TRANSPORT FOR NSW (TfNSW)

QA SPECIFICATION TfNSW 3201

CONCRETE SUPPLY FOR MAINTENANCE

NOTE: TfNSW 3201 IS AN ESSENTIAL COMPANION TO TfNSW M258

REVISION REGISTER

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 1/Rev 0	All	Draft for trial use.	GM, RNIC	28.09.04
Ed 2	4.1.5 Annexure M2	"Agitating Speed" replaced by "Mixing Speed". Definition of "Agitation Speed" deleted. Definition of "Mixing Speed" added. Amendment to definition of "Mixing Time"	GM, RNIC	26.05.06
Ed 3	Notes 1. 2	Rearranged & numbered Mix selection tables combined & simplified. Note re Alkali-Aggregate Reaction added. New clause 1.1 re Intended use added. Requirement of meeting AS 1379 added. Definition of RMS Mix Codes added. Mix Codes suffixes revised to a) distinguish S25A10 for spraying (becomes S25A10SH) from S25A10 for slipform and b) allow for introduction of SP40HC. Added req't for concrete supplier PQP. Added req't for documentary evidence. Added req't for 30 minutes workable time.	GM, IC	29.08.07

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 3 (cont'd)	2	Tables 1 to 4: • Revised Mix Code suffixes • Deleted N25, added N40 and SP40HC. • Differentiated S25A10SH from S25A10 • Added Early Age Strength to SP40H • Corrected cementitious in SP6 to match R82 • Moved cementitious materials so they adjoin. • Tightened air entrainment tolerance to 1% • Deleted " — " footnote symbol and substituted • (*) or (i) to clarify meaning.		
	3	Moved Table 6 so it applies only to Special-class concrete Confined Clause 3.4.6 to unsurfaced Base concrete. Deleted AAR clause and substituted Clauses 3.4.7 to 3.4.9 which are consistent with B80.		
	4	Added min. & max. temperature to Clause 4.1.2 Requirement for Work Method Statement to 4.1.4 Clause 4.1.5 simplified and clarified. Clause 4.1.6 tightened and renumbered to 4.1.7.		
	D.2.3	Less than 75 kg/m3 of steel fibre permitted provided equivalent performance can be demonstrated		
Ed 3/Rev 1	Most	Format corrected	GM, IC	24.10.07
Ed 3/Rev 2	Several	Updated cross references to suit new M spec. nos.	GM, IC	05.08.08
Ed 4/Rev 0	All	General technical review, and revision of some technical requirements. Format revised.	GM, IC	04.02.13
Ed 4/Rev 1	Guide Notes	New Clause 4.2.16 added to Guide Notes.	GM, CPS B Bestwick	20.08.15
	Tables 1, 3 &4	New mix code added to Table 1. Admixture row amended in Tables 3 & 4. Note (i) to tables amended with new Note (ix) added.		
	2.3.3	New Clause 2.3.3 added.		

Ed/Rev Number	Clause Number	Description of Revision	Authorised By	Date
Ed 4/Rev 1 (cont'd)	Annex 3201/A Annex M	New Clause A.2 added for non-chloride admixtures. Referenced documents updated.		
Ed 4/Rev 2	Global	References to "Roads and Maritime Services" or "RMS" changed to "Transport for NSW" or "TfNSW" respectively.	DCS	22.06.20

GUIDE NOTES

(Not Part of Contract Document)

THESE NOTES ARE NOT PART OF THE SPECIFICATION, CONTRACT OR AGREEMENT.

The following notes are intended to provide guidance to TfNSW personnel on the application of the Specification. They do not form part of the Specification, Contract or Agreement.

1 USING TFNSW 3201

This Specification has been specifically developed for TfNSW maintenance works. It should not be used without a review of its suitability for the application and in the contractual environment.

It is a QA specification. The use of QA specifications requires the implementation of a quality system by the service provider which meets the quality system requirements specified in TfNSW Q.

THE CLAUSE NUMBERING IN THESE NOTES DOES NOT CROSS-REFER TO THE NUMBERING IN THE SPECIFICATION PROPER.

2 OUTLINE

TfNSW 3201 is for the supply of concrete delivered to maintenance sites from commercial plants and accordingly relies on AS 1379. It recognises that the quantity of concrete in any one year will be relatively small and, therefore, it aims to use the materials and processes that can be reasonably expected at those plants.

TfNSW 3201 encompasses concrete for slab replacement, kerb & gutter, drainage structures, revetment mattresses and general purposes. For completeness, it incorporates the mixes included in TfNSW R53.

TfNSW 3201 aims to incorporate many requirements for concrete that are specified in TfNSW Specifications TfNSW R82 and TfNSW R83. It extends the mix options available to include high early strength concrete and steel fibre reinforced concrete.

TfNSW 3201 does NOT deal with formwork, placement or curing.

TfNSW 3201 is NOT SUITABLE for reconstruction of concrete pavements where more than three adjoining slabs are to be replaced. Such Work would normally use an extended lane closure. For reconstruction of concrete pavements, the appropriate concrete supply and construction specification must be used.

TfNSW 3201 is NOT SUITABLE for concrete for use in structural bridgeworks or major culverts (use TfNSW B80).

3 MIX CODE

Mix Codes (Clause 1.10) are supported by AS 1379 in association with a strength grade. In addition, a suffix is also included to indicate another criterion.

4 TECHNICAL

4.1 Concrete Mix Selection for Works Other than Concrete Pavement

Specify the MIX CODE that corresponds with the required application of the concrete.

APPLICATION	WORK CONSTRAINT	MIX CODE (SEE CLAUSE 1.10) & DESCRIPTION	COMMENTS
Slab replacement		**Refer to Note 5.2 below**	
Kerb/gutter			
▪ Alongside or on top of flexible pavement or on top of concrete base.	Extruded or slipformed	**S25A10** 25 MPa, 10 mm max aggregate.	Design to be matched to construction process so that finished product is at finished line and level (i.e. slump).
	Hand placed	**N40** 40 MPa, 80 mm slump	Increased from the N32 in earlier editions of TfNSW 3201 to better withstand damage.
▪ Alongside and tied to concrete base	Tied, slipformed	**S32A20Q** 32 MPa	Design to be matched to construction process so that finished product is at finished line and level (i.e. slump).
	Tied, hand placed	**N40** 40 MPa, 80 mm slump	Increased from the N32 in earlier editions of TfNSW 3201 to better withstand damage.
Drainage			
▪ Drainage structures		**N40** 40 MPa, 80 mm slump	Increased from the N25 in earlier editions of TfNSW 3201 to better withstand damage.
▪ Open drains	Sprayed	**S25A10SH** 25 MPa with 10 mm max aggregate	Design to be matched to construction process so that finished product is at finished line and level (i.e. slump).
	Hand placed. Must hold position and not flow under gravity.	**N20L** 20 MPa, 50 mm slump	
▪ Grout-filled revetment mattresses		**S20A5Q** Grout with 5 mm max aggregate	Design to be matched to construction process so that finished product is at finished line and level (i.e. slump).
General purposes			
▪ Concrete safety barrier	Slipformed	**S32A20Q** 32 MPa	Design to be matched to construction process so that finished product is at finished line and level (i.e. slump).
	Hand placed	**N32**	32 MPa 80 mm slump.
▪ Traffic facilities ▪ Control cabinets ▪ Plinths for lighting columns ▪ Signpost footings ▪ Telephone pillars ▪ Backfill for fence posts ▪ Unreinforced concrete on earth floors of excavations.	Hand placed	**N20** 20 MPa 80 mm slump	

APPLICATION	WORK CONSTRAINT	MIX CODE (SEE CLAUSE 1.10) & DESCRIPTION	COMMENTS
▪ Behind kerb and gutter ▪ Cycleways ▪ Driveways ▪ Edge strips ▪ Footways ▪ Medians ▪ Traffic islands.	Hand placed. Reinforced or Unreinforced	**N32** 32 MPa 80 mm slump	Increased from the N25 in earlier editions of TfNSW 3201 to better withstand damage.

4.2. CONCRETE IN SLAB REPLACEMENT

4.2.1 Technical Referenced Document

Technical information on slab replacement is available in the TfNSW Standard Concrete Pavement Drawings – Maintenance. The TfNSW Contract Manager and Surveillance Officer should be familiar with the specific requirements and underlying reasons for maintaining concrete pavements.

4.2.2 Concrete Mix Selection for Pavement

Previously, the standard mix for slab replacement was specified as a 35 MPa mix. However, for small projects a higher strength is now specified to provide an additional factor of safety. Consistent with standard strength mixes in AS 1379, the next higher standard strength classes of 40 MPa has been specified. Note that larger projects must rely on TfNSW R83.

TYPE OF CONCRETE PAVEMENT TO BE REPAIRED	WORK CONSTRAINT	MIX CODE (SEE CLAUSE 1.10) & DESCRIPTION	**COMMENTS**
PCP, PCP-R and JRCP	Lane closure of 2 days or more acceptable. Hand placed. Transverse joints.	SP40 Special-class 40 MPa concrete for pavement	Generally not suitable for slab corner angles sharper than 84°
PCP, PCP-R and JRCP	Lane closure less than 12 hours Hand placed. Transverse joints.	SP40H Special-class 40 MPa concrete for pavement with additional High Early Strength (HES) requirements and $CaCl_2 \leq 0.8\%$ OR SP40HC Special-class 40 MPa concrete for pavement with additional HES requirements. Up to 2% $CaCl_2$ permitted.	Generally not suitable for slab corner angles sharper than 84°
All types of Base Course	Hand placed. No time constraint on placement. No external accelerated curing used.	SFP5.5 Steel fibre reinforced concrete with a flexural strength of 5.5 MPa	Small repairs in all base types. Can be used for corners angles down to 75°
SFCP (such as roundabouts)	Lane closure 24 hours or more acceptable.	SFP5.5 Steel fibre reinforced concrete with a flexural strength of 5.5 MPa	
	Lane closure less than 12 hours.		Seek advice from Pavements Section. Avoid $CaCl_2$ with steel fibres.
Subbase	No time constraint.	SP6 Lean mix concrete greater than 6 MPa	

4.2.3 Aggregate

AS 2758.1 Clause 10.2 requires that the purchaser will specify requirements for dealing with Alkali-Aggregate Reaction (AAR) and requires the supplier to provide appropriate documentation. Therefore, established suppliers should already be in a position to comply. This should be true for suppliers able to meet the requirements for supplying concrete to TfNSW B80 or TfNSW R53. Clause 3.4.7 sets out the TfNSW requirements for SPECIAL-CLASS concrete.

4.2.4 Addition of water or admixture on site

Addition of water ('retempering') or admixtures on site should only be done under strict supervision and according to AS 1379.

With accelerated mixes, if the slump falls on site, it is better to add additional, diluted HWR rather than water.

It is important that the water added (including that in the admixture) does not cause the water / cement ratio to exceed that specified.

4.2.5 40 MPa mix ~ SP40

This 40 MPa mix is not intended as an 'accelerated' mix but it is nevertheless feasible to accelerate its strength gain to a moderate degree by applying a combination of measures which will not compromise its integrity.

The impact of these measures could be such as to reduce the delay to opening from, say, 5 days to 3 or 4 days.

$CaCl_2$ must NOT be added to this mix as it greatly increases the risk of premature failure. If a faster set is required then either of the accelerated mixes SP40H or SP40HC should be used.

The recommended practices are as follows:

Batch the mix at a reduced water/cement ratio. Note however that:

- unless sophisticated mix designs and advanced admixtures are being used, w/c lower than about 0.35 should not be attempted.
- low w/c mixes may be difficult to texture finish. It is suggested you conduct trials before use in practice.

Adjust the slump[i] by addition of HWR or HWRRe [ii].

Consider Hunter Region's practice of using flood-lights as radiant heaters.

Cover the work with thermal blankets as soon as possible without risking damage to the curing compound or the surface texture.

Cover with black polythene sheeting (or similar).

This will increase daytime slab temperatures and minimise overnight temperature losses.

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i The normal slump range for manual paving is 50 to 80 mm but adjustment by the on-site addition of HWR may not be as precise as with water ~ small increases in HWR dosage can have large effects on slump. Slumps in the higher range will increase the risk of downhill flow on grades. Slumps in the lower range are acceptable as long as the vibration (both internal and surface) is thorough enough to fully compact the concrete.

ii HWRRe may be preferable in hot conditions to retard the setting rate. This may reduce the strength within the first 24 hours but should have a diminishing effect at later ages.

- The covers must be thoroughly secured around all edges to prevent air movements.
- The covers should not be removed during very cold conditions because the resulting thermal shock could induce structural cracking. Removal between mid-morning and mid-afternoon is preferable.

4.2.6 HES 40 MPa accelerated mixes ~ SP40H and SP40HC

The aim with the 40 MPa Accelerated mixes is to:

- Limit the water/cement ratio (in order to maximise strength development and minimise steel corrosion).
- Achieve the desired slump/workability using admixtures (i.e. superplasticisers - HWR).

However, it is important that sufficient water be provided to sustain cement hydration.

4.2.7 Calcium chloride

$CaCl_2$ accelerates both the setting rate (aluminate reaction) and the strength gain (silicate reaction).

However, it accelerates the corrosion of steel tie bars, reinforcement and dowels, can adversely affect shrinkage and cause cracking.

Guidelines on dosage are provided below under the heading "Calculation of $CaCl_2$ dose rate".

Mixes containing doses of $CaCl_2$ greater than 0.8% greatly accelerate the corrosion of tie bars and reinforcement. Nevertheless, the "Sydney High $CaCl_2$ mix" (ie SP40HC) has been included pending the development and trial of a replacement able to meet Sydney Region's constraints and training in its use

$CaCl_2$ must NOT be used with steel fibres; having a large surface area per unit of mass, the steel fibres will quickly corrode.

4.2.8 Minimising Corrosion

Steel corrosion increases with permeability of the concrete, especially in mixes containing $CaCl_2$, hence it is important that:

- The water/cement ratio (w/c) is kept low (hence the use of HWR & fly ash).
- Compaction is thorough.
- Steel cover is adequate.
- The mix design minimises the dosage of $CaCl_2$. This is possible through the use of advanced admixtures.

4.2.9 Fly ash

Fly ash (as low as 50 kg/m^3) can assist later strength development from its pozzolanic reaction and reduce free lime in hardened concrete, thereby improving durability. However, it may not be beneficial at low temperatures. Accelerators can reduce the durability of concrete. This is another good reason for using fly ash in accelerated mixes, especially with potentially reactive aggregates.

4.2.10 Slump control

For best results, the HWR should be added at the batch plant but there may be situations where site addition is preferred.

$CaCl_2$ obviously must not be added until just before the concrete is to be placed on site. Delays may occur and if it is added too early then the concrete will be very difficult to place.

As with all mix additions (including water), it is critical that the batch be remixed after adding the HWR or $CaCl_2$ for the full mixing period of 3½ minutes.

RETEMPERING should only be done under strict supervision. With accelerated mixes, if the slump falls at site, it is better to add additional HWR rather than water.

4.2.11 Addition of admixtures

The mixing of admixtures is usually far more successful (thorough) if they are diluted with water prior to addition to the bowl. If admixtures are added in the concentrated form, there is a risk of producing uneven reactions through the mix.

Nevertheless, the manufacturer's recommendations must be followed.

The water used for dilution will obviously increase the water/cement ratio (w/c) and so should be compensated for during initial batching so that the w/c ratio of the concrete at discharge does not exceed the specified w/c ratio.

Personnel (at both the batch plant and in the field) must be provided with clear written guidelines for the incorporation of admixtures. Issues to be addressed include:

- Dose rates (and their method of calculation).
- Sequence of addition.
- Whether simultaneous addition is accepted or recommended (for example, can the HWR be combined with the $CaCl_2$ solution in order to minimise the volume of added water?).
- The upper limit on added water.
- The 3½ minute minimum re-mixing time after addition of extra ingredients (for example, admixtures and/or water) specified by TfNSW 3201.

There is a warning on the use of oxides in concrete because of a faster set than normal accelerator.

4.2.12 Compatibility of accelerating admixtures

WRA should not be mixed with HWR because of the resultant retarding effect.

HWRRe is also avoided in accelerated mixes because of its retarding effect.

4.2.13 Heated mixing water

Acceleration of the setting rate (and strength gain) can be assisted by heating the mixing water. The temperature of the concrete should be limited to less than 35°C to avoid the risk of flash set.

4.2.14 Curing

The early temperature of the finished concrete has a strong influence on both the setting rate and the rate of strength development. Hence, it is important that a suitable curing regime is specified in TfNSW M258 (e.g. thermal covers or the use of lights as radiant heaters, such as the practice in the Hunter Region).

4.2.15 SFRC mixes

Standard mix

The 5.5 MPa SFRC mix achieves enhanced flexural strength through a uniform dispersal of steel fibres incorporated at the batch plant.

$CaCl_2$ must NOT be used with this mix – having a large surface area per unit of mass, the steel fibres will quickly corrode.

The supplier must demonstrate that the nominated mix meets the flexural strength requirements by providing flexural test results of the trial mix.

Production control is expensive using flexural tests. A relationship between flexural strength and compressive strength value is to be developed in the laboratory to define an equivalent mean compressive strength, which corresponds to the acceptable flexural strength. To assess the quality of concrete during production, conformity against the equivalent mean compressive strength is used.

It is critical to ensure that the correct amount of steel fibres has been added to the mix and the fibres are evenly dispersed and do not clump. A person checking batching of steel fibres at the batch plant may be necessary.

HES SFRC mix

An accelerated strength version of the SFRC has not been developed.

The standard SFRC is not intended as an "accelerated" mix but it is nevertheless feasible to accelerate its strength gain to a moderate degree without compromise to its integrity.

The recommended practices are as follows:

(i) Adjust the slump [iii] by addition of HWR or HWRRe [iv].

(ii) Batch the mix at a lower water/cement ratio (w/c). Note however that unless sophisticated mix designs and advanced admixtures are contemplated w/c must be greater than 0.35 to ensure hydration of the cement.

(iii) Cover the work with thermal blankets as soon as possible without risking damage to the curing compound or the surface texture.

(iv) Consider Hunter Region's practice of using flood-lights as radiant heaters.

(v) Cover with black polythene sheeting (or similar). This will increase daytime slab temperatures and minimise overnight temperature losses. The covers must be thoroughly secured around all edges to prevent air movements. The covers should not be removed during very cold conditions because the resulting thermal shock could induce structural cracking. Removal between mid-morning and mid-afternoon is preferable.

4.2.16 Non-chloride, non-corrosive accelerating admixture

The Specification has been amended to allow the use of non-chloride, non-corrosive accelerating admixtures as an alternative to calcium chloride accelerating admixtures.

Non-chloride, non-corrosive accelerating admixtures can be used under this Specification for the production of steel fibre reinforced concrete.

A trial concrete mix must be specifically designed for the addition of a non-chloride, non-corrosive accelerating admixture using cement, fine and coarse aggregates, and other materials that will be used for the proposed work. The new concrete mix must be trialled under the conditions under which it will be used.

The work crew must be trained in the handling and placement of the new concrete mix because it cannot be assumed that a new accelerated concrete mix will necessarily behave similarly to accelerated concrete mixes that have been used previously.

[iii] The normal slump range for manual paving is 50 to 80 mm but adjustment by addition of HWR may not be as accurate as with water. Slumps in the higher range will increase the risk of downhill flow on grades. Slumps in the lower range are acceptable as long as the vibration (both internal and surface) is thorough enough to compensate.

[iv] HWRRe may be preferable in hot conditions to retard the setting rate. This may reduce the strength within the first, 24 hours but should have a diminishing effect at later ages.

5 CALCULATION OF $CaCl_2$ DOSE RATE

Traditionally, calcium chloride has been used to achieve high early strength. However, it also increases the risk of corrosion. Now $CaCl_2$ dose can be greatly reduced by the addition of advanced admixtures so that corrosion is no longer a major problem.

(a) The dose rate is specified in this document as the mass of $CaCl_2$ relative to the PORTLAND CEMENT CONTENT and NOT Total Binder Content. Hence, 1% $CaCl_2$ refers to 1 kg of $CaCl_2$ per 100 kg of Portland cement.

(b) It is important not to confuse the terms:

- "mass of $CaCl_2$", and
- "mass of $CaCl_2$ solution".

Commercial $CaCl_2$ solution is typically supplied at 22%, 30%, 33% or 37% strengths.

(c) In general terms the method for calculation of the $CaCl_2$ content is as follows:

V_s = $R \div M$

where: V_s = volume of solution (litres) per 100 kg Portland cement
= (Unit Mass of solution) x (Solution Strength)
R = $CaCl_2$ dose rate (%)
M = mass (kg) of $CaCl_2$ per litre of solution, as per Table Notes.1 below.

Dose rates are tabulated in Table Notes.1 for typical applications.

For example:

Calculate the volume of solution to be added per 100 kg Portland cement, using a 30% solution and design is 0.8% dose:

- From Table Notes.1 for a 30% solution the unit mass = 1.28 kg/litre
- M = 1.28 x 30% = 0.385 kg of $CaCl_2$ per litre of solution.
- For $CaCl_2$ dose rate (R) = 0.8% (i.e. 0.8 kg/100 kg Portland cement), You require:

V_s = 0.8 ÷ 0.385 = 2.08 litres of solution, say 2.1 litres of solution per 100 kg Portland cement in the batch.

Table Notes.1 - $CaCl_2$ dose rates

$CaCl_2$ Solution strength	Unit mass of solution (kg/litre)	$CaCl_2$ mass M (kg/litre)	Volume of solution V_S (= R÷M) (litres/100 kg Portland cement)			Water content W (litres/litre solution)
			$CaCl_2$ dose rate (R)			
			0.5%	0.8%	1.0%	
24%	1.22	0.285	1.8	2.8	3.5	0.8
30%	1.28	0.385	1.3	2.1	2.6	0.8
33%	1.30	0.430	1.2	1.9	2.3	0.75
37%	1.35	0.500	1.0	1.6	2.0	0.75

The total volume of solution to be added **to the batch** is calculated as follows:

V_t = [Volume of solution (V_s)] x [Batch volume] x [Portland cement content] / 100

Values for V_s are summarised in Table Notes.1.

Example continued:

Total volume to be added to a 3.5 m^3 batch with 450 kg/m^3 of cement using a 0.8% dose of 30% solution strength (from previous example and Table Notes.1 V_s= 2.1 litres/100 kg cement):

V_t = 2.1 x 3.5 x 450 / 100 = 33 litres, say 35 litres.

(d) The mix water must be adjusted for $CaCl_2$ solution added otherwise the limits on water/cement ratio (w/c) and slump could be exceeded. Assume that water constitutes 0.8 litres for each litre of added solution.

Example continued: Assuming a w/c ratio = 0.45

35 litres of solution includes 35 x 0.8 = 28 litres of water, which is 28 ÷ 3.5 m^3 = 8 litres/m^3.

For w/c ratio = 0.45 max[v], the upper water content = 0.45 x 450 = 202 litres/m^3.

Hence, at batching, the water content must not exceed 202 – 8 = 194 litres/m^3.

Adjustment of slump must be by addition of HWR and not by addition of extra water.

[v] If the supplier has designed the mix for a w/c limit lower than 0.45, the actual value must be adopted.

DOCUMENTER'S CHECKLIST

Specification Part::	TfNSW 3201	Date:	
Version for:			
Documenter's name:			
Checking undertaken by:			

Item	Description	Information (i) Yes or No	N/A
1.	Formatting and Typing complies with standard.	☐ 1	☐ 2
2.	Section Titles and Clause Headings logical and clear.	☐ 3	☐ 4
3.	Numbering logical and sequential on Clauses, Tables, Figures and Annexures.	☐ 5	☐ 6
4.	All Tables and Figures electronically embedded in document.	☐ 7	☐ 8
5.	Pay Items clearly identified and complete.	☐ 9	☐ 10
6.	Project Manager's written approval acquired for all script deletions and additions from Model Specifications.	☐ 11	☐ 12
7.	"Fly leaf" advice provided for specific project specifications.	☐ 13	☐ 14
8.	Change control conventions applied rigorously.	☐ 15	☐ 16
9.	Documenter's Notes prepared and submitted to Contracts Manager	☐ 17	☐ 18

Action necessary (i) comment on all No entries

Witnessed:	(Project Manager)	Date:	

Transport for NSW

QA SPECIFICATION 3201

CONCRETE SUPPLY FOR MAINTENANCE

IC-QA-3201

VERSION FOR:
DATE:

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CLAUSE PAGE

FOREWORD

TFNSW COPYRIGHT AND USE OF THIS DOCUMENT

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW 3201 Edition 4 Revision 1.

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

PROJECT SPECIFIC CHANGES

Any project specific changes are indicated in the following manner:

(a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. ***Additional Text***.

(b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

TfNSW QA SPECIFICATION TfNSW 3201

CONCRETE SUPPLY FOR MAINTENANCE

1 GENERAL

1.1	This Specification has been developed specifically for TfNSW maintenance works. It should not be used in any type of contract without consideration of its suitability in the prevailing circumstances.	**Intended use**
1.2	The work includes design, production, supply and delivery of concrete for maintenance.	**Scope**
1.3	Concrete must comply with AS 1379 and the additional requirements in this Specification. If there is an inconsistency, this Specification takes precedence over AS 1379.	**AS 1379**
1.4	The requirements for concrete to be supplied for the work are described in Annexure 3201/A.	**Requirements**
1.5	Some words or abbreviations have a special meaning in this Specification and they are explained in Annexure 3201/M. These words are highlighted in capitals eg Defined Text.	**Definitions**
1.6	The standards, specifications and test methods referred to by this Specification are referenced using an abbreviated form (e.g. AS 1379). The titles are given in Annexure 3201/M.	**Referenced documents**
1.7	Unless specified otherwise or expressly supplied by the Principal, the issue of an Australian Standard, TfNSW Test Method or referenced TfNSW Specification to be used is the issue current one week before closing date for pricing the work.	**Applicable issue**
1.8	You must provide all responsibilities, such as actions, works, supply of materials, unless specifically stated otherwise. Accordingly, this Specification does not generally use wording such as "You shall …" or "You must …" because this is the underlying requirement. However, it is used where actions in a clause involve both You and the PRINCIPAL and the roles need to be unambiguous.	**Interpretation**
1.9	Provide the identified records set down in the TfNSW Quality Management System Specification included in the Contract Documents (Specification TfNSW Q) and summarised in Annexure 3201/C2.	**Records**
1.10	THE TFNSW mix codes are consistent with AS 1379 and are defined in Table 1.	**TfNSW Mix Codes**

Table 1 – TfNSW Mix Codes

Prefix	
N	**N**ormal-class for general application xx MPa compressive strength
S	**SPECIAL-CLASS** xx MPa compressive strength for non-pavement use
SP	**SPECIAL-CLASS** concrete for **P**avement xx MPa compressive strength
SFP	**SPECIAL-CLASS** **F**lexural strength for **P**avement xx MPa flex. strength

Suffix	
A	**A**ggregate maximum size xx mm
H	**H**igh Early Strength specified.
HC	**H**igh Early Strength specified. Use of up to 2.0% $CaCl_2$ permitted.
L	**L**ow slump
Q	**Q**uality requirement specified
SH	**S**prayed
H-NC	**H**igh Early Strength specified. **N**on-Chloride, **N**on-Corrosive accelerating admixture

2 PLANNING

2.1 PLANNING REQUIREMENTS

General

2.1.1 The requirements of the PROJECT QUALITY PLAN are defined in TfNSW Q. In addition, the PROJECT QUALITY PLAN must:

Hold Points

.1 Address the Hold Points required by this Specification and summarised in Annexure 3201/C1. The Principal will consider the submitted documents prior to the release of any Hold Point.

Conformity data

.2 Include a requirement for the routine submission of data, which will certify conformity of all work and materials to the requirements of this Specification and include supporting documentation.

Supplier's PROJECT QUALITY PLAN

.3 Include the Concrete Supplier's Mix Design and PROJECT QUALITY PLAN.

Mix code

.4 Include a requirement that the MIX CODE is used to reference all identification certificates, test results and claims for payment.

.5 Provide documentary evidence that the proposed concrete mix complies with the requirements of this Specification. Where required, undertake a trial mix according to AS 1012.2.

Provide documentary evidence

2.1.2 Your Inspection and Test Plan required in TfNSW Q must nominate the proposed testing frequency to verify conformity of the work, and must not be less than the frequency specified in Clause 5.

Plan must propose frequency of testing

2.2 MIX DESIGN

2.2.1 You must nominate a mix design that complies with the requirements for the specified Mix Code as follows:

Types of concrete

.1 Normal-Class concrete according to Table 2, or

.2 SPECIAL-CLASS concrete for use other than in road pavements according to Table 3, or

.3 SPECIAL-CLASS mix for pavements according to Table 4.

2.2.2 The concrete mix must remain workable for at least 30 minutes after commencing discharge at the point of acceptance.

Workability after discharge

Table 2 – Normal-Class Mix Requirements.

Property	Mix Class and MIX CODE				
	N20	**N20L**	**N32**	**N32Q**	**N40**
Strength F'c (MPa)	≥ 20 at 28 days	≥ 20 at 28 days	≥ 32 at 28 days	≥ 32 at 28 days	≥ 40 at 28 days
Portland cement (kg/m^3)	(*)	(*)	(*)	(*)	(*)
Fly Ash (kg/m^3)	(*)	(*)	(*)	(*)	(*)
W/C	(*)	(*)	(*)	(*)	(*)
Nominal slump (mm)	80	50	80	80	80
Max nominal aggregate size (mm)	20	20	20	20	20
Placement method	Hand	Hand	Hand	Hand	Hand
Admixture	(i)	(i)	(i)	(i)	(i)
PROJECT ASSESSMENT required (vii)	No	No	No	Yes	No
Other		Low slump			

Table 3 – SPECIAL-CLASS Concrete Mix Requirements (other than pavements).

Property	General Purpose – Mix Class and MIX CODE			
	S20A5Q	**S25A10**	**S25A10SH**	**S32A20Q**
Compressive Strength (MPa)	≥ 20 at 28 days	≥ 25 at 28 days	≥ 25 at 28 days	≥ 32 at 28 days
Portland cement (kg/m^3)	(*)	(*)	≥ 380	≥ 250
Fly Ash (kg/m^3)	(*)	(*)	(*)	≤ 70
W/C	(*)	(*)	(*)	(*)
Nominal Slump (mm)	(ii)	(ii)	(ii)	(ii)
Max Nom Aggregate Size (mm)	5	10	10	20
Placement method	Grout	Slip-form	Sprayed	Slip-form
Admixture	(i)	(i)	(i)	(i)
PROJECT ASSESSMENT required (vii)	Yes	No (viii)	No (viii)	Yes

Table 4 – SPECIAL-CLASS (Pavement) Mix Requirements

Property		Mix Class and MIX CODE				
		SP40	**SP40H (vi)**	**SP40HC (vi)**	**SFP5.5 (iv)**	**SP6**
Compressive strength (MPa)		≥ 40 at 28 days	≥ 40 at 28 days	≥ 40 at 28 days		≥ 6 at 28 days
Early age compressive strength (MPa)			≥ 5 at 6 hours	≥ 5 at 6 hours		
Flexural strength (MPa)					≥ 5.5 at 28 days	
Portland cement (kg/m^3)		≥ 320	≥ 430	≥ 430	≥ 300	≥ 90
Fly ash (kg/m^3)		≤ 70	(*)	(*)	≤ 110	≥ 100
Total binder (kg/m^3)						≥ 250
W/C		≤ 0.5	≤ 0.45	≤ 0.45	≤ 0.5	(*)
Slump (mm)		55 to 75 (v)	55 to 75 (v)	55 to 75 (v)	50 to 60 (v)	55 to 65 (v)
Aggregate		(iii)	(iii)	(iii)	(iii)	(iii)
Placement method		Hand	Hand	Hand	Hand	Hand
Admixture	Accelerating (ix)	Nil	≤ 0.8% $CaCl_2$	0.8% < $CaCl_2$ ≤ 2.0%	Nil	Nil
	Air entraining	Air entrainment 4.5 ± 1.0 %	Air entrainment 4.5 ± 1.0 %	Air entrainment 4.5 ± 1.0 %	Nil	Air entrainment 4.5 ± 1.0 %
Project Assessment required (vii)		Yes	Yes	Yes	Yes	Yes
Cement		Type SL or GB Cement	Type SL, GB or HES Cement	Type SL, GB or HES Cement	Type SL or GB Cement	
Steel fibre					Steel fibre	

Notes to Tables 2, 3 and 4:

(*) You must select an appropriate value.

(i) Admixtures to be used as required in the mix design.

(ii) Mixes for slipformed, extruded and sprayed concrete and pumped GROUT must be designed by You so that the finished product retains its shape and size.
NORMAL-CLASS concrete of the same strength may be used where all requirements are met.

(iii) Aggregate must meet the requirements in Clause 3.4.

(iv) Steel fibre reinforced concrete must meet the additional requirements in Annexure 3201/D.

(v) Adjustment by on-site addition of HWR may not be as precise as with water. Slumps in the higher range will increase the risk of downhill flow on grades. Slumps in the lower range are acceptable as long as the vibration (both internal and surface) produces thorough compaction.

(vi) High Early strength and strength requirements must both be met.

(vii) According to AS 1379 Clause 6.5

(viii) Where there is no PRODUCTION ASSESSMENT report, then production will be subject to PROJECT ASSESSMENT for the mix.

(ix) Refer to Clause 2.3.3.

2.3 ADDITIONAL MIX REQUIREMENTS FOR SPECIAL-CLASS CONCRETE

2.3.1 You must notify the Principal of any change to the design of a SPECIAL-CLASS mix and initiate the Hold Point in Clause 2.3.2. **Change in mix-design**

2.3.2 **HOLD POINT**

Process Held:

Initial production of SPECIAL-CLASS concrete that uses a new or changed mix design.

Submission Details:

At least 5 BUSINESS DAYS prior to supply, a statement signed by You that the concrete and its constituent materials comply with this Specification. The statement must be supported by:

Information on the nominated mix:

- Cement source of supply, type and blend, water to cement ratio, cement content (kg/m^3).
- Fine and coarse aggregate size/submitted particle size distribution, type, source, AAR action (refer to Clauses 3.2 and 3.4).
- Admixture source of supply, type, dosage.
- Where steel fibres are specified, the source, dimension and nominated mix quantity.

Documentation of either:

- The most recent PRODUCTION ASSESSMENT Report; or
- Recent test reports where PRODUCTION ASSESSMENT has not been carried out or has been suspended since the most recent PRODUCTION ASSESSMENT Report.

For a mix specified by flexural strength:

- Test results for flexural strength according to Annexure C.
- The determination of the equivalent mean compressive strength.

Release of Hold Point:

The Principal will consider the submitted documents and may inspect test records prior to authorising the release of the Hold Point.

Non-chloride, non-corrosive accelerating admixture

2.3.3 If specified in Annexure 3201/A, design a SPECIAL-CLASS (Pavement) concrete mix that contains a non-chloride, non-corrosive accelerating admixture as an alternative to using a calcium chloride ($CaCl_2$) accelerating admixture. With the exception of the references to $CaCl_2$, the alternative concrete mix design must comply with the requirements of Table 4, including the Notes, and the other requirements of this Specification.

Use the mix code SP40H-NC.

Design a trial concrete mix specifically for the addition of a non-chloride, non-corrosive accelerating admixture using the cement, fine and coarse aggregates, and other materials that will be used for the proposed work.

The SPECIAL-CLASS (Pavement) SP40H-NC concrete mix design must have a demonstrated and documented record of successful application in concrete highway pavement maintenance work in accordance with Clause 2.1.1.5. The nature of this highway pavement maintenance work must be the same as the Work Under the Contract.

Produce a trial mix of the alternative SPECIAL-CLASS (Pavement) concrete mix in accordance with Clause 2.1.1.5.

3 RESOURCES

3.1 GENERAL

Section 2 of AS 1379 to be met

Materials used in the production of concrete must comply with Section 2 of AS 1379.

3.2 AGGREGATES

Aggregate to AS 2758.1

Aggregate must comply with AS 2758.1 and the nominated requirements in Table 5.

Table 5 – AS 2758.1 Requirements for Aggregates.

AS 2758.1	Requirement
Clause 7.1 Particle Density	Aggregate is generally 'normal weight' unless specified otherwise.
Clause 7.3 Water absorption	Maximum water absorption for aggregate 2.5%, except for slag aggregate 6%.
Clause 9.2 Exposure Classification	Exposure Classification is B1 unless specified otherwise.
Clause 9.2 Durability	Satisfy the fine aggregate durability requirements as appropriate for the concrete application defined in Appendix A of AS 2758.1.
Clause 9.3.2 Wet Strength and Wet/Dry Strength Variation	Satisfy the Wet Strength and Wet/Dry Strength Variation requirements for coarse aggregate for the concrete application defined in Appendix A of AS 2758.1.

3.3 PLANT AND EQUIPMENT

Plant and equipment

Plant and equipment used to produce concrete must comply with Section 3 of AS 1379 and this Specification.

3.4 ADDITIONAL REQUIREMENTS FOR SPECIAL-CLASS CONCRETE

Exposure classification of pavement concrete

3.4.1 Concrete to be used in pavement construction is deemed to have an exposure classification 'C'.

Cement

3.4.2 Cement, which includes supplementary cementitious materials, must comply with Specification TfNSW 3211.

Blending

3.4.3 Blending of cement must be achieved either at the cement manufacturer's facilities and/or at the concrete batching plant.

Compatibility of admixtures

3.4.4 Chemical admixtures must be of the type specified and compatibility must be certified in writing by the manufacturers.

Particle size

3.4.5 For all SPECIAL-CLASS concrete except for SP6, the particle size distribution of aggregate must comply with Table 6.

Table 6 – Combined Aggregate Particle Size Distribution.

AS sieve	Percent passing by mass
19.00 mm	95 - 100
13.20 mm	75 - 90
9.50 mm	55 - 75
4.75 mm	38 - 48
2.36 mm	30 - 42

AS sieve	Percent passing by mass
1.18 mm	22 - 34
600 μm	16 - 27
300 μm	5 - 12
150 μm	0 - 3
75 μm	0 - 2

Fine aggregate for unsurfaced Base concrete

3.4.6 Fine aggregate intended for use in unsurfaced Base concrete must have:

.1 At least 50% (by mass) natural sand, and

.2 The natural sand to have at least 70% (by mass) quartz and chert particles when tested in accordance with ASTM C295.

Alkali -Aggregate Reactive aggregates (AAR) in SPECIAL-CLASS concrete

3.4.7 All aggregate used in all SPECIAL-CLASS concrete must be:

.1 petrographically examined in accordance with Clause 3.4.8 and

.2 assessed and classified for AAR using either the accelerated mortar bar test method or the concrete prism test method, in accordance with Test Methods TfNSW T363 and TfNSW T364, respectively.

Petrographic Examination

3.4.8 Petrographic examination must be in accordance with ASTM C295. Those aggregates containing obviously reactive components such as:

.1 Opaline material.

.2 Unstable silica minerals such as moderate amounts of tridymite and cristobalite; or

.3 Sheared rock containing moderate amounts of strained quartz and microcrystalline quartz,

may be eliminated without further testing.

Actions Required for Control of AAR

3.4.9 For aggregates classified as non-reactive by either Test Method TfNSW T363 or TfNSW T364, no action is required.

For aggregates classified by TfNSW T363 as having potential for mild/slow or substantial AAR, actions required for control of potential AAR must be in accordance with Table 7.
Aggregates classified as reactive by TfNSW T364 in a particular concrete mix design must not be used in that mix. Alternative aggregates and/or alternative concrete mix designs must be used which conform to the requirements of this Specification.

Table 7 – Actions Required for Control of Potential AAR.

Based on Classification in Accordance with TfNSW T363

Aggregate Reactivity Classification	Actions Required
Mild/Slow AAR	Use Blended cement.
Substantial AAR	Use an alternative aggregate; or use Blended cement and assess the aggregate reactivity in the concrete mix design using TfNSW T364

Quality management system

3.4.10 Special-Class concrete must be produced using plant and equipment operating under a quality management system which satisfies the requirements of AS/NZS ISO 9001.

4 EXECUTION

4.1 PRODUCTION AND DELIVERY

Production and delivery

4.1.1 Concrete must be produced and delivered according to Section 4 of AS 1379 and the Specification.

Additional requirements

4.1.2 Concrete must meet the following additional requirements:

Freshly batched

.1 Concrete must be freshly batched for use on the Work and must not contain any mix from an earlier batch.

.2 The temperature of the concrete at the point of acceptance must not be less than 10°C. **Temperature at point of acceptance**

.3 The temperature of the concrete before adding admixture at the point of acceptance must not be greater than 30°C. **Maximum temperature**

4.1.3 The identification certificate (delivery docket) must contain the following information for the different classes of concrete (refer to AS 1379 Clause 1.8.3). **Identification certificate**

	Information	N class	S class
.1	Name of supplier, and place of manufacture	Yes	Yes
.2	Serial number of certificate (sequential & pre-numbered)	Yes	Yes
.3	Date of supply	Yes	Yes
.4	Name of customer	Yes	Yes
.5	Project name and location	Yes	Yes
.6	Delivery vehicle identification	No	Yes
.7	Quantity of concrete covered by certificate	Yes	Yes
.8	Mix identification (Mix Code)	Yes	Yes
.9	Specified slump	Yes	Yes
.10	Maximum nominal size of aggregate	Yes	Yes
.11	A time clock recording of both the commencement and completion of mixing	Yes	Yes
.12	Quantity of water or admixture added after batching Quantity of concrete to which water or admixture was added (for partial batch)	Yes No	Yes Yes
.13	Other details: Batch information when requested	No	Yes

4.1.4 Any admixture added at the point of acceptance must be accurately introduced into the mix by liquid dispensing equipment mounted on the truck. The admixture must be at the dilution recommended by the manufacturer. **Admixture added at the point of acceptance**

Provide a procedure from the concrete manufacturer for adding admixtures to the mix at the point of acceptance.

4.1.5 The concrete must be mixed on site for at least 3½ minutes at the rated MIXING SPEED before any concrete is discharged. **Minimum mixing criteria**

If any materials (for example, calcium chloride, other admixtures, and water for slump adjustment) are later added to the mixer, the batch must be remixed immediately after the addition for at least 3½ minutes at the MIXING SPEED.

4.1.6 Concrete that is not PLASTIC and has reached initial set must be rejected and not used in the Work. **Concrete not plastic**

Insufficient slump

4.1.7 Insufficient slump caused by a dry mix, but not due to an initial set, may be corrected by adding water or appropriate admixture within 40 minutes of the Completion of Batching. The requirements of AS 1379 Clause 4.2.3 must be met including:

.1 Record added water or admixture on the identification certificate for that batch.

.2 Sample and test after addition of water or admixture.

.3 Water-cement ratio, where specified, must not be exceeded.

.4 The requirements of Clause 4.1.5 must be met.

Disposal and wash down

4.1.8 Ensure that water, contaminants, debris, excess concrete and other materials from concrete supply operations are disposed of in accordance with Specification TfNSW G36.

Unless a wash-out point is designated on site, excess concrete or water from washing the agitator or other equipment must not be disposed of onto the Site.

Waste material

4.1.9 When material leaves the Site, it is Your property unless specified otherwise.

Record location

4.1.10 Record the location where each load of concrete was used.

5 CONFORMITY

5.1 GENERAL

Process control

5.1.1 You must warrant that the concrete supplied:

.1 Was batched using the nominated mix design, and

.2 Conforms to this Specification.

Sampling and testing

5.1.2 All sampling and testing of concrete specimens must be in accordance with AS 1379 Sections 5 and 6.

Production assessment

5.1.3 For concrete subject to PRODUCTION ASSESSMENT, register the project and obtain PRODUCTION ASSESSMENT information in accordance with AS 1379.

Project assessment

5.1.4 For concrete subject to PROJECT ASSESSMENT, produce a PROJECT ASSESSMENT Report each month for each strength grade, in a form similar to a PRODUCTION ASSESSMENT Report.

Batch information

5.1.5 Provide batch information for SPECIAL-CLASS concrete within 10 BUSINESS DAYS when requested by the Principal.

5.2 COMPRESSIVE STRENGTH

Normal-class concrete

5.2.1 NORMAL-CLASS concrete must meet the requirements of this SPECIFICATION and AS 1379.

SPECIAL-CLASS concrete

5.2.2 Each batch of SPECIAL-CLASS concrete, must comply with this SPECIFICATION and AS 1379.

Test cylinders

5.2.3 Concrete test cylinders must be 100 mm diameter by 200 mm long unless otherwise specified in Annexure 3201/D3.

SPECIAL-CLASS concrete

5.2.4 Each batch of SPECIAL-CLASS concrete, which is specified using flexural strength, must exceed the equivalent mean compressive strength determined for the mix.

ANNEXURE 3201/A – DETAILS OF WORK

A1 WORK SUMMARY

Contract Reference	

Mix Code (i)	Concrete Description (i)	Delivery Location			
		Road No.	Road Name and Location	Distance (km)	Quantity (m^3)
Note: (i) Refer to Tables 2, 3 and 4.					

Wash-out point designated on site: (Clause 4.1.8)	Yes / No

A2 NON-CHLORIDE, NON-CORROSIVE ACCELERATING ADMIXTURE

Non-chloride, non-corrosive accelerating admixture to be used in accordance with Clause 2.3.3.	Yes / No

ANNEXURE 3201/B – (NOT USED)

ANNEXURE 3201/C – SCHEDULES OF HOLD POINTS AND IDENTIFIED RECORDS

C1 SCHEDULE OF HOLD POINTS

Reference	Type	Process Held	Submission Details
2.3.2	Hold	Initial production of SPECIAL-CLASS concrete that uses a new or changed mix design.	At least 5 BUSINESS DAYS prior to supply, a statement signed by You that the concrete and its constituent materials comply with this Specification. The statement must be supported by: ▪ Information on the nominated mix; ▪ The most recent Production ASSESSMENT Report; or ▪ By test reports where PRODUCTION ASSESSMENT has not been carried out or has been suspended since the most recent PRODUCTION ASSESSMENT Report.

C2 SCHEDULE OF IDENTIFIED RECORDS

Reference	Description of Identified Record
Clause 2.1	PROJECT QUALITY PLAN including: Inspection and Test Plan
Clause 2.2.1	Nominated Concrete Mix Design
Clause 2.3.2	For SPECIAL-CLASS concrete and any subsequent changes, information on the nominated mix; and ▪ The most recent PRODUCTION ASSESSMENT Report; or ▪ Test reports where PRODUCTION ASSESSMENT has not been carried out or has been suspended since the most recent PRODUCTION ASSESSMENT Report.
Clause 3.3	Verification that plant and equipment operate under ISO 9001
Clause 4.1	Identification certificates (delivery dockets) and details of any added water or admixture. Records of location where each load was used
Clause 5.1	Warrant that concrete supplied meets this Specification
Clause 5.1	PRODUCTION ASSESSMENT Reports and PROJECT ASSESSMENT Reports where requested

ANNEXURE 3201/D – STEEL-FIBRE REINFORCED CONCRETE

D1 GENERAL

Additional requirements

D1.1 This Annexure sets out additional requirements for the production, delivery, and quality assurance of steel-fibre concrete mix (SFRC).

.1 Properties and proportion of steel fibres according to Annexure 3201/D2, and

.2 Sampling and testing according to Annexure 3201/D3.

The requirements of this Annexure apply in addition to and, where conflict exists, in place of, the requirements of the other clauses of this Specification.

D2 STEEL FIBRES

Ultimate strength

D2.1 The ultimate strength of steel fibres must be not less than 750 MPa. The hardness must be not less than 85 Hardness Rockwell B Scale.

Fibre factor

D2.2 The type and size of steel fibre must be such as to yield a Fibre Factor of at least 25 and no more than 90.

$$F = V_f \times \left(\frac{L}{D}\right) \times K_f$$

Where:

F = Fibre Factor

V_f = the fibre content (% volume) of the mix.
The maximum is 120 ÷ (L/D)

K_f = 0.75 as the bond coefficient of the fibre

(L/D) = the aspect ratio of the fibre

The length (L) must not exceed one-third of the least dimension of the flexure test specimen mould.

A steel density of 7850 kg/m^3 must be adopted.

Mass of steel fibre

D2.3 The mass of steel fibre must be at least 75 kg per yielded cubic metre of concrete.

Other masses may be permitted, provided that suitable concrete pavement performance can be demonstrated at the time of approval of the mix. Equivalent fibre factors may be used as a corresponding measure of performance provided documentation satisfactory to the TfNSW of in-service-performance is supplied.

The fibre factor corresponding to 75 kg/m^3 is 29 when calculated on the properties of an accepted fibre. Alternative masses of steel fibre would have to meet the requirement of at least 25 and no more than 90.

Uniform distribution

D2.4 The steel fibres must be incorporated to ensure uniform distribution throughout the concrete at the point of placement.

D3 CONFORMITY

Tolerance for weigh batching

D3.1 The permissible tolerance for weigh batching of steel fibres is +10%, -0%.

Compressive strength

D3.2 Test specimens to determine the compressive strength of concrete must be the diameter according to Table 8.

Flexure specimens

D3.3 Test specimens to determine the flexural strength of a nominated concrete mix must be:

1. Rectangular beams with dimensions determined by maximum nominal aggregate size and fibre length according to Table 8.
2. Made to minimise disturbance to the fibre distribution and orientation in the test specimen.
3. Made and cured according to AS 1012.8.2 unless otherwise specified in Table 8.

Table 8 – Specimen Sizes of SFRC mixes

Aggregate and Fibre Length	Flexure Specimens		Compressive Strength Cylinder Size (mm)
	Specimen Size (mm)	Standard	
Nominal maximum size of aggregate ≤ 20 mm, and $L_f \leq 33$ mm	100×100×350	AS 1012.8.2	100
Nominal maximum size of aggregate ≤ 40 mm, and $33 < L_f \leq 50$ mm	150×150×500	AS 1012.8.2	150
Nominal maximum size of aggregate ≤ 40 mm, and $L_f > 50$ mm	$W \times D \times L_s$ (i) where: $D \geq 3L_f$ and W = D, and $L_s \geq 3D+50$	ASTM C1018	150

Notes: L_f = maximum length of steel fibre in the mix

L_s = length of flexure specimen

(i) For L_s > 150 mm in width, AS 1012.11 must be amended as follows:

- Where reference is made to AS 1012.8.2 it is to also include ASTM C1018,
- AS 1012.11 Table 1 is to include testing of beam specimens >150 x150 mm. The centre-to-centre distance of the supporting rollers (L) must be 3W (+15, -8) mm where W is the width of specimen.

Flexural strength

D3.4 The flexural strength of the concrete represented by a set of three test specimens taken from one sample must be the average of individual results within 0.5 MPa of the median value.

ANNEXURES 3201/E TO 3201/L – (NOT USED)

ANNEXURE 3201/M – REFERENCED DOCUMENTS AND DEFINITIONS

M1 REFERENCED DOCUMENTS

M1.1 Australian Standards

AS 1012 Parts 1 to 18	Methods of testing concrete. Parts 1 to 18.
AS 1379	Specification and supply of concrete
AS 2758.1	Aggregates and rock particles for engineering purposes. Part 1: Concrete aggregates
AS/NZS ISO 9001	Quality management systems - Requirements

M1.2 TfNSW Documents

TfNSW T363	Accelerated AAR assessment
TfNSW T364	Concrete Prism Test for AAR Assessment
TfNSW G36	Environmental Protection
TfNSW Q	Quality Management System
TfNSW 3211	Cements, Binders and Fillers

M1.3 ASTM Standards

ASTM C295	Petrographic Examination of Aggregates for Concrete
ASTM C1018	Standard Test Method for Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading) (Withdrawn 2006)

M2 ABBREVIATIONS AND DEFINED TERMS

AAR	Alkali-aggregate reaction (refer to Clause 3.4.7)
HWR	High-range Water Reducing Admixture ~ generally a 'Superplasticizer'.
HWRRe	High-range Water Reducing Admixture with a Retarding effect on set time.
Grout	A mixture, similar to Mortar, but more workable and possibly without any sand or fine aggregate, proportioned to produce a pourable liquid which does not readily segregate into its constituents during pouring or pumping.
Mix Code	An alphanumeric code that uniquely defines the properties of the concrete mix. Refer to Clause 1.10 and Tables 2, 3 and 4.
Mixing Speed	The drum speed in revolutions per minute shown on the mixer identification plate as "Mixing Speed".
Mixing Time	The time that the agitator is run on site at its Mixing Speed.
Mortar	A mixture of cement, water and sand (fine aggregate), with or without chemical admixtures with a characteristic compressive strength at 28 days of not less than 20 MPa.
Nominated Mix Design	The mix proportions for concrete (refer Clause 2.2).
Normal-Class	Concrete which is specified primarily by a standard compressive strength grade and in accordance with AS 1379 Clause 1.6.3.
Plastic	The consistency of concrete when freshly mixed and before initial set occurs.
Production Assessment	Assessment procedure for concrete specified by compressive strength grade, carried out by the Contractor and based on statistical assessment of standard compressive strength tests on concrete, and produced by a specific supplying plant (refer to AS 1379).

Project Assessment	Assessment procedure for concrete specified by strength grade, specified at the Principal's option, which provides additional test data for the statistical assessment of concrete supplied to a specific project (refer to AS 1379). The Principal must provide test reports within 10 Business Days or within 2 Business Days where concrete is below the specified strength.
Special-Class	Concrete which is specified to have certain properties or characteristics different from, or additional to, those of Normal-Class concrete and in accordance with AS 1379 Clause 1.6.4.