

TRANSPORT FOR NSW (TfNSW)
SPECIFICATION D&C R53
CONCRETE FOR GENERAL WORKS

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GUIDE NOTES (Not Part of Contract Document)

Use of Specification D&C R53

This specification sets out the requirements for the supply and placement of concrete for a variety of general works. Where standard drawings and/or other specifications are cross-referenced in D&C R53 or *vice versa*, D&C R53 needs to be used in conjunction with those other TfNSW documents, which include (but not necessarily be limited to) the following documents:

- D&C R11 - Stormwater Drainage
- D&C R15 - Kerbs and Channels (Gutters)
- D&C R54 - General Concrete Paving
- D&C R132 - Safety Barrier Systems
- D&C R143 - Signposting
- D&C R151 - Street Lighting
- D&C R201 - Fencing
- D&C R204 - Property Adjustments
- D&C R225 - Concrete Injected Columns
- D&C TS101 - Traffic Control Signals – New Installation and Reconstruction
- DS2012/000293 - Rigid Pavement Standard Drawings for Bicycle Path Design



Transport
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SPECIFICATION D&C R53

CONCRETE FOR GENERAL WORKS

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FOREWORD

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BASE SPECIFICATION

This document is based on Specification TfNSW R53 Edition 3 Revision 5.

TfNSW SPECIFICATION D&C R53

CONCRETE FOR GENERAL WORKS

1 GENERAL

1.1 SCOPE

This Specification sets out the requirements for concrete for general works, such as drainage structures, footings and plinths for sign support structures, lighting columns and traffic signals, kerbs and channels (gutters), safety barriers, and paving for bicycle paths/shared paths, footpaths, medians, and driveways.

Concrete includes both unreinforced concrete and concrete reinforced with steel bars, wire, mesh or fibres and placed and formed using fixed formwork, slipforming, extruding and spraying.

This Specification also covers mortar (used, for example, for filling gaps), grout for grout filled revetment mattresses, and sprayed concrete for lining open drains, but it does not cover shotcrete which is covered under other specifications.

1.2 STRUCTURE OF THE SPECIFICATION

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

1.2.1 (Not Used)

1.2.2 (Not Used)

1.2.3 Schedules of **HOLD POINTS**, **WITNESS POINTS** and **Identified Records**

The schedules in Annexure R53/C list the **HOLD POINTS** and **WITNESS POINTS** that must be observed. Refer to Specification TfNSW D&C Q6 for the definitions of **HOLD POINTS** and **WITNESS POINTS**.

The records listed in Annexure R53/C are **Identified Records** for the purposes of TfNSW D&C Q6 Annexure Q/E.

1.2.4 Planning Documents

The PROJECT QUALITY PLAN must include each of the documents and requirements listed in Annexure R53/D and must be implemented.

1.2.5 Frequency of Testing

The Inspection and Test Plan must nominate the proposed frequency of testing to verify conformity of the item, which must not be less than the frequency specified in Annexure R53/L. Where a minimum frequency is not specified, nominate an appropriate frequency. Frequency of testing must conform to the requirements of TfNSW D&C Q6.

You may propose to the Principal a reduced minimum frequency of testing. The proposal must be supported by a statistical analysis verifying consistent process capability and product characteristics.

The Principal may vary or restore the specified minimum frequency of testing, either provisionally or permanently, at any time.

1.2.6 Referenced Documents

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 1234). For convenience, the full titles are given in Annexure R53/M.

1.3 DEFINITIONS OF TERMS

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

The following definitions apply to this Specification:

Mortar A mixture of cement, water and fine aggregate, with or without chemical admixtures with a characteristic compressive strength at 28 days of not less than 20 MPa.

Grout A mixture, similar to mortar, but more workable and possibly without any fine aggregate, proportioned to produce a pourable liquid which does not readily segregate into its constituents during pouring or pumping.

Production Assessment An assessment procedure for concrete defined by strength grade, carried out by the supplier and based on the statistical assessment of standard compressive strength tests on concrete, specified by compressive strength and produced by a specific supplying plant, as defined in AS 1379.

Project Assessment An assessment procedure for concrete defined by strength grade, specified at the customer’s option, which provides additional test data for the statistical assessment of concrete supplied to a specific project, as defined in AS 1379.

Other terms are used as defined in AS 1379, AS 3600, and AS 3610.1.

1.4 QUALITY MANAGEMENT SYSTEM

The manufacturer/supplier of concrete must have in place quality management systems independently certified as fully complying with AS/NZS ISO 9001, by an organisation accredited by JAS-ANZ or an affiliated international certification organisation. Provide evidence of the certification.

The supplier of steel reinforcement must be certified by the Australasian Certification Authority for Reinforcing and Structural Steels (ACRS) for the supply of steel reinforcement.

Suppliers of other materials covered under this Specification such as admixtures and curing compounds must have in place a quality assurance system complying with AS/NZS ISO 9001.

2 MATERIALS

2.1 CEMENT AND SUPPLEMENTARY CEMENTITIOUS MATERIALS

Cement and supplementary cementitious materials (SCMs) must conform to the requirements of Specification TfNSW D&C 3211.

Cement used in mortar or grout must be either Type GP or Type GB.

2.2 AGGREGATES

2.2.1 General

Aggregates used in the manufacture of concrete and mortar must comply with AS 2758.1 and must:

- (a) have a maximum water absorption of 2.5% for aggregate (refer AS 2758.1 Clause 7.3) except for slag aggregate which must have a maximum limit of 6%;
- (b) satisfy the fine aggregate durability requirements specified in AS 2758.1 Clause 9.2 for exposure classifications A1, A2 or B1, as appropriate for the concrete application defined in AS 2758.1 Appendix A; and
- (c) satisfy the wet strength and wet/dry strength variation requirements specified in AS 2758.1 Clause 9.3.2 for exposure classifications A1, A2 or B1, B2 as appropriate for the concrete use defined in AS 2758.1 Appendix A.

Granulated glass may be used as fine aggregate, up to a maximum 15% of the total fine aggregate. Granulated glass must meet the requirements of Specification TfNSW D&C 3154.

2.2.2 Alkali-Aggregate Reaction (AAR)

All aggregate for use in the concrete to be incorporated into the Works must be assessed and classified for AAR using the accelerated mortar bar test method in accordance with Test Method TfNSW T363.

From the classification obtained by the testing, deal with the aggregates as follows:

- (a) Where the aggregates classified as “non-reactive”: no further action is required.
- (b) Where any of the aggregates in the mix is classified as “slowly reactive”: use a blended cement for the mix.
- (c) Where any of the aggregates in the mix is classified as “reactive”:
either:
 - (i) use a different aggregate and repeat the test;or
 - (ii) re-test using a blended cement and re-assess the AAR potential using Test Method TfNSW T364.

Do not use aggregates that are classified as “reactive” by TfNSW T364.

Blended cements used for control of potential AAR must be in accordance with Annexure 3211/E of TfNSW D&C 3211 for special applications.

Submit documentation of AAR assessment including the results of petrographic examination undertaken in accordance with ASTM C295.

2.3 ADMIXTURES

Chemical admixtures and their use must conform to AS 1478.1.

Do not use admixtures containing calcium chloride.

2.4 CONCRETE

2.4.1 General

Manufacture and supply of concrete under this Specification must be in accordance with AS 1379, and supplemented by the requirements in this Specification.

The basic parameters for concrete to be specified by the customer in accordance with AS 1379 Clause 1.3 is shown in Annexure R53/E.

2.4.2 Steel Fibre Reinforced Concrete

The mix design of concrete containing steel fibre reinforcement, including the quantity of steel fibre reinforcement, must be in accordance with the fibre manufacturer's recommendations.

2.4.3 Submission of Nominated Mixes

Before commencing production of each mix, submit to the Principal the following:

- (a) Where the nominated mix(es) has had production assessment carried out in accordance with AS 1379 Clause 6.3, submit the production assessment report complying with AS 1379 Clause 6.4.2. Include a statement from each material supplier certifying that the constituent materials meet the requirement of this Specification. Upon request, submit copies of completed verification checklists of production assessment.

Alternatively, you may submit details of the nominated mix(es), together with NATA endorsed test results for all relevant tests carried out during mix design laboratory testing and a statement signed by you stating that the nominated mix(es) and its constituents meet the requirements of this Specification. The date of laboratory testing of the mix(es) and all its constituents must be within 18 months of the time when the nominated mix(es) is proposed to be used.

- (b) For slipform concrete, a statement certifying that the mix is suitable for slipforming.

Alternatively, you may propose a mix which is currently listed as conforming to this Specification in the TfNSW Register of Concrete Mixes, available at:

<http://www.rms.nsw.gov.au/business-industry/partners-suppliers/register-of-materials/concrete-mix/conform-conc-mix.pdf>.

HOLD POINT

Process Held: Commencement of production of each concrete mix.

Submission Details: At least 5 working days prior, submit any one of the following:

- (a) The documents specified in Clause 2.4.3 items (a) and (b);

or

- (b) Details of mix(es) selected from the TfNSW Register of Concrete Mixes, together with a statement certifying that the mix conforms to this Specification and is suitable for its intended use.

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

2.4.4 Transport and Delivery of Concrete

Transport concrete to the site in transit mixers or agitator trucks complying with the requirements of AS 1379.

Comply with Specification TfNSW D&C G36 when disposing of excess concrete, and washing the drum and other equipment to ensure that contaminated water is not allowed to run off into the stormwater drainage system.

2.5 MORTAR AND GROUT

2.5.1 Mortar

Mortar for filling gaps and distributing loads between components must be a mixture of 3 parts fine aggregate to 1 part cement with sufficient water to produce a mix consistency suitable for the intended use.

2.5.2 Grout for Revetment Mattresses

Grout for grout filled revetment mattresses must comply with the parameters specified in Annexure R53/E.

2.6 CURING COMPOUNDS

The curing compound must be:

- (a) a hydrocarbon resin compound complying with AS 3799 Class B, Type 1-D; or
- (b) a wax emulsion complying with AS 3799 Class A, Type 1-D.

2.7 STEEL REINFORCEMENT

2.7.1 Steel Bar and Mesh

Steel reinforcement must comply with AS/NZS 4671 or AS/NZS 4672 as appropriate.

Galvanising, where specified, must be in accordance with AS/NZS 4680.

2.7.2 Steel Fibre

Steel fibre reinforcement must be of a type recommended by the fibre manufacturer for the intended use.

3 CONSTRUCTION

Include in your PROJECT QUALITY PLAN details of equipment and methods for placing (including compaction) and finishing of concrete, mortar and grout.

3.1 FORMWORK

Formwork must comply with the relevant requirements of AS 3610.1. Joints in formwork must be watertight to prevent loss of grout.

Unless specified otherwise on the Design Documentation drawings or in other Specifications or approved by the Project Verifier, do not place concrete directly in contact with the sides of excavation, but use formwork to support the sides of the concrete.

3.2 STEEL FIXING

3.2.1 Lapped Splices

Do not lap steel reinforcement at locations other than those shown on the Design Documentation drawings.

Unless shown otherwise on the Design Documentation drawings, length of lapped splices must be as shown in Table R53.1.

Table R53.1 – Required Length of Lapped Splices

Reinforcement Type	Lap Length
Deformed bar, grade 500N	35 times bar diameter
Plain bars and hard-drawn wire	50 times bar diameter
Reinforcing mesh	Overlap distance between two sheets of mesh must be at least equal to the pitch, i.e. outermost two transverse wires of one sheet of mesh must overlap outermost two transverse wires of the other sheet
7-wire prestressing strand	90 times strand diameter

Welding of steel reinforcement must comply with Specification TfNSW D&C B203.

3.2.2 Edge of Mesh Sheet

Where a sheet of mesh has been cut so that the outermost wire parallel to an edge of the concrete is more than 20 mm from the end of the transverse wires or the wires are not parallel to the edge, tie a D500N12 bar at the edge of the sheet.

3.2.3 Concrete Cover

The minimum cover of any steel bar, wire or mesh reinforcement is 50 mm unless shown otherwise on the Design Documentation drawings or in other Specifications.

Support reinforcement using either concrete or plastic chairs. Do not use steel wire chairs (with or without plastic tips), bricks or pieces of timber or coarse aggregate to support reinforcement.

3.3 CONCRETE PLACING AND FINISHING

3.3.1 Preparation and Inspection

Remove all dirt and other foreign matter from inside the forms prior to placing concrete within the forms.

For reinforced concrete, do not place concrete directly against the floor of the excavation, but against a 50 mm thick blinding layer of unreinforced concrete, unless shown otherwise on the Design Documentation drawings.

HOLD POINT

(Where nominated in the relevant TfNSW Specification)

Process Held: Placing of concrete.

Submission Details: At least 2 working days prior, provide notice of:

- (a) expected completion time of fixing of the formwork and reinforcement (if applicable); and
- (b) expected commencement date and time of placement of concrete.

Release of Hold Point: The Nominated Authority may inspect the completed reinforcement and formwork prior to authorising the release of the Hold Point.

3.3.2 Concrete and Air Temperature

Measure and record the concrete temperature at the point of placement in accordance with ASTM C1064/C1064M for all concrete works.

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

Measure and record the air temperature outdoors in the shade remote from artificial influences such as machinery exhaust outlets.

Do not place concrete if the measured air temperature is:

- (a) below 5°C; or
- (b) predicted to be below 5°C in the 24 hours after placement; or
- (c) above 35°C.

Where air temperature is likely to exceed 30°C, take appropriate measures to reduce the concrete temperature as noted in AS 1379 Clause 4.4.2.

3.3.3 Rain

Do not place concrete in the Works during rain or when rain appears imminent.

Include in your PROJECT QUALITY PLAN details of measures to protect plastic concrete if rain does occur.

3.3.4 Placing and Compaction

Place concrete in such manner that:

- (a) limit segregation or loss of materials;
- (b) limit premature stiffening;
- (c) produce a dense homogeneous product which is monolithic between joints and edges;
- (d) provide the specified thickness and surface finish.

Compact concrete immediately after placing using internal and/or external vibration to expel all entrapped air. Carry out vibration in a regular and systematic manner to ensure that all the concrete is thoroughly compacted. Do not vibrate concrete to the point where segregation occurs.

Where internal vibrators are used, they must have a minimum diameter of 50 mm with an operating frequency between 130 Hz and 200 Hz. Use smaller diameter vibrators for compaction of narrow spaces or for compaction around dense reinforcement or as otherwise required.

3.3.5 Moisture Loss Control

Restrict the evaporation of water from the concrete surface and prevent plastic shrinkage cracking.

Where an evaporation retarder is used to restrict the evaporation of water, apply the retarder by using a fine uniform spray. Do not incorporate the evaporation retarder into the surface during any subsequent finishing operations.

Include in your PROJECT QUALITY PLAN the measures to restrict the evaporation of water from the concrete surface and to prevent the incidence of plastic shrinkage cracking.

Regularly inspect the concrete surface to monitor the effectiveness of the procedures used to prevent moisture loss.

3.3.6 Unformed Surface Finish

Finish unformed concrete surfaces in such manner that:

- (a) achieve the specified dimensions, grade and surface texture;
- (b) avoid plastic or drying shrinkage cracks.

Unless specified otherwise on the Design Documentation drawings or in other Specifications, do not finish unformed surfaces with a wood float.

Protect freshly finished surfaces from damage by rain or other causes until the concrete has set.

3.3.7 Stripping of Formwork

Do not strip formwork earlier than the minimum times specified in AS 3610.1 Table C2 but for vertical forms must not be less than:

- (a) **external surfaces:** 2 days;
- (b) **permanently hidden surfaces:** 1 day.

Carry out any necessary repairs to formed surfaces immediately after stripping the forms, using a method accepted by the Project Verifier.

3.3.8 Formed Surface Finish Requirements

Unless specified otherwise on the Design Documentation drawings or in other Specifications, the class of formed surface finish (as defined in AS 3610.1) must be as follows:

- (a) **external surfaces:** Class 3;
- (b) **permanently hidden surfaces:** Class 4.

Test panels or colour control are not required.

Where form tie rod marks will be visible in the completed structure, position the tie rods in a uniform pattern.

The minimum spacing of face steps on external surfaces are 2 m horizontally and 1 m vertically.

3.3.9 Joints

(a) Construction joints

Roughen the surface of concrete at construction joints to expose the coarse aggregate. Wash clean the roughened surfaces and projecting reinforcement, and remove all excess water and loose material prior to placing the adjoining concrete.

(b) Contraction and expansion joints

Refer to the relevant specification and/or drawings.

3.4 CURING

3.4.1 General

Cure the newly placed concrete for at least seven days by sealed curing, wet curing or using curing compounds.

If formwork is removed before the required seven day curing period has elapsed, continue curing the exposed surfaces for the remainder of the period.

Include in your PROJECT QUALITY PLAN details of the equipment and methods for curing the concrete.

3.4.2 Wet Curing

If using wet curing, after the concrete has reached initial set, spray all exposed surfaces with water and keep the concrete continually moist for at least 7 days.

Water used for curing must be free from deleterious materials.

3.4.3 Using Curing Compound

Apply the curing compound to unformed surfaces immediately after the surface is firm and free of bleed water, and to formed surfaces within 30 minutes of removal of formwork if formwork removal takes place earlier than 7 days after concrete placing.

Apply the curing compound to provide a uniform cover over the exposed surfaces at the rate specified by the manufacturer, or 0.2 litre/m², whichever is the greater. Check the application rate by calculating the amount of curing compound falling on felt mats, each approximately 0.25 m² in area, placed on the concrete surface.

Apply two coats when necessary to ensure complete and uniform coverage. The time between the first and second coat must be in accordance with the manufacturer's recommendation, or on the basis of a trial application.

The curing compound must be thoroughly mixed during application. Where a sprayer is used, it must incorporate a device for continuous agitation and mixing of the compound in its container during spraying.

During application, implement measures to prevent the curing compound drifting away from the target concrete surface and deposited on adjacent surfaces.

Maintain the curing membrane intact until at least seven days have elapsed after concrete placing. Make good any damage to the curing membrane by respraying the affected areas.

3.5 LOADING OF STRUCTURES

Do not impose loads (including loads from backfilling) on the concrete structure or subject the concrete to vibration until the concrete has attained adequate strength to be able to withstand the effects without damage.

3.6 MORTAR, GROUT AND SPRAYED CONCRETE

Remove all dirt and other foreign matter within the gaps which are to be filled with mortar.

Prepare revetment mattresses which are to be filled with grout in accordance with the manufacturer's recommendations.

Place sprayed concrete for open drains such that they achieve the minimum relative compaction specified in Clause 4.1.2.

WITNESS POINT

Process Witnessed: Placing of mortar, grout and sprayed concrete.

Submission Details: At least 2 working days prior, provide notice of expected commencement date and time of placement of mortar, grout or sprayed concrete.

4 SAMPLING AND TESTING, CONFORMITY

4.1 SAMPLING AND TESTING

4.1.1 Concrete

Sampling and testing of concrete for slump must be in accordance with AS 1379 Section 5.

Sampling, testing and assessment for compliance of concrete for strength must be in accordance with AS 1379 Section 6.

Where project assessment is specified in Annexure R53/E, comply with AS 1379 Clause 6.5.

4.1.2 Sprayed Concrete

Determine the relative compaction of sprayed concrete when directed by the Project Verifier, using 75 mm diameter cores taken from the sprayed concrete.

Secure the cores in accordance with AS 1012.14 and place them immediately either in a tank of lime saturated water or in an individual plastic bag sealed to prevent water loss. Do not subject cores to temperatures in excess of either ambient temperature or 23°C, whichever is the higher, and to a temperature less than 10°C, until delivered to the testing laboratory.

The core specimens must be wet conditioned in the laboratory in accordance with AS 1012.14.

Determine the relative compaction of a core specimen as the ratio, expressed as a percentage, of the mass per unit volume of the core specimen at an age of seven days to the average mass per unit volume of the standard cylinders used to determine the seven day compressive strength from the same Lot of concrete. Determine the mass per unit volume of both standard cylinders and cores in accordance with AS 1012.12.2.

The relative compaction of sprayed concrete must not be less than 95.0%.

4.1.3 Grout

Sample grout used for grout filled mattresses by injecting the grout into a 3 metre length of mattress.

Pressurise the grout to at least 1.4 MPa and, after expulsion of water ceases, collect the grout sample from a cut in the mattress at the end distant from the pump and mould the grout into cubes in accordance with AS 1012.8.1 or AS 1012.8.3.

Test in accordance with AS 1012.9 at the frequency specified in Annexure R53/L.

4.2 CONFORMITY - CONCRETE CRACKING

At the end of the curing period, the concrete surface must have no unplanned cracks of width greater than 0.2 mm, measured at the concrete surface after completion of 21 days drying.

Where such cracks exist, identify them as nonconformities.

Address the nonconformity in accordance with TfNSW D&C Q6.

4.3 CONFORMITY - DIMENSIONS AND LEVELS

Dimensions and levels of surfaces constructed using fixed forms must be as shown on the Design Documentation drawings or in the relevant Specification, and within the tolerances stated in AS 3610.1, unless specified otherwise on the Design Documentation drawings or in the relevant Specification.

Dimensions and levels of unformed exposed surfaces, and surfaces constructed by slipforming or extrusion, must be as shown on the Design Documentation drawings, and within the tolerances specified in the relevant Specification.

4.4 RESTORATION OF CORE HOLES

Where cores have been taken from the sprayed concrete (refer Clause 4.1.2), restore the core holes using a concrete having a compressive strength of not less than that of the sprayed concrete and having a maximum nominal aggregate size of 10 mm.

ANNEXURES R53/A TO R53/B – (NOT USED)**ANNEXURE R53/C – SCHEDULES OF HOLD POINTS, WITNESS POINTS AND IDENTIFIED RECORDS**

Refer to Clause 1.2.3.

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

Clause	Type	Description
2.4.3	Hold	Production of each concrete strength grade
3.3.1	Hold	Provision of notice of expected time of completion of formwork and reinforcement and commencement of placing of concrete
3.6	Witness	Provision of notice of expected time of commencement of placing of mortar, grout and sprayed concrete

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW D&C Q6 Annexure Q/E.

Clause	Description of Identified Record
2.4.3	Production assessment report in accordance with AS 1379 Clause 6.4.2
3.3.2	Concrete and air temperature

ANNEXURE R53/D – PLANNING DOCUMENTS

Refer to Clause 1.2.4.

The following documents are a summary of documents that must be included in the PROJECT QUALITY PLAN. Review the requirements of this Specification and other contract documents to determine any additional documentation requirements.

Clause	Description
3	Details of equipment and methods for placing and finishing concrete, mortar and grout.
3.3.3	Details of measures to protect plastic concrete if rain does occur.
3.3.5	Details of measures to restrict evaporation of water from concrete surface and to prevent incidence of plastic shrinkage cracking.
3.4.1	Details of equipment and methods for curing concrete.

ANNEXURE R53/E – BASIC PARAMETERS FOR CONCRETE

Refer Clause 2.4.1.

Description	Minimum Strength Grade ⁽¹⁾	Slump (mm)	Max Nom Aggregate Size (mm)	Project Assessment Required	Air Content (%)	Other Requirements
Footings for lighting columns, sign support structures and traffic signal mast arms/posts Types 5, 6, 9, 10, 11	N32	80 – 120 ⁽³⁾	20	Yes	-	-
Footings and plinths for all other traffic signal mast arms/posts, control cabinets, and telephone pillars	N25	80 – 120 ⁽³⁾	20	No	-	-
Concrete safety barrier systems, bicycle paths/shared paths						
Slipformed ⁽²⁾	S32	15 – 25 ⁽³⁾	20	Yes	2 – 7	Mix design including binder content and air content must be suitable for slipforming. SCM content must comply with Annexure 3211/E.
Hand placed	N32	80 – 120 ⁽³⁾	20	Yes	-	-
Footpaths, driveways, traffic islands, medians, edge strips and behind K&C						
Unreinforced	N20	80 – 120 ⁽³⁾	20	No	-	-
Reinforced	N25	80 – 120 ⁽³⁾	20	No	-	-
K&C alongside or on top of flexible pavement or on top of concrete base						
Extruded ⁽²⁾	S25	15 – 25 ⁽³⁾	10	No	-	-
Slipformed ⁽²⁾	S25	15 – 25 ⁽³⁾	10	No	2 – 7	Mix design including binder content and air content must be suitable for slipforming.
Hand placed	N25	80 – 120 ⁽³⁾	20	No	-	-
K&C alongside concrete base						
Tied, slipformed ⁽²⁾	S32		20	Yes	2 – 7	Mix design including binder content and air content must be suitable for slipforming.
Tied, hand placed	N32	80 – 120 ⁽³⁾	20	Yes	-	-
Not tied	Same as K&C alongside flexible pavement					
Backfill for fence posts, and unreinforced concrete blinding layer	N20	80 – 120 ⁽³⁾	20	No	-	-
Drainage structures	N25	80 – 120 ⁽³⁾	20	No	-	-
Open drains						
Sprayed	S25	-	10	No	-	Minimum binder content: 380 kg/m ³ at point of nozzle discharge
Hand placed	N20	50 ⁽³⁾	20	No	-	-

Concrete for General Works**D&C R53**

Description	Minimum Strength Grade ⁽¹⁾	Slump (mm)	Max Nom Aggregate Size (mm)	Project Assessment Required	Air Content (%)	Other Requirements
Grout for grout-filled revetment mattresses	S20	-	5	Yes	-	-
Concrete injected columns	S32 or S40 ⁽⁴⁾	120 ⁽³⁾	20	Yes	-	Where used, fly ash must be between 20 to 25% by weight of total binder content.

Notes: K&C = kerb and channel (gutter)

- (1) Specified strength grades may be substituted with higher strength grade concrete.
- (2) Normal-class concrete of the same strength grade may be used, provided that it meets all requirements.
- (3) Slump stated in table is a guide only.
- (4) Depending on the Exposure Classification in accordance with Clause 2.2.3 of TfNSW D&C R225.

ANNEXURES R53/F TO R53/K – (NOT USED)**ANNEXURE R53/L – MINIMUM FREQUENCY OF TESTING**

Clause	Characteristic Analysed	Test Method	Minimum Frequency of Testing
Production Assessment			
2.4.3	As specified in AS 1379		
Project Assessment			
4.1, Annex E	Compaction of sprayed concrete	AS 1012.12.2	One pair of test specimens per 50 m ³ of concrete, minimum 2 pairs per pour, when required by Project Verifier
4.1, Annex E	Grout compressive strength	AS 1012.9	One pair of test specimens per 20 m ³ of grout, minimum 2 pair per pour
Annex E	Concrete slump	AS 1012.3.1	For each homogeneously manufactured grade per day, one on each of the first three batches at the start of the day and after a nonconforming batch, then one per four batches
Annex E	Concrete compressive strength	AS 1012.9	Sampling, testing and assessment for compliance must be in accordance with AS 1379
Annex E	Air content of fresh concrete ⁽¹⁾	AS 1012.4.2, with compaction by internal vibration ⁽²⁾	In mix design, and first load on each day of concrete placing

Notes:

⁽¹⁾ Required only for slipformed concrete.

⁽²⁾ Use the same vibration pattern and duration as for cylinders in accordance with TfNSW T304.

ANNEXURE R53/M – REFERENCED DOCUMENTS

Refer to Clause 1.2.6.

TfNSW Specifications

TfNSW D&C G36	Environmental Protection
TfNSW D&C Q6	Quality Management System (Type 6)
TfNSW D&C B203	Welding of Reinforcing Steel
TfNSW D&C R225	Concrete Injected Columns
TfNSW D&C 3154	Granulated Glass Aggregate
TfNSW D&C 3211	Cements, Binders and Fillers

TfNSW Test Methods

TfNSW T304	Moulding of Concrete Specimens for Testing in Compression, Indirect Tension and Flexure
TfNSW T363	Accelerated Mortar Bar Test for AAR Assessment
TfNSW T364	Concrete Prism Test for AAR Assessment

Australian Standards

AS 1012	Methods of testing concrete
AS 1012.3.1	Determination of properties related to the consistency of concrete - Slump test
AS 1012.4.2	Determination of air content of freshly mixed concrete – Measuring reduction in air pressure in chamber above concrete
AS 1012.8.1	Method of making and curing concrete – Compression and indirect tensile test specimens
AS 1012.8.3	Methods of testing concrete - Methods of making and curing concrete - Mortar and grout specimens
AS 1012.9	Compressive strength tests – Concrete mortar and grout specimens
AS 1012.12.2	Determination of mass per unit volume of hardened concrete – Water displacement method
AS 1012.14	Method for securing and testing cores from hardened concrete for compressive strength
AS 1379	Specification and supply of concrete
AS 1478.1	Chemical admixtures for concrete, mortar and grout – Admixtures for concrete
AS 2758.1	Aggregates and rock for engineering purposes – Concrete aggregates
AS 3600	Concrete structures
AS 3610.1	Formwork for concrete – Specifications

AS 3799	Liquid membrane-forming curing compounds for concrete
AS/NZS 4671	Steel reinforcing materials
AS/NZS 4672	Steel prestressing materials
AS/NZS 4680	Hot dipped galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS ISO 9001	Quality management systems – Requirements

ASTM Standards

C295	Standard Practice for Petrographic Examination of Aggregates for Concrete
ASTM-C1064/1064M	Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete