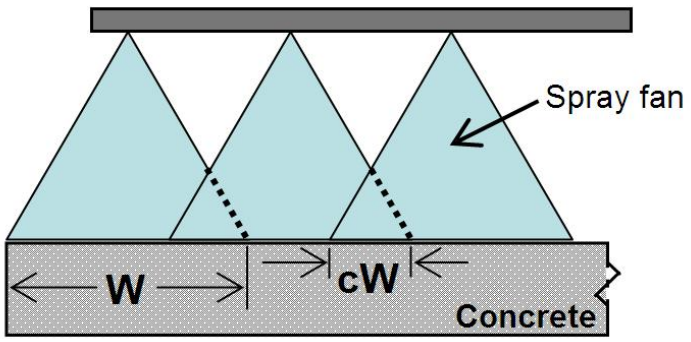
(iv) the variables and methods to be used to measure and calibrate a uniform output across the full spray width and edges (litres/m^2);

(v) field trials that are proposed in order to develop operating parameters such as nozzle height, spray pressure and the spray overlap factor 'c' (as shown in Figure R83.4) and to demonstrate uniform and conforming coverage, including edges. Determine these parameters and provide them to the Principal prior to a Paving Trial that requires Class 3 curing;

(vi) during the Paving Trial, verify the operating parameters developed under (v).

Apply the curing compound in a fine spray.

Set the spray nozzles to provide an overlap factor (by width measurement) as shown in Figure R83.4. Determine this factor in accordance with sub-clause (v) above.



where:

W = theoretical coverage

c = overlap factor (decimal)

Figure R83.4 - curing spray overlap

Fit protective hoods to Class 3 spray bars and lances to minimise the effects of wind on the variability in application rate and to reduce the drift of curing compounds to workers and roadside areas.

4.3.7.2 Verification of Curing Compound Application Rate

In the absence of an alternative method approved by the Principal, check the curing compound application rate as follows (see Clause 4.3.7.1 for curing Classes):

(a) by calculating the average application rate from the total measured quantity of compound applied within the area specified in Table R83.17;

(b) by testing the local amount of curing compound as measured on test mats placed on the pavement at random locations selected in accordance with RMS Q. Use three (3) felt mats per test each approximately 0.25 m^2 in area and placed within an area of 50 m^2 on the surface to be treated.

Table R83.17 - Testing procedures for application rate

Class of curing (1)	Test procedures (2)	Frequency
1 and 2	(a)	each Lot
3	(a) *and;*	each paving area of between 500 m^2 and 1000 m^2 (3)
	(b)	(i) in the Paving Trial, and thereafter; (ii) one in every third Lot until three (3) consecutive conformances are obtained, then; (iii) one in every sixth Lot until three (3) consecutive conformances are obtained, then; (iv) one every fifty (50) Lots. Testing frequency reverts to (ii) if a nonconformity is encountered.

Notes

1. For description of Classes see Clause 4.3.7.1.
2. See sub-clauses (a) to (b) above.
3. You may vary this area for each test to suit individual circumstances such as the timing of refilling the curing tank, conditional on the application procedure being homogeneous within each nominated test Lot.

The application rate within a test section is deemed to be conforming if:

(A) the application on the surface is visually uniform and homogeneous, and;

(B) the losses (by wind or other causes) are insignificant, and;

(C) all test results obtained in accordance with Table R83.17 are conforming.

4.3.7.3 Curing of other structural concrete

Cure all structural concrete members, including anchors, kerbs and gutters, for a minimum of seven (7) days from placing.

Use curing compounds in accordance with the principles stated within Clause 4.3.7, or use wet curing.

For plastic covers, ensure that they form a continuous barrier against loss of moisture and that they are fully secured around all edges such that they maintain a moist environment over the full mass of the concrete as evidenced by the presence of moisture on the underside of the covers.

4.3.8 Protection of Work

4.3.8.1 Temperature

Record continuous surface temperatures for the first 24 hours after placement to ensure that the temperature of the concrete does not fall below 5°C. Measure the true surface temperature at two or more locations within each day's paving using purpose-made surface thermometers.

Detail as part of 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 constitutes a Nonconformity.

4.3.8.2 Rain

Concrete must not be placed in the Works during rain or when rain appears imminent.

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

Industry comment sought *regarding improved wording for the following paragraph.*

Concrete is nonconforming if:

(a) it is exposed to rain during transport in tippers, or; at any time until it is sufficiently hard to resist disturbance of the surface mortar

(b) it is exposed on the ground after discharge in a way which will incorporate the water into the slab during spreading or paving, or;

(c) it is exposed after paving such that the water is incorporated into the surface mortar during finishing operations.

Beyond this time, rain-exposed surfaces must be assessed under the finished surface criteria of this Specification.

4.3.8.3 Anchor slabs

Regardless of temperature levels, the base above anchors must be thermally protected for a minimum of 24 hours after placement. The covering must include vertical edges and must extend at least 5 metres over adjoining base slab which was cast at the same time. The covers must be adequately fastened around all edges to prevent air flow under them.

4.3.8.4 Trafficking of the base

Trafficking of the base (including foot traffic) must be monitored and strictly minimised according to the insitu concrete strength and to minimise damage to the curing compound. Non essential traffic must not have access until an insitu compressive strength of 25 MPa is reached.

Control essential traffic as follows:

(a) Concrete saws and coring machines may have access before 20 MPa strength is reached, subject to a 0.5 tonne limit on any item.

(b) Other vehicles must not have access until 20 MPa compressive strength is reached and all joints have been permanently sealed, and then the following limits apply:

(i) axle group loads single: 5.0 T
tandem: 8.0 T total
triaxle: 9.0 T total

(ii) tracked vehicles: 15 T/m^2 pressure over the track area, with the concrete protected from surface damage.

(c) Higher axle loadings, limited in accordance with Road Transport Regulations, may be applied after 25 MPa compressive strength is reached and all joints have been permanently sealed.

(d) Steel implements such as grader blades and loader buckets must not be allowed to impact joints or edges of the base.

(e) Compaction of granular verge material against the edge of base must not occur until 20 MPa compressive strength is reached and all joints have been permanently sealed, including the vertical faces.

For trafficking purposes, assess the insitu concrete strength by using cylinders which have been moulded, cured and tested in accordance with RMS T367 and at a frequency selected to suit your construction program.

Alternatively, trafficking strength may be assessed from cores taken for the purposes of Clause 5.2, subject to the following:

(f) The cores must be wet-conditioned, prepared and tested in accordance with AS 1012.14 except that the total duration of wet-conditioning (including that required for compaction testing) must be not less than 24 hours nor more than 36 hours and must conclude within 3 hours prior to strength testing.

(g) Except for the period of wet-conditioning, the cores must not be exposed to temperatures in excess of ambient air temperature.

(h) Do not take additional cores for this purpose without the prior approval of the Principal.

(i) the requirements of Clause 5.3 apply except that assessment may be based on a single core per Lot[10], and;

(j) assessment of any particular Lot must be based on not fewer than three core results of equal or lesser age (in days) compared with the Lot under assessment;

(k) Upon determination of an acceptable insitu strength of any Lot, all concrete placed prior to that Lot using the same concrete mix may be assumed to have achieved an equivalent trafficking strength.

A Hold Point applies to trafficking of the base at both the 20 MPa and the 30 MPa compressive strength levels.

HOLD POINT	
Process Held:	Trafficking of base - 20 MPa level.
Submission Details:	Insitu strength test results of the base.
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.

10 Cl 5.3.3 requires two cores per lot for acceptance purposes, but assessment for trafficking purposes may be based on a single core per lot.

HOLD POINT	
Process Held:	Trafficking of base - 25 MPa level.
Submission Details:	Insitu strength test results of the base.
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.

Any damage caused to any part of the work by your operations must be rectified to produce a dense, homogeneous concrete base with the specified surface finish and texture. The cost of rectifying such damage must be borne by you.

Failure to comply with this clause constitutes a Nonconformity on the base concrete.

4.4 CONCRETE PAVING TRIAL

Prior to routine concrete base paving, construct a trial section of concrete base using the nominated materials, authorised concrete mix, equipment and methods.

Construct trial sections in a continuous operation without intermediate construction joints.

Construct a separate trial for each paver.

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

(i) the paving trial;

(ii) construction of the concrete base on any section of work.

Table R83.18 details the requirements for construction and testing of paving trials.

Table R83.18 – Concrete Paving Trial construction and testing requirements

Property and Testing Requirements		**Paving type**	
		Fixed-form	**Slipform**
Length of paving trial	Minimum	15 m	50 m
	Maximum	50 m	100 m
Minimum concrete volume of trial		20 m³	-
Cylinders: minimum testing for UCS(1) and MUV(1). As per Clause 5.2.1, except test MUV at age between 2 and 3 days.	7 days(2)	4 loads	6 loads
	28 days(2)	4 loads	6 loads
Flexure beams(2): minimum testing for strength and MUV(1)	7 days(2)	3 loads	4 loads
	28 days(2)	3 loads	4 loads
Cores: minimum testing for relative compaction. As per Clause 5.2.1, except: (a) extract cores at age between 2 and 3 days, and; (b) determine MUV within 2 days of extraction.	Transition Lots	not applicable	2 per Lot
	Standard Lots	4 (3)	3 (3)
	At inserted tiebars at induced joints	NA	See Cl 4.1.2.2
	At inserted tiebars in formed joints	2 (4)	2 (5)
Photographs of cores through inserted tiebars (Clauses 4.1.2.1 & 4.1.2.2).(6) (a) Inspect and photograph within 1 day of coring; (b) photograph resolution must be adequate to show entrapped voids around and above the tiebars.		All (4)	All
Metal detector survey for tiebar location (plan location and depth in accordance Clause 4.1.2.2.		not applicable	All

Notes

1. MUV: mass per unit volume (or "unit mass").
   UCS: ultimate compressive strength
2. See Clause 4.2.1.2 for conditions on moulding from the same sample or batch (as applicable).
3. These cores are additional to those taken at tiebars within the same Lot.
4. Testing is not required in fixed-form paving if the tiebars are pre-placed and are subjected to internal vibration.
5. Inserted tiebars at formed joints are treated in Clause 4.1.2.1. Coring is required only in the paving trial, for advance assessment ahead of 30-day pull-out testing.
   Locate cores to intersect a tiebar but offset them from the longitudinal joint by 250 mm ± 100 mm and not closer than 1.5 m to a transverse contraction joint nor 3.0 m to a transverse construction joint.
6. Inspect and photograph all cores for compaction within 1 day of coring as advance warning ahead of compaction testing.

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:	Base paving subject to the trial.
Submission Details:	Submission of checklists, test results (as listed in Table R83.19) and concrete pavement training records (in accordance with Clause 26.8 of RMS 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.

Provide a written report with the 7-day test results which compares all results from the paving trial with those from the laboratory trial mix. Provide a table which shows, as a minimum, the information contained in Table R83.19 together with an assessment of the consistency between the mixes in the laboratory trial and the paving trial. Include comment on any notable inconsistencies and any consequential risks.

Within 5 working days of its receipt, the Principal will assess the report and provide comments on any issues of concern.

Table R83.19 - Paving Trial Analysis

Row	Item	Result		
		Laboratory trial mix	**Paving trial**	**Alphanumeric notes**
A	Location	(a)	(b) Length (m):	(a) Name of laboratory & suburb (b) Location of the Trial (c'way, Ch etc)
B	Mix details	Date: Mix No: Mix type: (tick one) - Fixed-form ☐ - Slipform ☐	Date: Trial No: Mix variations(c): ▪ ▪	(c) List any variations to the authorised mix except for admixtures and water
C	Air content (%)	(1)	Min: Max: Mean:	
D	Admixture content	AEA: WRA Other	AEA(g): WRA(g): Other(g):	(g) Provide the ranges (max & min).
E	Added water (L/m^3)		Min (1): Max(1): Mean:	
F	Compressive strength 7D	(1)	(3)	
G	Compressive strength 28D	(1)	(3)	
H	Flexural strength 7D	(1)	(3)	
I	Flexural strength 28D	(1)	(3)	
J	Unit mass - cylinders	Mean:(1)	Min (1): Max(1): Mean:	
K	Unit mass - beams	Mean: (1)	Min (1): Max(1): Mean:	
L	Core length (mm) (d)	NA	(e)	(d) excluding any debonding material (e) provide all results
M	Cores (f): Unit mass (& relative compaction)	NA	Transition Lots Non-transition Lots	(f) Record all individual results eg 2360 (99.5%), 2340 (98.5%)
N	Curing application rates	NA	Min (h): Max(h): Mean(i):	(h) For Class 3, report min and max values for each test; (i) For all Classes

Numerical notes

1. Record the reported result (not individual specimens).
2. Record individual specimen results.
3. Provide all results for cylinder pairs or beam sets, as applicable.

Submit the Paving Trial test results at timings in accordance with Table R83.20.

Table R83.20 - Paving Trial Submissions

Item	Timing of submission	Clause reference
Surface profile	Hold Point submission	5.5.1 & 5.5.2
Tiebar location	Hold Point submission	4.1.2.2
Texture depth	Hold Point submission	4.3.6
Curing application	Hold Point submission	4.3.7
Table R83.19 Rows A to E	Hold Point submission	Table R83.18
Class 3 curing calibration results	Hold Point submission	4.3.7
Photographs of cores at inserted tiebars	within 4 days of the Trial	Table R83.18
Table R83.19 Rows J, K, L, M	within 5 days of the Trial	Table R83.18
Table R83.19 Row F, H	within 7 days of the Trial	Table R83.18
Assessment of paving mix	with the 7-day test results	
Table R83.19 Rows G, I	within 30 days of the Trial	
Tiebar pull-out testing	within 30 days of the Trial	4.1.2.1

The trial section will be accepted as part of the work if it complies with this Specification. If the relative compaction of the trial section is less than 98.0 per cent, remove the trial section and construct a new trial section, all at no cost to the Principal.

In the event of other nonconformity in 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, mix design, materials, plant or rate of paving, or

(B) the concrete base fails substantially to comply with the Specification, or

(C) NCRs are not submitted in accordance with the Quality System documents.

4.5 JOINTS AND EDGES

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

Refer to Annexure R83/A for project-specific details of treatments required on existing pavements and/or kerbs abutting new Works.

Do not sawcut the pavement for any purposes other than those shown in the Drawings. Traffic presence detector loops must not be sawn unless specifically approved.

4.5.1 Sealants

Handle and install sealants in accordance with the manufacturer's written recommendations, which must include the following items:

(a) earliest concrete age at the time of installation;

(b) minimum temperature of air and concrete at installation;

(c) condition (both moisture and cleanliness) of the joint faces at installation, together with guidelines for their assessment;

(d) requirements for priming of the joint face;

(e) tooling requirements;

(f) minimum trafficking age.

Test the dimensions of the cured sealants in accordance with the Drawings and in accordance with the following requirements.

Where an asphalt surfacing is to be placed over the base, use a silicone sealant which has been approved by the manufacturer for that application.

4.5.1.1 Testing of Sealants

Test joints and sealants at random locations at the minimum frequency specified in Table R83.21.

Table R83.21 - Joint and sealant testing

Test type	**Joint type**		
	Transverse contraction	**Other untied joints (1)**	**Tied sealed joints (2)**
Joint face condition (3) - cleanliness(6) and - dryness	Test at two locations per joint, and (a) at every joint commencing with the paving trial, until three consecutive conforming Lots are obtained, and thereafter; (b) at every third joint If any joint fails, re-clean all joints within the Lot and revert to test frequency (a).	Include all joint types in the calculation of jointing output, and in the selection of testing location. Test at one location per joint per Lot, and (a) at every Lot commencing with the paving trial, until three consecutive conforming Lots are obtained, and thereafter; (b) at every third Lot. If any test fails, re-clean all joints within the Lot and revert to test frequency (a).	Test at one location per joint per Lot, and (a) at every Lot commencing with the paving trial, until three consecutive conforming Lots are obtained, and thereafter; (b) at every third Lot. If any test fails, re-clean all joints within the Lot and revert to test frequency (a).

Sealant dimensions - depth [4] - width [3] - recess	(a) Three tests per Lot commencing with the paving trial, until six consecutive conforming samples are obtained, and thereafter; (b) two per Lot, until a further four consecutive conforming samples are obtained, and thereafter; (c) one per Lot. Testing frequency reverts to (a) if a nonconformity is encountered at any time under (b) and (c).	Include all joint types in the calculation of jointing output, and in the selection of testing location. Test: (a) two locations per 30 m of joint until six consecutive conforming samples are obtained, and thereafter; (b) one per 30 m. Testing frequency reverts to (a) if a nonconformity is encountered.	(a) Two tests per 50 m of joint until six consecutive conforming samples are obtained, and thereafter; (b) one per 50 m. Testing frequency reverts to (a) if a nonconformity is encountered.
Sealant bond [5]	(a) One test per Lot commencing with the paving trial, until three consecutive conforming samples are obtained, and thereafter; (b) one test every fifth Lot. Testing frequency reverts to (a) if a nonconformity is encountered at any time.	Include all joint types in the calculation of jointing output, and in the selection of testing location. (a) One test per Lot commencing with the paving trial, until three consecutive conforming samples are obtained, and thereafter; (b) one test every third Lot. Testing frequency reverts to (a) if a nonconformity is encountered at any time.	(a) One test per Lot commencing with the paving trial, until three consecutive conforming samples are obtained, and thereafter; (b) one test every third Lot. Testing frequency reverts to (a) if a nonconformity is encountered at any time.

Notes

1. Examples include isolation and expansion joints.
2. For example tied longitudinal sawn joints.
3. Test at the time of installing the permanent sealant.
4. Check the depth (or thickness) by removal of a continuous section of cured sealant of length not less than 30 mm. Dissect the sample transversely at two random cross-sections and measure the meniscus depth to the nearest millimetre. The sample complies if both test sections comply with the Drawings.
5. Cut the silicone sealant at each arris in one location and lift the tail, stretching the sealant. For an acceptable test result to be achieved, the sealant shouldmust stretch to four times its length before breaking the bond.
6. Test for cleanliness as stated below.

Assess the cleanliness of the joint face using a piece of 100% cotton black cloth inserted into the cut to a depth of at least 25 mm using a tonguesuitable depressor. (or similar). An acceptable result is achieved when no residue appears on the cloth. when rubbed at a minimum depth of 25 mm from the top of the arris.

HOLD POINT	
Process Held:	Installation of silicone sealants.
Submission Details:	A joint inspection involving either the Contractor's Representative, Project Verifier or RMS Representative.
Release of Hold Point:	The Principal will assess the cleaning, testing and sealing procedures prior to authorising the release of the Hold Point.

4.5.2 Transverse Construction Joints

Transverse construction joints must:

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

(b) be continuous over the paved 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 straightedge;

(c) be constructed at 90°± 6° to the longitudinal joint, with the joint face corrugated and square (± 6°) to the finished top surface of the base;

(d) in jointed bases, have tiebars installed as detailed on the Drawings and in accordance with Clause 4.1 (except for dowelled construction joints, if and where applicable). Where the ties are installed by drilling and fixing in hardened concrete, a suitable epoxy mortar must be used giving an anchorage strength of at least 85 per cent of the yield strength of the bar;

(e) be formed by sawcutting if the concrete has previously hardened, with the face of the joint scabbled to expose the coarse aggregate (excluding the upper and lower arrises as shown in the Drawings), in lieu of corrugations. Clean the roughened surface and projecting reinforcement and remove all loose material and excess water;

(f) if initially nonconforming or damaged, be reinstated or repaired prior to the placement of adjoining concrete. The repair material must not be placed integrally with the adjoining concrete.

(g) have the face of the joint debonded to prevent intimate microtexture bond;

(h) conform in all regards to the requirements of Clause 4.3.2.

Intimate bond at the microtexture level can induce spalling at arrises and must be avoided. For this reason, debonding of the joint face is specified including joints between new and existing concrete pavements.

The first-placed face must be dense and fully compacted and must be free of honeycombing and re-entrant angles. Where the face is nonconforming or the edge is damaged, reinstate or repair it prior to the placement of adjoining concrete. Do not place the material used for the repair integrally with the adjoining concrete.

Re-spray the first-placed face with curing compound not more than 10 days prior to placing the abutting concrete. All aspects of the treatment must be in accordance with Clause 4.3.7 except that the compound must be a wax emulsion complying with RMS R82 and a single application must be used at a rate 25 per cent higher than the rate stated on the test certificate for curing efficiency, subject to a minimum value of 0.20 L/m^2. The coating must be intact and effective at the time of subsequent concrete placement.

Steel tiebars must not be sprayed with wax or bitumen compounds.

4.5.3 Transverse Contraction Joints

Provide transverse contraction joints in jointed pavements as shown on the Drawings. Contraction joints are not used in CRCP.

Transverse contraction joints must:

(a) be initiated by sawcutting unless the Drawings allow the use of crack inducing inserts outside trafficked areas.

(b) be continuous across the full width of the base without steps or offsets in any axis so that the line of the joint does not deviate by more than 10 mm from a 3 m straightedge.

(c) be skewed at 1 in 10 unless specified otherwise on the Drawings, or reduced locally to accommodate construction joints and slab anchors.

(d) be sawn, where a deflection angle is specified, such that the sawing on any alignment does not extend beyond the intended limit as defined by intersecting joints (typically longitudinal).

(e) be sealed in accordance with this Specification.

(f) have trafficking controlled in accordance with Clause 4.3.8.4.

(g) be maintained at all times free of incompressible and foreign materials and sealed for this purpose at all formed edges (including vertical faces, where any underlying induced crack exceeding 2 mm in width must also be sealed).

The two methods of inducing contraction joints are sawcutting and knifing (also known as guillotining). Knifing is only used in untrafficked areas or low-speed areas.

Use sawcutting, except where otherwise shown on the Drawings.

4.5.3.1 Sawcutting

Transverse contraction joints are sawn using either a two-cut operation (comprising an initial sawcut and a widening sawcut) or a single cut operation.

Sawcutting must proceed in a timely manner so as to prevent cracking of the base concrete other than at the bottom of the sawcut.

Use the type of blade and equipment and the method of control best suited to the hardness of the concrete being sawn. Have sufficient standby equipment available on site to maintain continuity of sawing.

The surface of the transverse contraction joint must not show more than 10 mm of vertical or horizontal edge ravelling. The cumulative length of ravelling with a dimension greater than 3 mm must not exceed 300 mm in any 3 m length of joint edge (a length of joint is assumed to comprise of two edges).

The vertical face at the edge of the slab must not show ravelling greater than 20 mm in any axis at the point of intersection with the sawn joint.

If a nonconformity occurs, immediately implement Corrective Action in accordance with the requirements of RMS Q.

4.5.3.2 Cleaning

Clean all debris from the sawcut soon after sawing and before the residue dries. TheUse a cleaning method used mustwhich does not damage the sawcut or arrises and does nornot

leave any substance deleterious to the concrete or to the adhesion of the joint sealants to be used. Adjust the timing of cleaning and other variables (such as pressure) to suit the prevailing concrete characteristics.

For wet cutting, Uuse a liquid or liquid/air oil-free jet at a sufficiently high pressure to ensure that the faces are dust-free when dry. Gravity fed liquid from tanks is not acceptable.

For dry cutting, remove the powder residue in a way which prevents its entering the joint.

Grit blasting must not be used.

4.5.3.3 Preliminary Sealing

Within two hours of cleaning an initial sawcut, seal the joint against drying and contamination by installing a continuous closed-cell polyethylene backer rod with the top of the seal being neither higher than the concrete surface nor more than 5 mm below it.

Sealing must include the vertical faces of the slab at the ends of sawcuts.

Maintain the preliminary sealant in sound condition until the joint is temporarily or permanently sealed.

In a two-cut operation, the preliminary seal must remain in position until, and must be pushed to the bottom of the initial sawcut immediately prior to, commencing the widening sawcut.

In a single-cut operation, the preliminary seal must remain in position until permanent sealing.

4.5.3.4 Temporary Sealing in Two-Cut Operation

In a two-cut operation, clean the widened sawcut in accordance with Clause 4.5.3.2. The joint must then be temporarily sealed by a continuous closed-cell polyethylene backer rod of diameter shown on the Drawings.

Sealing must include the vertical faces of the slab at the ends of sawcuts.

The top of the backer rod must be neither higher than the concrete surface nor more than 10 mm below it. The backer rod must pass over any longitudinal joint seal already in place.

Maintain the temporary sealant in sound condition until the joint is permanently sealed. Remove damaged or disturbed temporary sealants, clean the transverse contraction joint and insert a new temporary sealant.

4.5.3.5 Permanent Sealing

The permanent sealant must be an insitu cast silicone sealant, stored and installed in accordance with the manufacturer's written instructions.

Place a permanent seal in the joint within 14 days of initial sawing and within two hours of removing or depressing the existing temporary seal.

At slab edges and formed joints, the permanent seal must extend down the vertical faces of joints and any underlying crack.

Use a continuous closed-cell polyethylene backer rod located at a depth so that the bottom of the silicone sealant is at the planned location and of the correct shape. If the backer rod is damaged in any way it must be replaced for the full length of the joint.

Immediately pPrior to introducing the silicone sealant into the groove, clean any foreign or disturbed material such as dust from the joint and from the top of the backer rod by a dry, oil-free air jet. Alternatively, use high-pressure air to clean and dry the joint.

Grit blasting must not be used.

Ensure that, at the time of sealant installation, the joint faces are clean and surface-dry. Assess the cleanliness in accordance with Clause 4.5.1 and at the frequency specified in Table R83.21.

The joint faces must be fully surface dry at the time of installation and the joint must then be Use a joint primerd in accordance with theif and when recommendedations of by the sealant manufacturer.

Unless otherwise stated in the manufacturer's recommendations, tool the sealant to the specified shape before a surface skin forms.

4.5.4 Expansion Joints

Provide expansion joints as shown on the Drawings to a position tolerance of 25 mm. Expansion joints must be:

(a) continuous across the full width of the base 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 straightedge;

(b) constructed with the joint face square (± 5°) to the finished top surface of the base;

(c) treated with joint filler complying with RMS 3204 and joint sealant installed in accordance with Clause 4.5.2, except that references to backer rod apply only where shown on the Drawings;

(d) maintained at all times free of incompressible and foreign materials. At free edges, the sealant must extend down the full vertical face of the joint. At other edges, the filler must prevent the ingress of concrete to the joint space during subsequent work.

4.5.5 Longitudinal Joints

Provide longitudinal joints as shown on the Drawings to a position tolerance of 25 mm. Longitudinal joints must:

(a) be continuous over their full length 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 straightedge after due allowance for any planned curvature.

(b) for tied joints, have tiebars installed in accordance with Clause 4.1.2.

(c) for formed joints (both tied and untied):

  (i) have the face square (± 6°) to the finished top surface of the base, and corrugated unless otherwise specified;

  (ii) have the face of the joint debonded to prevent intimate microtexture bond;

  (iii) where nonconforming or damaged, reinstate or repairthe joint prior to the placement of adjoining concrete. The repair material must not be placed integrally with the adjoining concrete;

(iv) where a joint cavity is created with a temporary filler, prepare the faces to a clean condition which complies with the requirements of the sealant manufacturer, except that it must be done either by sawing or by using a circular wire brush.

(d) for induced joints:

(i) be provided by sawcutting to a width of 3 mm in accordance with this Specification.

(ii) exhibit at the surface not more than 10 mm width of vertical or horizontal edge ravelling. The cumulative length of ravelling with a dimension exceeding 3 mm must not exceed 300 mm in any 3.0 m length of joint edge (that is, each side of the joint assessed separately).

(iii) be cleaned and sealed in accordance this Specification. Sealing must include the full vertical face at the ends of sawcuts.

4.5.5.1 Condition of Formed Joints and Debonding

Intimate bond at the microtexture level can induce spalling at arrises and must be avoided. For this reason, debonding of the joint face is specified including joints between new and existing concrete pavements.

The first-placed face must be dense and fully compacted and must be free of honeycombing and re-entrant angles. Where the face is nonconforming or the edge is damaged, any reinstatement or repair must be carried out prior to the placement of adjoining concrete. Do not place the repair material integrally with the adjoining concrete.

Re-spray the first-placed face with curing compound not more than 10 days prior to placing the abutting concrete. All aspects of the treatment must be in accordance with the requirements for curing the concrete, except that the compound must be a wax emulsion complying with RMS R82 and a single application must be used at the specified rate plus an increase of 25 per cent. The coating must be intact and effective at the time of subsequent concrete placement.

Steel tiebars must not be sprayed with wax or bitumen compounds.

4.5.5.2 Sawcutting

Sawcutting must proceed in a timely manner so as to prevent cracking of the base concrete other than at the bottom of the sawcut.

Use the type of blade and equipment and the method of control best suited to the hardness of the concrete being sawn. Ensure that sufficient standby equipment is available on site to maintain continuity of sawing.

4.5.5.3 Cleaning

Clean all debris from the sawcut soon after sawing and before the residue dries. The cleaning method used must not damage the sawcut or arrises nor leave any substance deleterious to the concrete or to the adhesion of the joint sealants to be used.

Use a liquid or liquid/air oil-free jet at a sufficiently high pressure to ensure that the faces are dust-free when dry. Gravity fed liquid from tanks is not acceptable. Alternatively, use high-pressure air to clean and dry the joint.

Grit blasting must not be used.

4.5.5.4 Temporary Sealing

Within two hours of cleaning, temporarily seal the joint with a continuous closed-cell polyethylene backer rod or PVC spline rubber seal as shown on the Drawings. Sealing must include the vertical faces of the slab at the ends of sawcuts in order to prevent ingress of materials from subsequent operations.

The top of the backer rod/seal must not be higher than the concrete surface or more than 5 mm below it.

Maintain the temporary sealant in sound condition until the joint is sealed permanently. Remove damaged or disturbed temporary sealants, clean the joint and insert a new temporary sealant.

4.5.5.5 Permanent Sealing

Install permanent sealant as for transverse contraction joints except that, if the backer rod is damaged, only the damaged length needs to be replaced.

4.5.5.6 Widening of existing concrete base

Where the work involves widening of an existing concrete base, treat the existing edge as follows and in accordance with the Drawings and Annexure R83/A.

Undertake correction work (such as sawcutting) to the existing face, as and where specified.

Seal the vertical face of all transverse untied joints in accordance with Clause 4.5.3.5, to prevent ingress of mortar. Seal all cracks (whether induced or unplanned) which are wider than 2 mm at the time of paving.

Fix drilled tiebars and scabble the central part of the joint. Debond the existing face in accordance with Clause 4.5.5.1.

4.5.6 Isolation Joints

Provide isolation joints as shown on the Drawings to a position tolerance of 25 mm. Isolation joints must:

(a) where indicated on the Drawings, be continuous across the full width of the base 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 straightedge.

(b) be constructed square to the finished top surface of the base with a tolerance of ± 5°.

(c) be treated with joint filler complying with RMS 3204 and joint sealant installed in accordance with Clause 4.5.2, except that references to backer rod do not apply.

(d) be maintained at all times free of incompressible and foreign materials. At free edges, the sealant must extend down the full vertical face of the joint. At other edges, the filler must prevent the ingress of concrete to the joint space during subsequent work.

4.5.7 Mismatched Joints and re-entrant angles

Mismatched joints may only be constructed as shown on the Drawings. Do not allow untied joints to form mismatched joints except at a junction with an isolation joint.

Re-entrant angles that exceed 190^0 must be reinforced with SL82 reinforcing fabric.

4.5.8 Outer Edges

Outer edges must:

(a) not deviate from the design position at any point by more than 25 mm.

(b) be continuous over the full length without steps or offsets in any axis so that the line of the edge does not deviate by more than 20 mm from a 3 m straightedge, after due allowance for any planned curvature.

(c) have face geometry complying with Clause 4.5.4, but having corrugations and tiebars only if and as specified on the Drawings.

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.

4.6 KERB AND GUTTER

Construct kerb and gutter in accordance with RMS R15 and as shown on the Drawings, and subject to the following conditions:

(a) kerbs of types SA, SB, SC, SE, SK, SO and SL beside concrete base must not to be extruded unless the Drawings specifically allow extrusion;

(b) concrete for the above kerb types must comply either with this Specification or with AS 1379 for normal class concrete with strength grade N32 and 20 mm aggregate, unless specified otherwise on the Drawings or in RMS R53;

(c) kerb longitudinal joints must comply with Clause 4.5.4 (including debonding of formed joints), but the rounding of the kerb or gutter lip must not be greater than 5 mm, even if a larger rounding is shown on the kerb Drawings;

(d) untied joints must be sealed in accordance with the Drawings;

(e) at all kerb joints, the first placed joint face must be reinstated or repaired if initially nonconforming or damaged, prior to the placement of adjoining concrete. The repair material must not be placed integrally with the adjoining concrete;

(f) all inlet pits must be separated from adjoining base concrete by a Type 15 isolation joint (unbeamed) in accordance with the Drawings;

(g) cure all kerbs in accordance with Clause 4.3.7.

4.7 SPECIAL SLABS

4.7.1 Odd-shaped and Mismatched Slabs

Odd-shaped and mismatched slabs must:

(a) be reinforced if and as shown on the Drawings.

(b) if not shown on the Drawings, be reinforced with SL82 reinforcing fabric, unless transverse construction joints are responsible for the odd shape or mismatch.

(c) be marked by imprint into the surface at the slab edge with the letter "R", except for anchor slabs which must be marked in accordance with Clause 4.7.2. The imprint must be to a depth of 4 mm ± 1 mm below the circular surround.

Omit any stamp that will be covered by an asphalt surfacing.

4.7.2 Anchor Slabs

Construct terminal anchor slabs adjoining bridge approach slabs and at changes from rigid to flexible pavement.

Reinforce anchor slabs as shown on the Drawings and mark their presence by imprinting the letter "A" into the surface at the slab edge. Place the imprint above the anchor centreline and within 0.5 m of each end of the anchor in a relatively low trafficked area. The imprint must be to a depth of 4 mm ± 1 mm below the circular surround.

Omit any stamp that will be covered by an asphalt surfacing.

4.7.3 Bridge Approach Slabs

Construct bridge approach slabs at bridge abutments as shown on the Drawings.

4.8 SLAB ANCHORS

Construct slab anchors as shown on the Drawings, and in accordance with the following:

(a) In jointed base:
  (i) a Type 12 or 18 is provided at bridge approaches;
  (ii) a Type 6 or 12 is provided at flexible pavement transverse interfaces;
  (iii) a Type 12 is provided on steep grades at locations shown on the Drawings.

(b) In CRC base:
  (i) multiple Type 12 anchors are provided at bridge approaches and at flexible pavement transverse interfaces;
  (ii) anchors may be provided at other CRC slab transitions as shown in the Drawings;
  (iii) anchors are not provided within continuous lengths of CRC, regardless of the grade.

(c) Cast the anchor at least 24 hours before the overlying base slab;

(d) trim the trench to neat lines, free of loose soil material, and compact the bottom to at least match the adjacent undisturbed material;

(e) concrete must comply either with this Specification or with AS 1379 for normal class concrete with strength grade N32 and 20 mm aggregate, and slump at the point of placement between 40 mm and 80 mm;

(f) place and compact the concrete using internal vibration in accordance with Clause 4.3.2;

(g) anchor stirrups must be lapped (as defined) to the base reinforcement;

(h) at the junction with an existing flexible pavement, make a straight sawcut to the full depth of any asphalt in the flexible pavement along the joint line. Excavation of the trench must then take place without disturbance or damage to the existing flexible pavement. Any disturbance or damage to the flexible pavement must be made good.

  Drainage of the interface between flexible and rigid pavements must be as shown on the Drawings.

Detail in the PROJECT QUALITY PLAN how you will pave over anchors without damaging the stirrup reinforcement.

5 END PRODUCT CRITERIA

5.1 CONCRETE CRACKING

Detail in the PROJECT QUALITY PLAN the inspection schedule for cracking in base slabs. Cracking is categorised as follows:

(a) In jointed bases:

(i) Plastic shrinkage cracks:
discrete cracks of length less than 500 mm and of depth less than 50 per cent of the base thickness which form during the plastic stage and which do not intersect a longitudinal edge or a formed joint (that is, not an induced joint).

(ii) Drying shrinkage cracks in reinforced slabs (PCP-R and JRCP):
occurring in the central part of the slab, extending full depth and continuous between joints and/or edges. Restraint cracks over anchors are included in this category.

(iii) Unplanned structural cracks:
all other cracks, including drying shrinkage in unreinforced slabs.

Slabs will be accepted as conforming according to the following criteria:

(A) PCP and SFCP slabs: if they contain only plastic shrinkage cracks with a cumulative length of 1 m or less in any slab.

(B) PCP-R, SFCP-R and JRCP slabs: if they contain only plastic shrinkage cracks with a cumulative length of 1 m or less in any slab, and drying shrinkage cracks.

Remove and replace all other cracked slabs in accordance with Clause 5.6.

(b) In CRC base:

(i) Plastic shrinkage cracks:
discrete cracks of length less than 500 mm and of depth less than 50 per cent of the base thickness which form during the plastic stage and which do not intersect a longitudinal edge or a formed joint (that is, not an induced joint).

(ii) Planned cracks other than induced joints:
full depth discrete transverse cracks without branches or convergences over the full width between longitudinal formed joints or edges. These cracks do not require any treatment.

(iii) Restraint cracks over anchors.

Plastic shrinkage cracks with a cumulative length of 1 m or less in any 5 m x 5 m square area of base must be filled with a suitable low viscosity penetrating epoxy resin, within 7 seven days of casting of the concrete.

Planned cracks forming induced longitudinal joints must be treated in accordance with Clause 4.5.5.

Any cracking beyond that listed above will render that concrete nonconforming.

(c) General:

Within 4 days of paving, report all nonconforming cracking and submit scaled crack maps of all nonconforming cracking.

5.2 CONCRETE COMPACTION

5.2.1 Conformity for Compaction

Lot definition for compaction is as defined in Clause 1.3, except for Transition Zones in slipformed work.

For the purpose of compaction testing, treat Transition Zones as separate Lots of work according to the following rules:

(i) At each transverse construction joint in slipformed work, generate one discrete Transition Zone on each side of the joint, each for a length of 3 m or as otherwise nominated under Clause 4.3.3(viii).

(ii) where a transition point (as defined) is remote from a transverse construction joint, treated the transition point as if it were a joint (that is, generate two transition Lots as in (i) above).

In fixed-formed paving:

A Lot conforms for compaction if:

(a) it has been internally vibrated by a planned and systematic procedure, followed by a minimum of two passes of a vibrating screed, all in accordance with Clause 4.3.2, and;

(b) vibration was undertaken in such a way as to limit lateral spreading of the mix, and;

(c) any disturbed areas (such as workers' footprints) in the compacted mix have been reinstated in accordance with Clause 4.3.2, and;

(d) the relative compaction is at least 98.0 per cent, determined in accordance with RMS T381 as the percentage ratio of the core unit mass of the Lot to the rolling cylinder unit mass (RCUM) for the Lot, and;

(e) the within-core variability does not exceed 40 kg/m^3, determined in accordance with Clause 5.2.4.

Lots which do not comply with sub-clauses (a), (b) and (c) will not be assessed under sub-clauses (d) or (e), and they must be removed and replaced.

Lots which comply with sub-clauses (a), (b) and (c) but which do not comply with sub-clauses (d) and (e) must be assessed as follows:

(A) If the relative compaction is between 97.0 per cent and 98.0 per cent, take cores in accordance with Clause 5.3.3 and assess the Lot in accordance with Clause 5.3.4.2 on the basis of the 28-day core compressive strength.

(B) If the relative compaction is less than 97.0 per cent, the Lot must be removed and replaced in accordance with Clause 5.6.

(C) If the only nonconformity is the within-core variability, the Lot will be accepted subject to corrective action being taken in the compaction process in accordance with Clause 4.3.1 or 4.3.2, as appropriate.

In slipformed paving:

A Lot conforms for compaction if:

(f) it has been internally vibrated by a planned and systematic procedure in accordance with Clause 4.3.1, and;

(g) vibration was undertaken in such a way as to limit lateral spreading of the mix, and;

(h) the relative compaction is at least 98.0 per cent, determined as the percentage ratio of the core unit mass of the Lot to the rolling cylinder unit mass (RCUM) for the Lot, and;

(i) the within-core variability does not exceed 40 kg/m^3, determined in accordance with Clause 5.2.4.

Lots which do not comply with sub-clauses (f) and (g) will not be assessed under sub-clauses (h) or (i), and they must be removed and replaced.

Lots which comply with sub-clauses (f) and (g) but which do not comply with sub-clauses (h) and (i) must be assessed as follows:

(D) If the relative compaction is between 97.0 per cent and 98.0 per cent, take cores in accordance with Clause 5.3.3 and assess the Lot in accordance with Clause 5.3.4.2 on the basis of the 28-day core compressive strength.

(E) If the relative compaction is less than 97.0 per cent, the Lot must be removed and replaced in accordance with Clause 5.6.

(F) If the only nonconformity is the within-core variability, the Lot will be accepted subject to corrective action being taken in the compaction process in accordance with Clause 4.3.1 or 4.3.2, as appropriate.

5.2.1.1 Moulding and Testing of Cylinders

Determine the unit mass reference values for concrete compaction using standard moulded cylinders and in accordance with the following provisions:

(a) The test cylinders are those which are moulded for 28-day compressive strength testing. Determine the unit mass on all cylinder specimens cast for 28-day strength testing at an age of between four and seven days in accordance with AS 1012.12 Method 2, amended in accordance with sub-clauses (b) and (c) hereunder.

(b) Mass testing must be in the saturated surface-dry condition and without dressing of voids; RMS T368 refers.

(c) Individual results must be rounded to the nearest even number (in contrast to AS1012.12 which requires rounding to the nearest 10 kg/m^3). The unit mass for a pair of cylinders is the average of the two results unless they differ by more than 20 kg/m^3, in which case the higher result represents the unit mass of the pair. Round the averaged results to the nearest 5 kg/m^3.

For each nominated mix in use, make a statistical check to determine the rolling cylinder unit mass (RCUM) using the pair unit mass as defined under sub-clause (c).

For the paving trial, the RCUM is the mean of all 28-day pairs from that trial of the same concrete mix. Round the mean result to the nearest 5 kg/m^3.

Thereafter, take the RCUM for any Lot as the mean of the five consecutive pairs of 28-day cylinders of that mix up to and including that Lot (including the results from the paving trial, where applicable). Where fewer than five pairs of a nominated mix are available, take the RCUM as the mean of all available pairs from that mix. In each case, round the mean result to the nearest 5 kg/m^3.

Do not use the unit mass of flexure specimens and 7-day strength specimens in calculations of the RCUM.

5.2.1.2 Core Specimens

Specimens for determining the relative compaction of concrete must be cores of nominal diameter 75 - 100 mm, cut and extracted from the full depth of the concrete base, in accordance with AS 1012.14 except that the minimum concrete age for coring is:

(a) four days in the cool season;

(b) two days in the warm season,

subject to the cores being extracted without damage.

The location of coring must comply with Clause 5.2.1.3.

Within two hours of being extracted, place the cores in either a tank of lime saturated water or individual plastic bags that are sealed to prevent water loss and stored in the shade.

Cores must not be subjected to temperatures:

(i) in excess of the ambient temperature or 28°C, whichever is higher, and

(ii) less than 10°C.

Test all cores for unit mass and report all results.

5.2.1.3 Frequency and Location of Coring for Compaction

The Lots for determining compaction are based on the Lots created in accordance with Clause 1.3 of this Specification. Transition zones generate separate sub-Lots.

(a) In slipformed concrete:

  (i) take at least one core specimen from each Lot until ten consecutive conforming Lots (that is, not less than 98.0 per cent compaction) are obtained, and then;

  (ii) at least one core from each second Lot until ten consecutive conforming Lots are obtained, and then;

  (iii) one core from each third Lot.

  In each case, avoid transition zones and select sampling Lots 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).

(b) In manually paved base, take two cores from each Lot.

(c) In transition zones, commencing with the trial section, the minimum frequency of coring is as follows:

  (i) two cores from each Lot until three consecutive conforming Lots (that is, not less than 98.0 per cent compaction) are obtained; and then

  (ii) two cores from each third Lot, which must be selected on the basis of time sequence, until four consecutive Lots conform; and then

  (iii) one core from each fifth Lot, 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).

Choose the location of coring in accordance with RMS Q but with grid lines established in accordance with the criteria shown for a dual-lane paving run in Figure R83.5. Apply consistent criteria for single-lane paving runs such as shoulders and ramps.

Use a metal detector to locate all reinforcement.

Adjust the longitudinal location by the minimum extent necessary to:

(A) exclude steel reinforcement and tiebars from the core except as required under Clause 4.1.2.2 or as otherwise required by the Principal to assess process uniformity.

(B) in jointed pavements, to maintain a longitudinal separation of 1.51.0 m minimum from any transverse untied joint.

In continuously reinforced pavement, also adjust the transverse location in both directions by the minimum extent necessary to avoid the longitudinal reinforcement.

For small and/or odd-shaped slabs, avoid coring:

(C) within 0.50 m of an edge or longitudinal joint, and;

(D) within 0.30 m of a transverse tied joint, and;

(E) within 1.5 m of a transverse untied joint.

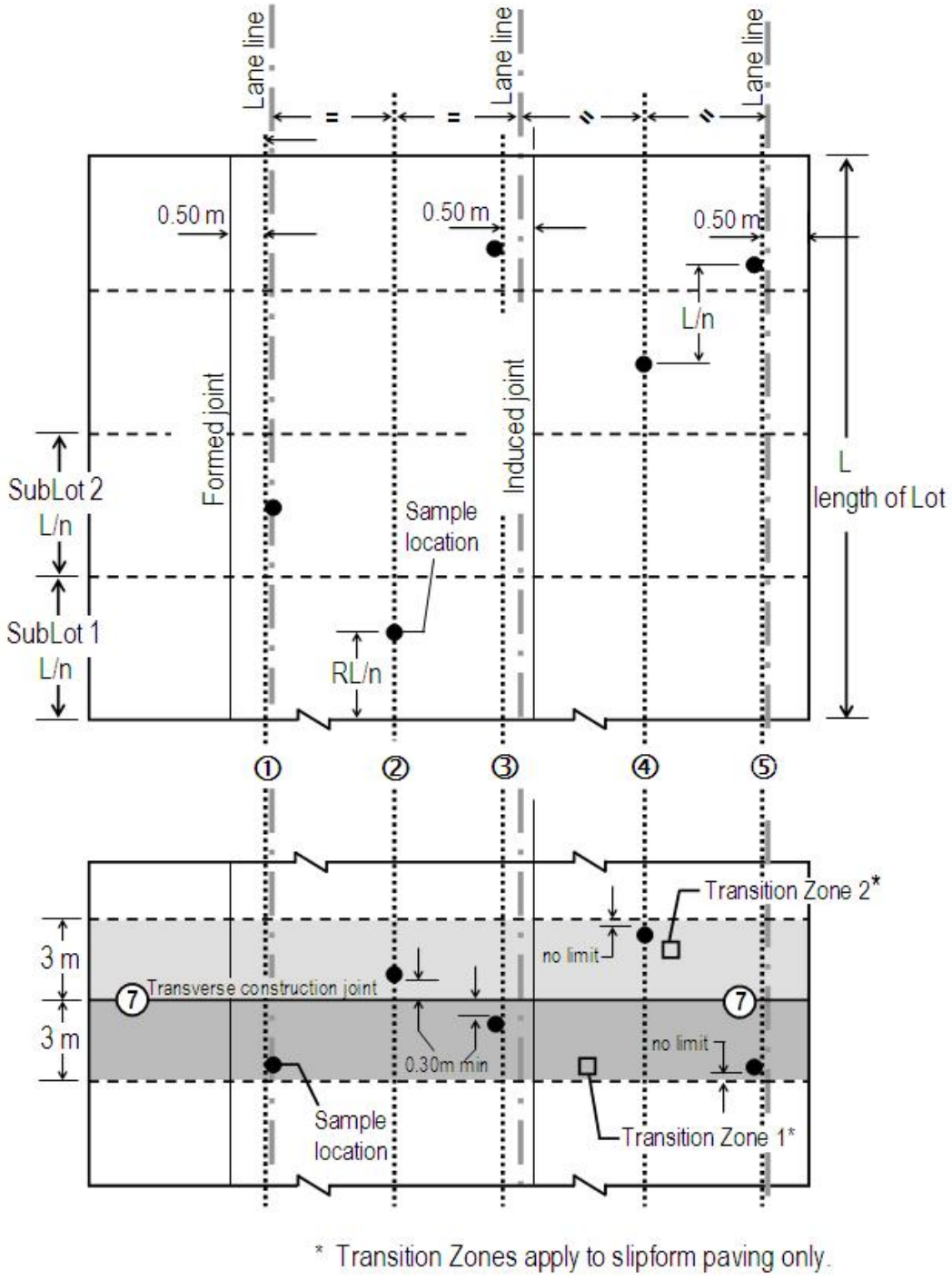
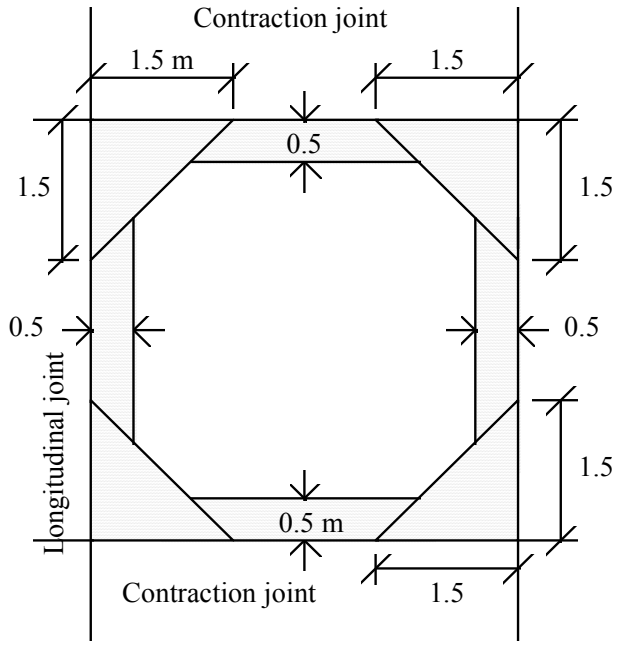


Figure R83.5 - Sampling locations for a dual-lane paving Lot



The Contractor shall not take cores from within shaded areas except as otherwise stated in this Specification.

Figure R83.6 - Preferred location of cores

5.2.2 Repair of Core Holes

Clean and restore all core holes taken in the base with low-shrink cementitious concrete having a compressive strength of not less than that in the base. The authorised base mix may be used for this purpose.

The surface of the restored hole must be similar in colour to the surrounding surface. Prior to trafficking, the concrete in the core must be cured sufficiently to achieve an expected compressive strength of 10 MPa. Demonstrate the expected strength gain by previous testing or by a technical data sheet.

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

5.2.3 Core Testing for Unit Mass

Determine the unit mass of the cores in accordance with AS 1012.12.2, qualified as follows:

(a) Determine the initial mass (m_1) of the specimen, prior to any dressing, in accordance with AS 1012.12.2 Clause 6(a) and in the saturated surface-dry (SSD) condition. This will require wet conditioning for 24 hours in accordance with Clause 6(c).

(b) assess the cores in accordance with RMS T368 for excessive voids. Dress voids where required.

(c) determine the immersed mass (m_2) in accordance with AS 1012.12.2.

(d) determine m_3 (the SSD mass including dressing). The dressing must be fully intact at the time of weighing.

(e) calculate the volume and mass per unit volume in accordance with AS 1012.12.

(f) the concrete age at testing must be between three and seven days.

(g) adjust the unit mass for the presence of steel reinforcement in accordance with RMS T368.

(h) test the full depth of the core except that:

(A) non-concrete materials such as bitumen must be removed.

(B) up to 20 mm of concrete may be removed from each end of the core.

(i) report the height and diameter of the core, as tested.

(j) round individual results for unit mass to the nearest even number (in contrast to AS1012.12 which requires rounding to the nearest 10 kg/m^3).

Where two cores are available from a Lot, the unit mass of the Lot is the average of the test results unless they differ by more than 20 kg/m^3, in which case the lower result applies. Round averaged results to the nearest 5 kg/m^3.

Where three or more cores are available from a Lot, the unit mass of the Lot is the average of the test results rounded to the nearest 5 kg/m^3. However, if the lowest result differs from the average by more than 30 kg/m^3, the lowest result applies.

5.2.4 Within-Core Variability

Industry comment welcome *on the specified values and frequencies.*

Test the cores for variability in unit mass between the upper and lower parts of the core. The variability must not exceed 40 kg/m^3 when calculated as the difference between the two results using the measured unit mass values rounded to the nearest even number.

Where more than one core is available from a Lot, do not choose the lowest unit mass core to test within-core variability.

Use the cores which have been extracted under Clause 5.2.1 to test variability at a minimum frequency of one in three commencing at the pavement trial until five consecutive conforming results are obtained, and thereafter at a minimum frequency of one in ten unless a nonconformity occurs, in which case the frequency reverts to one in three. Select the cores for testing on the basis of time sequence of paving.

Prepare the core for testing by sawing into two cylinders of equal length with a tolerance of ± 20 mm. Jointly condition and test the two parts. Assess each specimen in accordance with RMS T368 for excessive voids and, if required, dress the specimen prior to testing.

5.3 CONCRETE COMPRESSIVE STRENGTH

5.3.1 Lot Definition

See Clause 1.3.

5.3.2 Cylinder Strength Testing

For each Lot of base, mould two pairs of cylinder test specimens for compressive strength testing; one at 7 days and the other at 28 days. Seven-day testing is covered by Clause 4.2.1.

Sampling must comply with AS 1012.1.

Mould the specimens in accordance with Table R83.6.

Determine the compressive strength of concrete using moulded 28-day test cylinders of 100 mm nominal diameter complying with Clause 3.5, with compaction by internal vibration in accordance with T304.

The following provisions also apply:

(a) All specimens of a set must be moulded from the same sample of concrete.

(b) For concrete delivered by mobile mixer, sampling must occur at the point of discharge or the point of testing, and after final retempering.

Inspect, cap and crush the concrete specimens in accordance with AS 1012.9. Determine their unit mass in accordance with Clause 5.2.1.

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 is the average test value, except that the higher result applies if the difference in the results exceeds 10 per cent of the average. However, as soon as ten pair results become available, the following condition applies:

(c) If the mean of such differences for 10 consecutive pairs (up to and including that in question) is greater than or equal to 5 per cent of the mean strength value for all 20 cylinders, then the compressive strength for a pair is taken as the average of the two results.

5.3.3 Core Strength Testing

Where core strength testing is required, it must be carried out as follows:

(a) for slipformed base, take two cores at locations separated by at least one third of the length of the Lot.

(b) for manually paved base, take two cores at locations separated by at least one third of the length of the Lot.

(c) for transition Lots, take one core.

(d) wet-condition the cores up to the time of testing and in accordance with AS 1012.14, except that Clause 6.4(d)(i)(B) therein is amended by replacing the words "for three days" with the words "for not less than two days nor more than three days".

Do not take additional cores for this purpose without the prior approval of the Principal.

Adjust the test results for age and shape in accordance with Clause 5.3.5.

5.3.4 Conformity for Compressive Strength

5.3.4.1 Test Cylinders

Assess the concrete within the following discrete categories:

(a) slipformed;

(b) fixed-formed;

(c) transition Lot.

If the 28-day compressive strength of test cylinders for any Lot is less than $0.9f_{cMin}$, remove and replace the Lot represented by the test cylinders in accordance with Clause 5.6.

Concrete with a 28-day cylinder strength between $0.9f_{cMin}$ and f_{cMin} occurring during progress of the Contract will be accepted subject to a deduction, provided that it represents less than 5 per cent of the area of the applicable base category placed up to and including that Lot. Such concrete will be subject to a deduction of 4 per cent of the schedule rate for supply and place concrete in base, for each 0.5 MPa or part thereof deficiency in strength.

5.3.4.2 Cores

Alternative wording welcomed

Where required to be tested in accordance with Clause 5.2.1(A) or (D), the Lot will conform for core strength if the corrected strength is greater than or equal to f_{cMin} for all core specimens from that Lot.

Where this criteria is not met, the Lot is nonconforming but will be accepted subject to a deduction of 4 per cent for each 0.5 MPa or part thereof deficiency in strength, provided that:

(a) the mean of all corrected core strength results from the Lot is greater than or equal to f_{cMin}.

(b) no result is less than 0.9 f_{cMin}.

(c) the total area of such a Lot is less than 5 per cent of the area of the applicable base category placed up to and including that Lot.

(d) the deficiency in strength is based on the lowest corrected core strength result from that Lot.

(e) the deduction is applied to the schedule rate for supply and place concrete in base.

Nonconforming Lots which do not meet these criteria must be removed and replaced in accordance with Clause 5.6.

5.3.5 Correction Factors for Age and Shape

Correction factors, AF for age and SF for shape, are given in Table R83.22 and Table R83.23 respectively. For intermediate ages, determine factor AF on a pro-rata basis rounded to two decimal places.

Alternatively, you may derive AF for your mix as follows:

(a) derive AF for cylinders and beams as a part of the trial mix, and;

(b) calculate AF for cores by apportioning your cylinder AF in the ratio used at specific ages in Table R83.22.

Multiply the test strength by factor SF and divide by factor AF to derive the factored strength. Apply the correction factors to the unrounded strength.

Table R83.22 - Age Correction Factors

Age of specimen at time of test (days)	Correction Factor (AF)					
	Compressive Strength				Flexural Strength [2]	
	Cylinders		Cores		Beams	
	SCM content (%) [1]					
	0	≥ 15	0	≥ 15	0	≥ 15
28[3]	1.00	1.00	0.90	0.90	1.00	1.00
35	1.02	1.03	0.93	0.94	1.01	1.02
42[3]	1.04	1.06	0.96	0.98	1.02	1.03
49	1.06	1.09	0.98	1.01	1.02	1.04
56[3]	1.08	1.12	1.00	1.04	1.03	1.05
70	1.10	1.15	1.02	1.07	1.03	1.07
84	1.12	1.18	1.03	1.09	1.04	1.07
112[3]	1.14	1.21	1.06	1.12	1.05	1.09
140	1.16	1.24	1.07	1.14	1.06	1.11
168	1.18	1.27	1.08	1.16	1.07	1.12
196	1.20	1.30	1.09	1.18	1.07	1.12
224	1.22	1.33	1.09	1.19	1.08	1.13
308	1.24	1.36	1.10	1.20	1.09	1.13
365 or greater	1.25	1.38	1.10	1.21	1.10	1.13

Notes:

1. Relative to the total cementitious content.
2. Not specified for Lot acceptance.
3. Where you elect to derive factor AF for your mix, data must be obtained, as a minimum, at these ages, with a tolerance of three days.

Table R83.23 - Shape Correction Factors for Cores

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

5.4 GEOMETRY AND THICKNESS

5.4.1 Alignment Tolerances

Within four days of placing an area of concrete base, survey the alignment and inspect each joint for conformity. Tolerances on horizontal alignment are given in Clause 4.5 for the outer edges of the base and for joints.

If nonconformity is detected, immediately implement Corrective Action in accordance with the requirements of RMS Q.

5.4.2 Level Survey

Carry out a survey in accordance with RMS G71 to determine finished surface levels on the subbase. Regardless of the subbase type, carry out the survey in accordance with RMS R82and base.

Within four days of placing an area of concrete base, carry out a survey in accordance with RMS G71 to determine conformity of the base surface level and thickness. Rectification of nonconformity must comply with Clause 5.7.

The level at any point on the top of the base must not vary by more than 20 mm above or 5 mm below the contract level.

Assess levels within Lots which correspond to those established under Clause 1.3. Round the departures from the contract level to the nearest 5 mm. A Lot is nonconforming if it contains any individual nonconforming levels.

Take levels with a flat based staff of base area between 300 mm^2 and 4000 mm^2 at the following locations. Report the levels to the nearest millimetre:

(a) (i) at cross-section offsets shown in Figure R83.5, and;

(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, and;

(b) randomly selected at a minimum frequency of at least half the frequency required to comply with (a) above.

If a survey procedure is adopted which produces an as-built level model of the top of both the subbase and base, each with comparison to the design model, this model may be accepted by the Principal. A condition of acceptance is continued correlation with all pavement thickness results calculated from

the model with pavement thickness measured from cores and production of a schedule at locations the same as those for accurately located levels.

The schedules of measured levels must show actual and contract levels (after applying the approved design adjustment, refer to Clause 3.2.4) 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 contract levels as positive differences and actual levels that are below contract levels as negative differences.

Exclude locations that are nonconforming and then calculate the mean of differences.

Assess the base surface levels for conformity on the basis of individual survey points. Submit a nonconformity report and attach the survey report and the relevant assessment of thicknesses in accordance with Clause 5.4.3.

5.4.3 Thickness Assessment

(a) Assess thickness within Lots which correspond to those established under Clause 1.3. Calculate base thickness to the nearest 1 mm at individual survey points selected in accordance with Clause 5.4.2 as the difference between the finished base level and the base 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. Include in the PROJECT QUALITY PLAN the method of determining the thickness adjustment.

(b) Measure the base thickness to the nearest 1 mm on the cores taken for compaction testing. Adjust the measured thickness in accordance with Clause 3.2.4 to remove the contribution of the interlayer treatment.

(c) Wherever a core result differs by 5 mm or more from a survey result located within 1.5 m, or by 10 mm or more in the range 1.5 m to 2.5 m, the core result must be accepted and the survey result culled from the assessment.

The surveys are deemed to be nonconforming if the frequency of such occurrences is higher than three in any group of 10 consecutive comparisons.

The Principal may authorise the drilling of 40 mm diameter cores in areas where the thickness calculated from survey results is nonconforming and no representative cores are available for comparison. Do not take additional cores for the purpose of thickness assessment without the prior approval of the Principal.

(d) Show excess thicknesses as positive values and deficient thicknesses as negative values. Calculate the mean thickness for each Lot using all core results and un-culled survey results (all to the nearest 1 mm). Round the mean to the nearest 5 mm.

Then, Ffor the purpose of assessing thickness conformity, round all individual deficiency results to the nearest 5 mm.

5.4.4 Conformity for Thickness

Assess Lots for thickness in accordance with Table R83.24.

Apply deductions to the schedule rate for supply and place of concrete in base.

Table R83.24 - Assessment Criteria for Thickness

Text Reference	Thickness deficiency (mm)				Status/Action
	Mean (mm)		Individual (mm)		
			Result (mm)	Frequency	
Conformity with Clause 5.4.3	Nil	⇦ and ⇨	5 and ≥ 10	≤ 2 Nil	Conforming
Nonconformity	Nil	⇦ and ⇨	5 and 10 to 15	> 2 Nil	Nonconforming 12% deduction
Nonconformity	Nil	⇦ and ⇨	5 and ≥ 20	> 2 Nil	Nonconforming 45% deduction
Nonconformity	Nil	⇦ and ⇨	10 to 15 and ≥ 20	≥ 1 Nil	Nonconforming, 45% deduction
Nonconformity	5	⇦ and ⇨	≥ 20	Nil	Nonconforming, 24% deduction
Nonconformity	≤ 10	⇦ and ⇨	≥ 20	≥ 1	Nonconforming, remove and replace
Nonconformity	10	⇦ and ⇨	≥ 20	Nil	Nonconforming, 60% deduction
Nonconformity	≥ 15				Nonconforming, remove and replace

Table R83.24 - Assessment Criteria for Thickness

Thickness deficiency (mm)				Status
Mean of Lot [1]	Individual points [1, 2]			
	≥ 20 mm	10 - 15 mm	5 mm	
≥ 15 mm	U	U	U	Nonconforming, remove and replace
10 mm	2 or more	U	U	Nonconforming, remove and replace
	0 - 1	U	U	Nonconforming, 60% deduction
5 mm	2 or more	U	U	Nonconforming, remove and replace
	0 - 1	3 or more	U	Nonconforming, 60% deduction
		0 - 2	U	Nonconforming, 45% deduction
≤ 0 mm[3]	2 or more	U	U	Nonconforming, 60% deduction
	1	3 or more	U	Nonconforming, 45% deduction
		0 - 2	U	Nonconforming, 24% deduction
	0	3 or more	U	Nonconforming, 24% deduction
		1 - 2	U	Nonconforming, 12% deduction
		0	U	Conforming

Notes:

1. All values represent deficiencies except as stated in Note 3.
2. In cells labelled "U", there is no limit on the allowable number of under-thick points.
3. A value less than zero denotes a mean thickness that exceeds the specified minimum.

5.5 SURFACE PROFILE

5.5.1 Transverse Profile

Within two days of paving, Ttest surface deviations in a transverse direction in accordance with RTARMS T183. Deviations under a 3 m straightedge must not exceed 5 mm, except for areas within 10 m of superelevation transitions where deviations must not exceed 3 mm. Where the surface deviation is convex, place the straightedge so that the canti-lever length does not exceed 0.75 m.

Commencing with trial paving, test for conformity with the straightedge criteria as follows:

(a) within each day's paving at random locations at a minimum frequency of:

(i) one test per 15 m of paving run, until four conforming results are recorded; and thereafter

(ii) one test per 50 m of paving run.

(b) across longitudinal joints, at a minimum frequency of:

(i) one test per 15 m of joint, until four conforming results are recorded; and thereafter

(ii) one test per 50 m of joint.

Testing frequency reverts to (i) if nonconformity is detected.

(c) testing, additional to the above, must be undertaken at each superelevation transition at three random locations within 10 m, at both mid-slab and longitudinal joints.

5.5.2 Longitudinal Profile

Within 48 hours2 days of paving, test the longitudinal profile by either:

- measuring deviations under a 3 m straight-edge in accordance with RMS T183, or;
- testing with a Class 1 Profiler device which is capable of measuring at intervals not greater than 250 mm with an accuracy of 0.5 mm in accordance with RMS T369.

Test in each trafficked lane and the near-side shoulder in the following areas:

(a) within 15 m each side of transverse construction joints.

(b) at approach sections (as defined).

Extend the limit of profile testing beyond the defined 15 m in accordance with Clause 5.5.3 to cover any area paved under the Contract which cannot be tested for roughness. Profile testing must also extend beyond the limit of the Contract (where an abutting running surface is available at base level) by at least 10 m or whatever lesser length is available. Assessment for payment deduction purposes will be limited to the first level recorded beyond the limit of Contract.

(c) at all slab replacements, including 10 m beyond the replacement in each direction.

Where a Class 1 Profiler device is used, test using the following procedure:

(d) Measure the surface profile along a straight line within 0.3m of the centre of a traffic lane (or potential lane), and in accordance with the operating manual for the device in used.

(e) A discontinuity in measurement occurs when the data acquisition system is reset during recording. At discontinuities in measurement of a profile, provide an overlap of at least 5.0 m on a line within 0.01 m offset of the original, and record the chainage (longitudinal location) of the discontinuity to an accuracy of at least 0.2 m.

Discontinuities are not permitted in profile measurements of test lengths that are less than 100 m. are not permitted. Captured data must be discarded and testing recommenced from the start point.

(f) At junctions of testing lines at ramps and intersections of road pavement, extend the measurement for a distance of at least 1.0 m beyond the junction, and record the point of intersection to an accuracy of 1.0 m in both measurement series.

(g) On road pavement at the approach to a bridge structure, extend the pavement profile testing onto the bridge approach slab or abutment by 15.0 m, or the maximum lesser length available.

(h) Report the longitudinal profile in terms of the International Roughness Index (IRI), with units of metres level change per kilometre (m/km)deviations using the simulated straightedge function.

Report results at intervals as follows:

(i) For test lengths of 100 m or less, at 10.0 m test intervals;

(ii) For test lengths greater than 100 m, at both 10.0 m and 100 m test intervals.

The requirements for surface correction are as follows:

(A) grind high deviations under a 3 m straightedge that exceed 5 mm;

(B) grind areas which are high by 1020.0 mm or more. Such grinding may be used under Clause 5.5.3 to reduce the level of deduction or to increase the level of incentive payment.

(C) grinding may be carried out at your discretion for areas which are high by less than 10.0 20.0 mm. Such grinding may be used under Clause 5.5.3 to reduce the level of deduction or to increase the level of incentive payment.

Carry out grinding in accordance with Clause 5.7.

5.5.3 Ride quality

5.5.3.1 Testing

After completion of grinding under Clause 5.5.2, assess the ride quality of the finished surface by measuringusing either:

(a) IRI using thea laser profilometer in accordance with RMS T188, or;

(b) IRI by longitudinala Class 1 profiler testing in accordance with Clause 5.5.2RMS T369.

Report the longitudinal profile in terms of the International Roughness Index (IRI), with units of "metres level change per kilometre (m/km)".

Report results at intervals as follows:

- for test lengths of 100 m or less, at 10.0 m test intervals;
- for test lengths greater than 100 m, at both 10.0 m and 100 m test intervals.

The timing of testing must also comply with Clause 4.3.8.4. Measure the ride quality within the sections nominated in Table R83.25. For testing under RMS T188, use a test speed of:

(i) 50 km/h where the posted speed limit is less than 80 km/hr; and

(ii) 80 km/h where the posted speed is 80 km/h or greater.

The roughness value for any Lot is the average of three survey runs over that Lot.

Roughness testing must extend as close as practicable to approach sections (as defined). Any area not assessed for roughness must be assessed for profile in accordance with Clause 5.5.2sub-clause (b) above. No area will be assessed on both tests.

Use the following procedure for testing.

(A) Divide each nominated pavement test section into segments 100 m long.

On multiple lane carriageways, test and assess each traffic lane separately.

Include any segment less than 100 m with the segment immediately preceding it, and determine an average roughness for the total segment.

(B) Include transverse construction joints in the count except where they constitute the limits of contract or where they border an area of pavement which is exempt from assessment for roughness. For the purpose of roughness testing, transverse joints are deemed to include the pavement within 5 m of the joint.

(C) Conduct testing within each traffic lane and within the planned wheel paths, except that the testing line must be adjusted to comply with sub-clause (ivD).

(D) The testing wheels must not run closer than 0.3 m to a formed longitudinal joint except in ramp gore areas as per (E) hereunder. Ramp gore areas (for the purpose of this specification) are indicated in Figure R83.6.

(E) Test ramp gore areas in the wheel path which a vehicle would typically follow when loading on or off the through carriageway.

Unless otherwise specified, the gore kerb nose (between the ramp and the through carriageway) constitutes the limit of the gore area.

Ignore longitudinal joints within the ramp gore for the purpose of roughness testing.

For gore areas which widen to dual ramp lanes, the roughness result is the average of separate runs along wheel paths leading to each lane.

(F) The incentive/deduction for any segment (with the exception of ramp gores) applies to the width of the slab bounded by longitudinal joints.

For the left (slow) lane of a typical dual lane carriageway, the incentive/deduction applies to the slab width bounded by the formed shoulder joint and the induced central joint. For the adjacent right (fast) lane, the result applies to the width bounded by the central induced joint and the outer median edge, including any integrally placed median shoulder.

(G) Within ramp gores, the incentive/deduction applies to the total width of the traffic lanes bounded by outer edge lines.

(H) Where a longitudinal joint runs down the middle of a traffic lane, ignore the joint for the purpose of roughness testing, subject to compliance with sub-clause (iv) (D). The result so obtained applies to the combined width of the two adjoining slabs bounded by the next longitudinal joints.

For the purpose of profile testing, adjust the test line where required in order to comply with sub-clause (D).

(I) Where shoulders are too narrow to fully contain the test vehicle, run the vehicle with two wheels within the test lane and the other wheels within the adjacent lane. The result so obtained is hereafter referred to as a composite result.

Where the adjacent lane was constructed under the Contract, the composite result is applied to the shoulder in accordance with this Specification.

Where the adjacent lane was constructed by others, no incentive/deduction applies to the shoulder.

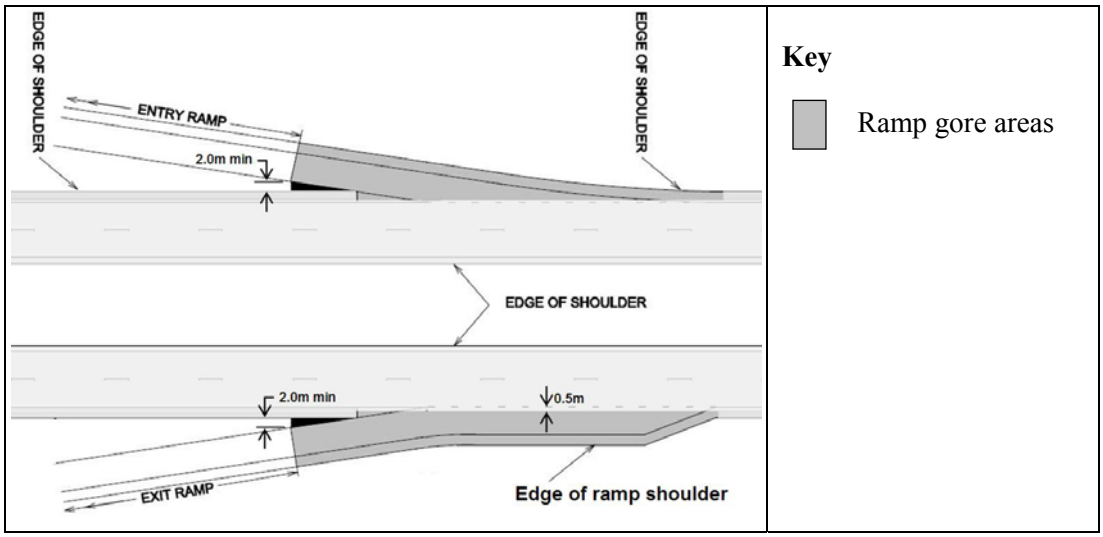


Figure R83.6 - Ramp gore areas

5.5.3.2 Assessment

Assign a pavement roughness category (PRC) according to Table R83.25 for each test segment.

Assess the roughness according to Table R83.26. Segments of base which score a positive value will earn an incentive payment. Segments of base which score a negative value are deemed nonconforming but may be accepted subject to a deduction.

Table R83.25 - Pavement Roughness Categories (PRC)

Nominated pavement section		PRC
Through carriageways	trafficked lanes [3] - longitudinal grade ≤ 4.0%	1
	trafficked lanes [3] -longitudinal grade > 4.0%	3
	shoulders [2]	2
Ramps [2]	within gore areas:[4]	3
	beyond gore areas:[4] - speed limit greater than or equal to 80 km/h - speed limit less than 80 km/h	2 3
Minor roads [2]	speed limit greater than or equal to 80 km/h	3
	speed limit less than 80 km/h	4
Project specific areas [1]		
Under asphalt surfacing [5]		5

Notes:

1. Values to be provided, if applicable, by the Principal. Some areas may not be assessable. Annexure R83/A refers.
2. Shoulders on ramps and minor roads are not to be separately assessed.
3. See Clause 5.5.3.1 for possible exemption of approach sections.
4. Unless otherwise specified, the gore kerb nose will be the limit of the gore area.
5. The Principal may elect to add further areas which will be asphalt surfaced at a later date under separate contract; see Annexure R83/A.

5.5.3.2 Assessment

In accordance with Clause 5.5.3.1, assess the base for roughness according to Table R83.26.

Segments of base which score a positive value will earn an incentive payment. Segments of base which score a negative value are deemed nonconforming but may be accepted subject to a deduction as follows.

Calculate an incentive/deduction value for roughness for each segment in accordance with Table R83.265, and Pay Items R83P10 and R83P11.1, and Clause 5.5.3.3, except that:

(a) An incentive/deduction will not apply to any area of a segment which is to be removed, for whatever reason, at no cost to the Principal.

(b) For base which is nonconforming in terms of thickness, compaction or strength:

  (i) an incentive will not apply, notwithstanding its possible acceptance by the Principal.

  (ii) a deduction will be applied to base which is accepted by the Principal.

(c) Replacement base (as covered by Clause 5.6) must be assessed for both incentive and deduction.

Carry out surface grinding in accordance with Clause 5.7 where specified in Table R83.26.

Table R83.26 - Incentive/Deduction Levels

NAASRA Roughness (Informative [3]) **R**	**Roughness Index IRIqc (RI)** [2]	**Incentive/Deduction (%)** "+" denotes an incentive "-" denotes a deduction				
(counts per km)		PRC 1 [1]	PRC 2 [1]	PRC 3 [1]	PRC 4 [1]	PRC 5 [1]
R < 20	RI < 0.9	+ 3.0	+ 3.0	+ 3.0	+ 3.0	0
20 ≤ R < 25	0.9 ≤ RI < 1.1	+ 2.0	+ 2.0	+ 2.0	+ 2.0	0
25 ≤ R < 30	1.1 ≤ RI < 1.3	+ 1.0	+ 1.0	+ 1.0	+ 1.0	0
30 ≤ R < 35	1.3 ≤ RI < 1.5	+1.0	+ 1.0	+ 1.0	+ 1.0	0
35 ≤ R < 40	1.5 ≤ RI < 1.7	0	0	0	+ 1.0	0
40 ≤ R < 45	1.7 ≤ RI < 1.9	- 2.0	0	0	+ 1.0	0
45 ≤ R < 50	1.9 ≤ RI < 2.1	- 2.0	- 1.0	0	0	0
50 ≤ R < 55	2.1 ≤ RI < 2.3	- 4.0	- 3.0	- 2.0	0	0
55 ≤ R < 60	2.3 ≤ RI < 2.5	- 8.0	- 5.0	- 2.0	0	0
60 ≤ R < 65	2.5 ≤ RI < 2.7	- 16.0	- 8.0	- 4.0	- 1.0	0
65 ≤ R < 70	2.7 ≤ RI < 2.9	Grind	- 12.0	- 8.0	- 4.0	- 2.0
70 ≤ R < 75	2.9 ≤ RI < 3.1	Grind	- 16.0	- 16.0	- 8.0	- 4.0
75 ≤ R < 80	3.1 ≤ RI < 3.3	Grind	Grind	Grind	- 12.0	- 8.0
80 ≤ R ≤ 85	3.3 ≤ RI ≤ 3.5	Grind	Grind	Grind	- 16.0	- 12.0
R > 85	RI > 3.5	Grind	Grind	Grind	Grind	- 16.0

Notes:

1. Categories defined in Table R83.25.
2. RI: measured Roughness Index using the quarter-car model (IRIqc).
3. This column is Informative only. Base the assessment on the Roughness Index.

5.6 REMOVAL AND REPLACEMENT OF CONCRETE BASE

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

5.6.1 General

Where nonconforming base is to be removed and replaced, submit the proposed method with the nonconformity report at least seven days before the work is expected to commence. The proposal must include precautions to prevent damage to the adjoining base and the underlying subbase.

HOLD POINT	
Process Held:	Removal and replacement of concrete base.
Submission Details:	A nonconformity report for each location with the proposed method and precautions to prevent damage.
Release of Hold Point:	The Principal will consider the submitted documents prior to authorising release of the Hold Point.

Replace the nonconforming base in full slab widths between longitudinal joints and/or external edges.

Carry out paving by the slipform method where practicable.

5.6.2 Jointed Base

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

(a) in a straight line and continuous between adjacent longitudinal joints and and at an angle of $90^0 \pm 6^0$ to the longitudinal joint;

(b) at a location not closer than 1.5 m to a transverse contraction joint in the concrete which is to remain;

(c) for the full depth of the base without over-sawing into the adjacent base or the underlying subbase.

At each longitudinal edge of the nonconforming base:

(A) make longitudinal sawcuts along existing longitudinal joints to define the edges of the base section to be removed. These must not extend more than 250 mm past the transverse sawcut at each end of the section to be removed, nor into the underlying subbase.

(B) Prepare each longitudinal joint in compliance with the criteria for longitudinal construction joints as defined in this Specification;

Any additional internal sawcuts must be made without over-sawing into the adjacent base or the underlying subbase. Any base adjoining the removed slabs, which is damaged by your operations, must also be removed and replaced.

Dispose of the removed base slabs in accordance with the RMS Specification for ENVIRONMENTAL PROTECTION.

Prepare and debond the subbase in accordance with RMS R82 prior to construction of the replacement base.

All work involved in the replacement of base must comply with this Specification, including the following requirements:

(i) Seal all joints and cracks which become exposed with silicone sealant to prevent the ingress of mortar and other incompressible matter.

(ii) At tied joints, the joint faces on the adjoining slabs must be scabbled (unless the removal has resulted in the exposure of a corrugated face), and assessed and treated in accordance with Clauses 4.5.1 and 4.5.4, including the installation of tiebars as appropriate.

(iii) Transverse contraction joints must be continuous across the full width of the base containing the replaced section. Seal the length of the joint across the full width of the base with a silicone sealant.

5.6.3 CRC Base

In CRC base, the proposed method must take appropriate account of the daily movements within the adjacent base.

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

(a) in a straight line and continuous between adjacent longitudinal joints and at an angle of $90^0 \pm 6^0$ to the longitudinal joint;

(b) to a depth of 50 mm ± 5 mm,;

(c) at a location not closer than 500 mm to an existing transverse crack in the concrete which is to remain;

(d) without over-sawing into the adjacent base.

Remove the concrete within these sawcuts in such a way that:

(i) the face of the construction joint is left scabbled below, but not within, the depth of the sawcut.

(ii) not less than 0.15 m of every longitudinal bar is left protruding and undamaged beyond those joints. Mechanical couplers must be used at all of these laps in lieu of tied laps.

At each longitudinal edge of the nonconforming base:

(A) make longitudinal sawcuts along existing longitudinal joints to define the edges of the base section to be removed. These must not extend more than 250 mm past the transverse sawcut at each end of the section to be removed, nor into the underlying subbase.

(B) Prepare each longitudinal joint in compliance with the criteria for longitudinal construction joints as defined in this Specification;

Any additional internal sawcuts must be made without over-sawing into the adjacent base or the underlying subbase. Any base adjoining the removed slabs, which is damaged by your operations, must also be removed and replaced.

Dispose of the removed base concrete in accordance with the RMS Specification for ENVIRONMENTAL PROTECTION.

5.7 RECTIFICATION OF FINISHED SURFACE AND RIDE QUALITY

Areas requiring surface rectification must be diamond ground with purpose-built equipment employing gang-mounted diamond saw blades. Impact methods such as milling must not be used.

Carry out the work in accordance with RMS R93 as modified hereunder.

Unless otherwise stated in Annexure R83/A, Ggrinding equipment must be capable of grinding to a width of not less than 1.0 m in a single pass and must create a line-type texture as follows:

(a) grooves must be uniformly spaced and must number between 170 and 200 per metre of width to suit the particular concrete and; to produce grooves as per (b).

(b) the height between the peaks and troughs must be 2 mm ± 1 mm.produce a fin width in the range of 2.0 to 3.0 mm and a groove width of 3.2 ± 0.2 mm;

(c) with a minimum average texture depth in accordance with Clause 4.3.6.

Grinding must not be carried out until all necessary slab replacements have been completed within the area to be ground.

Where grinding is required, it must be carried out over the full width of a traffic lane.

CollectControl the residue from grinding in accordance with R93 and remove it from the pavement. and Ddo not allow itthe residue to flow into the drainage system or across lanes which are in public use.

Carry out grinding in such a way that positive lateral drainage is provided by maintaining a uniform slope without steps across the ground surfacewithin the trafficked lanes. Grinding must be transitioned at all edges of the work to maintain drainage and to provide acceptable ride quality. Where surface correction results in water ponding on any part of the carriageway (including shoulders), carry out transverse grooving to the extent necessary to remedy the ponding.

Measure the deviations on the finished surface (both within the grinding work and across boundaries). The deviations must not exceed 5 mm under a 3 m straightedge when measured in any direction.

Within seven days of grinding, Rre-assess the surface for conformity in accordance with Clauses 5.4 and 5.5.

Restore sealants and transverse texturing to comply with this Specification.

Where surface correction results in water ponding on any part of the carriageway (including shoulders), carry out transverse grooving to the extent necessary to remedy the ponding.

6 STEEL FIBRE REINFORCED CONCRETE

6.1 GENERAL

Use steel fibre reinforced concrete base pavement (SFCP) where shown on the Drawings.

The requirements for the supply and placement of steel fibre reinforced concrete (SFRC) and steel fibre reinforced concrete base pavement (SFCP) are the same as for base concrete and concrete base pavement in this Specification, except as provided below. The requirements of this clause are in addition to, and where in conflict, in place of, the requirements of the other clauses of this Specification.

6.2 STEEL FIBRES

6.2.1 Properties

The ultimate strength of fibres must be not less than 750 MPa.

The hardness must be not less than 85 HRB (Hardness Rockwell; B Scale) for all slit sheet fibres.

6.2.2 Fibre Volume Determination

Determine the minimum allowable steel fibre volume proportion (Vf) as follows:

$V_f = (25 \times S_f) / (A_p \times L/D)$ where:

V_f is the fibre content (% volume) of the mix

A_p is the anchorage performance of the fibre

(L/D) is the aspect ratio of the fibre

S_f is the shape factor of the fibre

The aspect ratio (L/D) of the steel fibre must be less than 68 and greater than 30.

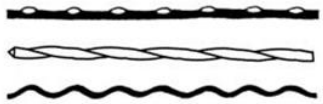
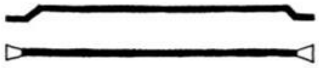
The shape factor (S_f) is determined using Table R83.27

Table R83.27 - Steel Fibre Shape Factor (S_f)

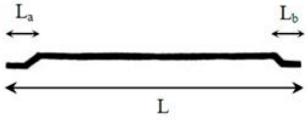
Volume of Single Fibre (mm^3)	Shape Factor (S_f)
0 - 5	1.2
6 - 10	1.3
11 - 20	1.4
21 - 30	1.5
31 - 40	1.6
41 - 50	1.7
51 - 60	1.8

The anchorage performance (A_p) is determined using Table R83.28

Table R83.28 - Steel Fibre Anchorage Performance (A_p)

Fibre Shape Type		Anchorage Performance (A_p)
No deformation		0.7
Fully deformed 		0.75
Partially deformed (or anchored) (1) 	0-20%	0.8
	21-50%	0.9

Notes:
1. For partially deformed fibres, the proportion of deformation is calculated as follows:

Deformation % = $(L_a + L_b)/L$ where 

6.2.3 Fibre Mass Determination

Determine the minimum allowable mass of the steel fibre content (M_f) as follows:

$M_f = V_f \times 7850$ where

M_f is the mass of steel fibre (kg/m³)

6.3 QUALITY REQUIREMENTS FOR STEEL FIBRE REINFORCED CONCRETE

The use of steel fibre reinforced concrete (SFRC) is limited to applications specifically shown in the Drawings. In summary:

(a) it is always used in SFCP and SFCP-R;

(b) it is not used in PCP or JRCP;

(c) it is not used in CRCP under this specification.

6.3.1 Cement and Fly Ash Content

Comply with RMS 3211.

6.3.2 Strength

Acceptance of strength in the Works is based on 28-day flexural strength.

Compressive strength testing is required as follows:

- in the trial mix (in accordance with Clause 3.8) and in the paving trial(s) (in accordance with Clause 4.4), at both 7 and 28 days.
- in the Work at 7 days for the purpose of a statistical check on concrete uniformity (in accordance with Clause 4.2.1).

28-day compressive strength testing is not required in the Work except for the paving trial(s).

6.3.2.1 Compressive Strength

Determine the compressive strength in accordance with AS1012.9. Mould the specimens in accordance with T304. Cure the specimens in accordance with AS 1012.8.

Compressive specimens must be of the size listed in Table R83.30according to the maximum length (L_f) of steel fibre in the mix.

The compressive strengths at 28 days in the trial mix (F_{28}) must be not less than 40 MPa.

6.3.2.2 Flexural Strength

Determine the flexural strength in accordance with AS 1012.11 (as amended below) and Clause 6.6.

The flexural strength at 28 days in the trial mix (F_{28}) must be not less than 5.8 MPa and in the Work must be not less than 5.5 MPa.

The flexural strength at 7 days in the Work must be reported in accordance with Clause 4.2.1.4.

Flexure specimens must be the size listed in Table R83.29. Take care during sampling and moulding to minimise disturbance to the fibre distribution and orientation in the test specimen.

For flexure specimens exceeding 150 mm in width, amend AS 1012.11 as follows:

(a) Amend Clause 3 (paragraph 1) to read as follows: “Moulded flexure test specimens ... provisions of AS 1012, Part 8 or ASTM C1018 as relevant, and if they appear ..”

(b) In Table 1 of AS 1012.11 the centre-to-centre distance of the supporting rollers (L) is 3W (+15, -8) mm where W is the width of specimen.

Table R83.29 - SFCP Specimen Sizes

	Flexure Specimens		Compression Specimens
Fibre Length L_f (mm)	**Specimen Size (mm)**	**Standard Reference**	**Specimen Diameter (mm)**
$L_f \leq 33$	100×100×350	AS 1012.8	100
$33 < L_f \leq 50$	150×150×500	AS 1012.8	150
$L_f > 50$	$W \times D \times L_s$ where: $D \geq 3L_f$ and W=D, and $L_s \geq 3D+50$	ASTM C1018	150
Key: L_f = maximum length of steel fibre in the mix L_s = length of flexure specimen			

6.3.3 Consistence

Determine consistence by measuring slump in accordance with AS 1012.3 Method 1.

Nominate a slump for each nominated concrete mix, within the range specified below and such as to allow the production of a dense, non-segregated base with bleeding limited to prevent bleed water flowing over the slab edge under the conditions of placement.

The nominated slump must be:

Between 15 mm and 40 mm for slipform mixes.

Between 50 mm and 60 mm for fixed-form mixes.

6.3.4 Shrinkage

The drying shrinkage must not exceed 450 microstrain after 21 days air drying. Determine the drying shrinkage in accordance with AS 1012.13.

6.3.5 Air Content

Do not use air entraining agent in SFRC. Air content testing is not required.

6.3.6 Not used

6.3.7 Batching, Mixing & Transport

(a) Charging

In addition to the requirements of Clause 4.2.2, the method of charging the mixer must be consistent with the recommendations of the supplier of the steel fibre.

(b) Mixing

For mobile mixers, provide the full period of mixing 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 period for steel-fibre reinforced concrete is:

(i) 5.0 minutes for initial mixing;

(ii) as determined under Clause 4.2.2.2 for subsequent re-mixing.

6.4 NOMINATED CONCRETE MIXES

In addition to the requirements of Clause 3.8, submit details of the source, dimensions and nominated mix quantity of steel fibres.

In addition to the requirements of Clause 4.2.2, the permissible tolerance for weigh batching of steel fibres is +10 per cent and -0 per cent. If you propose to vary the quantity of steel fibres in the nominated mix, submit a new nominated mix in accordance with Clause 3.8.1.

6.5 TEXTURING

With reference to Clause 4.3.6, delete the longitudinal hessian-drag on fibre reinforced concrete. Transverse tining must be in accordance with Table R83.16 and Clause 4.3.6.

Power trowelling must not be used.

6.6 CONFORMITY FOR FLEXURAL STRENGTH

6.6.1 Test Specimens

Test specimens for determining the flexural strength of concrete must be standard beams complying with Table R83.29for both size and Standard Reference according to the maximum length (L_f) of steel fibre in the mix.

Employ a laboratory with appropriate NATA registration to conduct the sampling of fresh concrete and the making, curing and testing of test specimens. Take samples of concrete for testing in accordance with AS 1012.1. Mould the test specimens in accordance with T304 using the compaction method specified. Cure the test specimens in accordance with AS 1012.8.

6.6.2 Frequency of Test Specimens

For each Lot of base placed at the one time, take a set of three test specimens to determine the flexural strength at 28 days.

For the purpose of this clause a Lot is defined as a continuous pour of up to 50 cubic metres of base represented by test specimens cast from a sample of concrete used in its construction.

6.6.3 Flexural Strength

The flexural strength of the concrete represented by a set of beams taken from one sample is the average of individual results not more than 0.5 MPa from the median value.

Should any specimen be tested more than 28 days after moulding, the equivalent 28-day flexural strength is the test flexural strength divided by the factor BAF applicable to the age of the specimen at the time of test as shown in Table R83.30.

For intermediate ages, determine the factor on a pro-rata basis.

Table R83.30 - Age Factors for Beams

Specimen age (days)	Beam Age Factor (BAF)	
	Fly ashSCM content (%) [1]	
	< 150	≥ 15
28	1.00	1.00
35	1.01	1.02
42	1.02	1.03
49	1.02	1.04
56	1.03	1.05
70	1.03	1.07
84	1.04	1.07
112	1.05	1.09
140	1.06	1.11
168	1.07	1.12
196	1.07	1.12
224	1.08	1.13
308	1.09	1.13
≥ 365	1.10	1.13

Note:
1. Relative to the total cementitious content

If the 28-day flexural strength of test beams for any Lot is less than 5.0 MPa, the Lot represented by the test beams must be removed and replaced in accordance with Clause 5.6.

Concrete with a 28-day flexural strength between 5.0 MPa and 5.5 MPa may be accepted providing that it represents isolated sections and such sections comprise less than 5 per cent of the area of base placed up to and including that Lot. Such concrete is subject to a deduction of 8 per cent of the schedule rate for supply and place steel fibre reinforced concrete in base, for each 0.1 MPa or part thereof deficiency in flexural strength.

6.7 CONFORMITY FOR THICKNESS

Clause 5.4 applies with the following amendments to the deduction values given in Table R83.24.

(a) 18 per cent for areas with a mean thickness of 5 mm less than the specified thickness.

(b) 45 per cent for areas with a mean thickness of 10 mm less than the specified thickness.

6.8 CONFORMITY FOR COMPACTION

Lot definition for compaction is in accordance with Clause 6.6.2.

The relative compaction of a core specimen is the ratio, expressed as a percentage, of the core unit mass to the representative beam unit mass (RBUM) for that Lot. Calculate the RBUM in accordance with Clause 6.9.

Calculate the relative compaction in accordance with RMS T381.

Determine the unit mass of cores in accordance with Clause 5.2. Determine the unit mass of flexure beams in accordance with AS 1012.12 Method 2, amended as follows.

(a) Test the specimens in the saturated-surface-dry condition.

(b) Specimens must not be dressed for voids.

(c) Take the unit mass for a set of beams as the average of results within 25 kg/m^3 of the median value.

(d) Carry out testing for unit mass on all beams.

If the relative compaction of the core specimen is less than 97.0 per cent, remove and replace the Lot represented by the core in accordance with Clause 5.6.

6.9 REPRESENTATIVE BEAM UNIT MASS

For each nominated mix in use, make a statistical check of the beam unit mass. For all 28 day flexure beams, test the unit mass at age 7 days to calculate the representative beam unit mass as follows.

The RBUM for any Lot is the rolling mean of the five consecutive sets prior to and including that Lot. In situations where fewer than five sets of a nominated mix are available, the RBUM is the mean of all available sets.

In each case, round the mean result to the nearest 5 kg/m^3.

ANNEXURE R83/A – DETAILS OF WORK

A4.3.6 Texturing of Surface

Table A1.1 is to be read in conjunction with Table R83.16. It lists pavement areas which must be textured differently to that specified in Clause 4.3.6. Examples might include:

(a) a light transverse broom texture (in fixed-form paving) in lieu of a longitudinal hessian drag;

(b) transverse grooving at superelevation transitions.

Table A1.1 - Schedule of Texturing Exceptions

Control/chainage	Texture type(s)	Texture Depth	Test Method

A4.5 Treatment of an existing base edge or kerb

Prior to widening, treat existing edges and/or kerbs in accordance with Table A1.2.

Table A1.2 - Schedule of treatments

Control/chainage	Treatment type	Details

Notes:

1. Treatments may include:
   (a) sawing and removal of the outer edge;
   (b) scabbling of the exposed face;
   (c) installation of drill-ties.

A5.5.3.1 Roughness Testing

Table A1.3 is to be read in conjunction with (and provides information supplementary to) Table R83.24.

Table A1.3 - Pavement Roughness Categories for Project-specific Areas

Nominated project-specific areas [1]			
Location	**Control/Chainage**	**Assessable? (Yes/No)**	**PRC**
Through carriageways			
Ramps			
Minor roads			
Under asphalt surfacing		Yes	5
		No	Not applicable
Notes: 1. Nominations are to be limited to areas which are not covered in Table R83.24.			

A5.7 Rectification of Finished Surface and Ride Quality

Table A1.4 is to be read in conjunction with (and provides information supplementary to) Clause 5.7.

Table A1.4 – Diamond Grinding Details

Number of blades per metre (specification of this detail optional):	..... / m
Minimum texture depth:	…….. mm

ANNEXURE R83/B – MEASUREMENT AND PAYMENT

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

A lump sum price for any of these items must not be accepted.

Pay Item R83P1 – Supply and Place Concrete in Base

The unit of measurement is the cubic metre.

The width and length is as specified on the Drawings or directed by the Principal. The thickness is the thickness specified or as directed by the Principal across each section. Include in the measurement the additional base above terminal anchors, taken from the Drawings.

Provide a separate rate for each type of base concrete specified on the Drawings.

The pay item includes the costs of mix designs and trials, paving trials, construction joints, outer edges and all concrete required to produce paved concrete.

Pay Item R83P2 – Finish, Cure and Texture Base

The unit of measurement is square metres of surface of the base. The width and length is as specified on the Drawings or as directed by the Principal.

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

Pay Item R83P3 – Supply and Place Wire Reinforcing Fabric

The unit of measurement is the square metre.

The width and length is as specified on the Drawings or as directed by the Principal. The areas that contain laps must only be measured once.

Pay Item R83P4 – Supply and Place Steel Bar Reinforcement

The unit of measurement is the tonne.

The mass is determined from the unit masses given in AS/NZS 4671 Clause 7 and the actual length of bar, excluding laps and splices, measured in place. Only one bar may be measured within a lap or splice.

The pay item includes bar reinforcement in anchors and bridge approach slabs. The pay item excludes dowels and tiebars.

Pay Item R83P5 – Longitudinal Joints

The unit of measurement is the metre.

The measurement is along the line of the joint.

The pay item includes the provision of tiebars (where specified) and the application of debonding treatment at formed joints.

Pay Item R83P6 – Expansion Joints and Isolation Joints

The unit of measurement is the metre.

The distance is measured along the line of the joint.

The pay item includes the provision of dowels, where specified.

Pay Item R83P7 – Transverse Contraction Joints

The unit of measurement is the metre.

The measurement is along the line of the joint.

Provide a separate rate for SFCP, where applicable.

The pay item includes the provision of dowels, where specified.

Pay Item R83P8 – Terminal and Slab Anchors

The unit of measurement is the cubic metre.

The volume is taken from the Drawings or as directed by the Principal. The depth is measured from the top of the subbase.

The pay item includes excavation for the anchor.

Pay Item R83P9 – Bridge Approach Slabs

The unit of measurement is the cubic metre.

The width, thickness and length is as specified on the Drawings or as directed by the Principal.

No account is taken of the allowable tolerances.

The pay item includes finishing, curing and texturing of the slab.

Pay Item R83P10 – Incentive for Ride Quality

The width and length is as specified in Clause 5.5.3.

The incentive is applied to pay item R83P1 after conversion to a square metre rate based on the thickness as specified or as directed by the Principal across each test segment.

Pay Item R83P11 – Deductions

Pay items R83P11.1 to R83P11.4 apply to nonconforming work where there is a specified disposition for acceptance that includes deductions. The value is negative.

Pay Item R83P11.1 – Ride Quality

This pay item includes deductions for nonconforming works as defined in Clause 5.5.3.

The deduction is applied to pay item R83P1 after conversion to a square metre rate based on the thickness as specified or as directed by the Principal across each test segment.

Pay Item R83P11.2 – Compaction

This pay item includes deductions for nonconforming works as defined in Clauses 5.2 and 5.3.

Pay Item R83P11.3 – Compressive Strength

This pay item includes deductions for nonconforming works defined in Clause 5.3.

Pay Item R83P11.4 – Thickness

This pay item includes deductions for nonconforming works defined in Clause 5.4.

Pay Item R83P12 – Provision of Base Protective Covers

The unit of measurement is the square metre.

The measurement is of base covered per night.

Payment is made only for temperature protection which is warranted by, and complies with, Clause 4.3.8.1. Payment is limited to the first night after concrete placement, unless an extension of protection is approved by the Principal. Payment will not be made for covering over anchors (Clause 4.3.8.3) or for rain protection (Clause 4.3.8.2).

ANNEXURE R83/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 levels
3.2 and RMS G71	Hold	Survey Report verifying subbase conformity
3.8.1	Hold	Submission of nominated mix
3.8.1	Witness	Trial mix
4.1.1	Hold	Placing concrete around steel reinforcement
4.2.1	Hold	Results from process control charts
4.3.8.4	Hold	Trafficking of base
4.4	Witness	Base paving subject to paving trial
4.4	Hold	Base paving subject to paving trial
4.5.1.1	Hold	Installation of silicone sealants
5.4.2 and RMS G71	Hold	Survey Report verifying base conformity
5.6.1	Hold	Removal and replacement of nonconforming concrete base

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of RMS G2 Clause 16.

Clause	Description of the Identified Record
2.6	Certify by written report that the curing compound complies with this Specification, and submit NATA endorsed test results
2.7	Certify that the proposed sealant complies with this Specification and provide all relevant test results
2.7	Certify compliance of each production batch of sealant.
2.8	Evidence that steel reinforcement material supplier and reinforcement fabricator are certified by ACRS.
3.2	Schedule of base invert levels and relevant nonconformity report.
3.8.1	Certify that each nominated mix and its constituents meet the requirements of this Specification, submit NATA endorsed test results for all relevant tests (except Vebe) and submit a copy of the verification checklist.
3.8.2	Notification of variations to a nominated mix
4.1.1	Certificate of compliance covering the installation of reinforcement and embedments
4.2.1	Results for compressive and flexural strength, relative compaction and thickness for the same Lot plus proposal for Corrective Action to achieve conformity
4.3.8.4	Insitu strength test results of the base
4.4	Submission of checklists and test results, excluding results for compressive and flexural strength
5.6.1	Nonconformity report for each location of removal and replacement of concrete base with the proposed method and precautions to prevent damage

ANNEXURE R83/D – QUALITY SYSTEM

You must supply the information specified in the following clauses:

a) Control of cement and fly ash; Clause 2.6

b) Admixture selection; Clause 2.7

c) Certification for curing compounds (both nominated and delivered); Clause 2.8

d) Joint sealant details and certification; Clause 2.9

e) Subbase level survey; Clause 3.2

f) Consistence; Clause 3.6

g) Concrete mix design and constituent details; Clause 3.8.1

h) Dowel debonding and support system; Clause 4.1.3

i) Bending of anchor stirrups; Clause 4.1.65

j) Materials handling, batching and mixing proposals; Clause 4.2.2

k) Admixture incorporation method; Clause 4.2.2.3

l) Control of batching time under Clause 4.2.2.4 and retempering under Clause 4.2.2.7 and nomination of your representative under Clause 4.2.2.7(f)

m) Determination of maximum forming time; Clause 4.2.2.8

n) System to indicate the malfunction of individual vibrators Clause 4.3.1

o) Equipment and methods for spreading and paving; Clauses 4.3.1, 4.3.2, and 4.3.3

p) Details of staff training; Clause 4.3.3

q) Monitoring location of loads of concrete placed; Clause 4.3.3

r) Meteorological data and measures to restrict evaporation; Clause 4.3.5

s) Handling and spraying of curing compounds; Clause 4.3.7.1

s)t) Protection of work from low temperatures (Clause 4.3.8.1) and rain (4.3.8.2)

t)u) Notice of trial paving and subsequent paving; Clause 4.4

v) Method of paving over anchors; Clause 4.8

w) Crack inspection schedule; Clause 5.1

v)x) Locations for coring; Clause 5.2.1

w)y) Definition of a Lot by a method that is different to Clause 5.2.1, if applicable.

w) Method of calculating adjusted thickness from survey; Clause 5.4.3

ANNEXURE R83/E – REQUIREMENTS FOR TECHNICAL PROCEDURES – NOT USED

Deleted

ANNEXURES R83/G TO R83/K – NOT USED

ANNEXURE R83/L – MINIMUM FREQUENCY OF TESTING

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
Supply of Concrete for Base			
	Fine aggregate:	---	---
2.3	Material < 75 micrometre	AS 1141.12	One per 5000 tonnes[5] for the first 15,000T and thereafter one per 10,000T. Manufactured or unwashed natural sand: One per 1000 tonnes. Washed natural sand: One per 5000 tonnes.
2.3	Material < 2 micrometre	AS 1141.13	One per 5000 tonnes[5] for the first 15,000T and thereafter one per 10,000T.
2.3	Dominant clay type	X-Ray diffraction	Once within 6 months prior [4].
2.3	Methylene Blue Adsorption Value (MBV)	RMS T659	One per 10,000 tonnes[5]
2.3	MBV75 value		One per 10,000 tonnes[5]
2.3	Bulk Density (compacted)	AS 1141.4	In the trial mix
2.3	Water Absorption	AS 1141.5	Once within 12 months prior [4]
2.3	Soundness (sodium sulfate)	AS 1141.24	One per 40005000 tonnes[5] for the first 15,000T and thereafter one per 10,000T.
2.3	Organic impurities	AS 1141.34 & AS 1289.4.1.1	One per 2000 tonnes[5] for the first 10,000T and thereafter one per 10,000T. See Table R83.2 Note 4.
2.3	Sugar content	AS 1141.35	One per 10,000 tonnes[5]
2.3	Micro-Deval loss	ASTM D7428	TBA
2.3	Flow Cone time [5]	RMS T279	TBA
2.3	Hardness	Vickers Hardness Tester	TBA
2.3	Glass content		TBA
	Coarse aggregate:	---	---
2.32.4	Bulk and particle density	AS 1141.4, AS 1141.6	In the trial mix
2.32.4	Water absorption	AS 1141.6	Once within 12 months prior [4]

2.3	Material < 75 micrometre	AS 1141.12	One per 5000 tonnes
2.32.4	Particle shape	AS 1141.14	One per 2000 tonnes (1)
2.32.4	Average Least Dimension	T235	One per 2000 tonnes (1)
2.32.4	Wet strength	T215	One per 2000 tonnes (2)
2.32.4	Wet/dry strength variation	T215	One per 2000 tonnes (2)
2.32.4	Weak particles	AS 1141.32	One per 5000 tonnes
2.32.4	Light particles	AS 1141.31	One per 5000 tonnes
2.32.4	Iron unsoundness (slag)	AS 1141.37	One per 5000 tonnes
2.32.4	Falling or dusting unsoundness (slag)	AS 1141.61	One per 5000 tonnes
2.32.4	Fractured faces	T239	One per 1000 tonnes
2.5.1	Alkali-aggregate reactivity	See Clause 2.5.1	Once within 12 months prior (4)
Placing Concrete in Base			
2.62.8	Conformity of curing compound	AS 3799, as supplemented by RTA 3202 Annexure R83/3	As per Clause 2.8RTA 3202 Annexure R83/3 Clause A2.6
2.11	Water	AS 1379	At the trial mix and thereafter one per 5000 m^3 of concrete
3.7	Chloride ion content		One per 30,000 m^3 of concrete
3.7	Sulfate ion content		One per 30,000 m^3 of concrete
3.7	Coefficient of Thermal Expansion (CTE)	AASHTO T336	In the trial mix. Report only.
4.1.2	Pull-out test on tiebars		As per Clause 4.1.2
4.1.3	Pull-out test on dowels	RMS T366Annexure R83/3	3, prior to construction, as per Clause 4.1.3
4.2.1	Particle size distribution of combined aggregate:	AS 1141.11	
	- by calculation or	By calculation	One per 4001000 tonnes for the first 10,000T and thereafter one per 5000T.
	- by wet-sieving (3)	T329 (3)	One per 1500 m^3 of concrete(6)
4.2.2	Concrete slump	AS 1012.3 Method 1	As per Clause 4.2.2
4.2.2	Air content of concrete	AS 1012.4 Method 2	As per Clause 4.2.2
4.2.2	Mixer Uniformity	AS 1379 and Clause 2.4.4	As per Clause 4.2.2

4.3.6	Average depth of longitudinal surface texture	TBA	TBA
	(a) Hessian drag only Longitudinal texture	T240 or T192	Only where transverse tining is not specified, one per 2000 m^2 of bBase.
	(b) Combined Total surface texture	T240 or T192	One per 2000 m^2 of base
4.3.7	Application rate of curing compound	See Clause 4.3.7	One per 2000 m^2 of base
4.3.8.4	In-situ compressive strength (for trafficking purposes)	Cylinders as per T367, or Cores as per Clause 4.3.8.4	Moulding frequency of two (2) pairs per 250 m^3 As per Clause 4.3.8.4
	Cylinder compressive strength of concrete at		
4.2.1	- 7 days	AS 1012.9	As per Clause 5.3.2
5.3.2	- 28 days	AS 1012.9	As per Clause 5.3.2
4.2.1	Flexural strength	AS 1012.11	As per Annexure R83/3 Clause 4.2.1.2
4.5.1	Joint & sealant dimensions	As per the Drawings	As per Clause A4.5.1.1
5.2	Relative compaction of concrete	RMS T381 AS 1012.12 Method 2, as amended	As per Annexure R83/3 Clause A5.2.1
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
5.5.3	Roughness	T182 or T187	As per Clause 5.5.3

Notes:

1. Provided that all of the six previous tests have met specification requirements for both particle shape and average least dimension then a reduced minimum frequency of 1 per 10,000 tonnes must apply.
2. 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 must apply;
   - where all wet/dry variation results are < 25% : 1 per 15,000 tonnes
   - where all wet/dry variation results are < 30% : 1 per 10,000 tonnes
3. Only the + 1.18 mm fraction need be tested; Clause 4.2.1(b) refers.
4. Within the specified months prior to the date of closing of tenders, or else in conjunction with the trial mix.
5. Frequencies are based on combined fine aggregate quantities.
6. Where a plant produces less than 1000T per day of Fine or Coarse aggregate for use in the project, the minimum of one test per day is required for grading.

ANNEXURE R83/M – REFERENCED DOCUMENTS

Refer to RMS R83 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 1580	Paint and related materials
AS 2350	Method of Testing Portland and Blended Cements
AS 2706	Numerical values – Rounding and interpretation of limiting values
AS 2758.1	Concrete Aggregates
AS 3600	Concrete structures
AS 3799	Liquid membrane-forming curing compounds for concrete
AS 3940	Quality control – Guide to the use of control chart methods including Cusum techniques
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

ASTM Standards

ASTM-C793	Weathering of sealants
ASTM-C794	Peel adhesion of sealants
ASTM-D792	Density of Plastics
ASTM-D2240	Rubber hardness
ASTM-C295	Petrographic Examination of Aggregates for Concrete
ASTM-C603	Extrusion Rate & Application Life of Elastomeric Sealants
ASTM-C679	Tack-free Time of Sealants
ASTM-D7428	Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus

RMS Specifications

RMS Q	Quality Management System
RMS G2-C2	General Requirements
RMS G35	Environmental Protection (Management Plan)
RMS G36	Environmental Protection (Management System)
RMS G71	Construction Surveys
RMS R53	Concrete (for General Use), Mortar and Grout

RMS R82	Lean-Mix Concrete Subbase
RMS R106	Sprayed Bituminous Surfacing
RMS B204	Welding of Bridges and other Road Structures
RMS 3202	Wax Emulsion Concrete Curing Compound
RMS 3204	Preformed joint fillers
RMS 3211	Portland and Blended Cements, Binders and Fillers

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

RMS Standard Drawings

MD.R83.CP	Plain concrete pavement (PCP)
MD.R83.CC	Continuously reinforced concrete pavement (CRCP)
MD.R83.CJ	Jointed reinforced concrete pavement (JRCP)

RMS Test Methods

RMS T182	Pavement roughness
RMS T183	Surface deviation using a straightedge
RMS T187	Laser profilometer
RMS T188	Project ride quality (Vehicular laser profilometer) - *Draft under review*
RMS T192	Texture depth usingby TRL Meter
RMS T215	Ten percent fines
RMS T233	Polishing value of aggregate
RMS T235	Aggregate least dimension
RMS T239	Aggregate fractured faces
RMS T240	Surface texture depth
RMS T276	Foreign materials content
RMS T278	Aggregate Shape by the Ratio of Greatest to Least Dimension
RMS T279	Flow time and voids content of fine aggregate by flow cone
RMS T304	Moulding of concrete specimens
RMS T363	Accelerated AAR assessment
RMS T364	Concrete prism test for AAR assessment
RMS T366	Dowel pull-out test
RMS T367	Field simulated curing
RMS T368	Dressing of voids and adjustment for steel
RMS T369	Longitudinal profile testing
RMS T371	Determination of Calcium Nitrite Quantity in Fresh Concrete (Test Strips)
RMS T381	Relative compaction of pavement concrete
RMS T659	Methylene Blue Adsorption of Road Construction Materials
RMS T1005	Infrared spectrophotometer
RMS T1192	Adhesion of sealant

RMS T1193	Sealant accelerated ageing

AUSTROADS Test Method

Manual	ARRB Walking Profilerometer

Regulation

Road Transport (Mass, Loading & Access) Regulation 1996

International Slurry Surfacing Association documents

Technical Bulletin No 145	Test method for determination of methylene blue adsorption value (MBV) of mineral aggregate fillers and fines

.