

COFFS HARBOUR CITY COUNCIL



**DEVELOPMENT SPECIFICATION
DESIGN**

0310 Minor Concrete works

Version 1 01 January 2009

0310 MINOR CONCRETE WORK

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the supply and placement of concrete, including sprayed concrete, and ancillary requirements like excavation, preparation of foundations, forming up, placement of reinforcement and backfilling for work shown on the Drawings but not having individual Specifications.

These works include drainage pits and other supplementary structures, headwalls, box culverts, box culvert base slabs, driveways, footpaths, median toppings, retaining walls, footings, paving edge strips and works of a similar nature.

1.2 QUALITY

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are given in *0165 Buildings and facilities maintenance plan*.

1.3 REFERENCED DOCUMENTS

The following documents referred to in this Worksection shall be deemed as the latest edition of the Australian Standards, including amendments and supplements.

Worksections

0165 Buildings and facilities maintenance plan

Standards

AS 1012	Methods of testing concrete
AS 1012.1	Sampling fresh concrete
AS 1012.3.1	Determination of properties related to the consistency of concrete—Slump test
AS 1012.8.1	Method of making and curing concrete—Compression and indirect tensile test specimens
AS 1012.9	Determination of the compressive strength of concrete specimens
AS 1012.14	Method for securing and testing cores from hardened concrete for compressive strength
AS 1141	Methods for testing and sampling aggregates
AS 1141.14	Particle shape by proportional calliper
AS 1141.21	Aggregate crushing value
AS 1141.23	Los Angeles value
AS 1141.24	Aggregate soundness—Evaluation by exposure to sodium sulphate solution
AS 1289	Methods of testing soils for engineering purposes
AS 1289.3.3.1	Soil classification tests—Calculation of the plasticity index of a soil
AS 1289.5.4.1	Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
AS 1379	Specification and supply of concrete
AS 1478	Chemical admixtures for concrete, mortar and grout
AS 1478.1	Admixtures for concrete
AS 1554	Structural steel welding
AS 1554.3	Welding of reinforcing steel
AS 2082	Timber—Hardwood—Visually stress-graded for structural purposes
AS 2758	Aggregates and rock for engineering purposes
AS 2758.1	Concrete aggregates
AS 3600	Concrete structures
AS 3610	Formwork for concrete
AS 3799	Liquid membrane-forming curing compounds for concrete
AS 3972	Portland and blended cements
AS/NZS 1859	(Various) Reconstituted wood-based panels
AS/NZS 2271	Plywood and blockboard for exterior use
AS/NZS 4671	Steel reinforcing materials

Other publications

Dept of Environment and Conservation (NSW)

Environmental Best Management Practice Guideline For Concreting Contractors.

1.4 ENVIRONMENTAL BEST MANAGEMENT PRACTICE

All work covered by this worksection (where applicable) should be carried out in accordance with the *Environmental Best Management Practice Guideline For Concreting Contractors*.

1.5 LOADS ON MINOR CONCRETE STRUCTURES

No superimposed load shall be allowed on any part of what will become a load bearing structure within 21 days after placing concrete unless the structure is effectively and independently supported to the satisfaction of the Superintendent or when the Contractor can demonstrate that 95% of the design strength of the concrete has been achieved.

2 EXCAVATION AND FOUNDATIONS

2.1 SHORING

The Contractor shall supply all necessary sheeting and bracing to safely support the excavation in accordance with Statutory requirements.

2.2 EXCAVATION

The subgrade, or subbase where specified, shall be formed at the required depth below the finished surface levels shown on the drawings.

2.3 FOUNDATIONS

Suitable bed

Rock foundations shall be neatly excavated to form a bed for the concrete, and shall be thoroughly scraped and cleaned.

Soil foundation shall, as far as possible, be excavated neatly from the solid material to coincide with the under-surface of the concrete, or of the subbase material (where specified).

The excavation shall be kept free of water.

Unsuitable material

All soft, yielding or other unsuitable material shall be replaced with sound material approved by the Superintendent, and the subgrade shall be compacted to provide a minimum relative compaction of 95% as determined by AS 1289.5.4.1 for standard compactive effort.

If the subgrade is dry it shall be sprinkled with as much water as it will readily absorb, before the concrete is placed.

2.4 DRIVEWAYS AND FOOTPATHS

Subbase

For driveways and footpaths a subbase of approved quality and of minimum 150 mm compacted thickness, unless otherwise shown on the Drawings, shall be placed over the subgrade.

The surface shall then be checked for uniformity, line and level, and all irregularities shall be made good.

Compaction

The subbase material shall be compacted to provide a minimum relative compaction as determined by AS 1289.5.4.1 of 100% for standard compactive effort or 97% for modified compactive effort as appropriate.

Subbase tolerance

The finished subbase shall not deviate more than 15 mm under a straight edge 3 metres long, subject to any necessary allowance on vertical curves.

2.5 DRAINAGE PITS AND OTHER SUPPLEMENTARY STRUCTURES

Where the excavation is in sound rock, and the Superintendent so directs, part of the concrete lining of gully pits and other structures may be omitted, provided that a neatly formed pit of the required

dimensions is constructed, and provided that the wall of the pit adjacent to and parallel with the road is constructed of formed concrete in all cases.

2.6 RETAINING WALLS, HEADWALLS AND WINGWALLS

Rock foundations

In the case of rock foundations for retaining walls, headwalls and wingwalls, the excavation shall be carried into the rock for a minimum depth of 150 mm.

Where cut-off walls are to be provided, the depth of cut-off in rock foundations may be less than that shown in the Drawings, if approved by the Superintendent.

Earth foundations

Prior to the construction of cast-in-situ concrete walls on earth foundations, the latter shall be covered by a mass concrete bedding layer at least 50 mm thick and finished to a uniform surface.

No forms or other materials shall be placed upon the bedding layer within a period of 48 hours after the concrete has been placed.

Mass concrete bedding

Unless otherwise specified, precast concrete wall sections shall be placed on a fresh mass concrete bedding layer while it is still in plastic state.

In the case of soil foundations, the concrete shall be not less than 50 mm thick, and where the foundation is in rock, the concrete shall be of such thickness as is required to provide a uniform surface at least 50 mm above the highest points of rock.

3 FORMWORK

3.1 GENERAL

Specification

Formwork shall be provided in accordance with AS 3610 to produce hardened concrete to the lines, levels and shapes shown on the Drawings or specified elsewhere.

It shall have adequate strength to carry all applied loads, including the pressure of fresh concrete, vibration loads, weight of workers and equipment, without loss of shape.

Forms shall be mortar tight and designed to allow removal without risk of damage to the completed structure.

Joints in the formwork shall be perpendicular to the main axis of the shape of the concrete.

Side forms

Where concrete is placed in earth excavations, side forms shall be provided to prevent contact between concrete and the in situ earth.

Design for placement of concrete

Design of formwork for high sections shall be such that it shall not be necessary to drop concrete freely from a greater height than 1.2 metres or to move concrete along the formwork after deposition.

Material

Formwork material used shall be sound and suitable for the purpose intended and surface finish specified.

Formwork fittings

Provision shall be made for the accurate location and firm support of fittings, bolts, anchorages and formers of holes as shown on the Drawings.

Temporary fittings used for the support of the formwork shall be arranged to permit removal without damage to the concrete.

The use of wires and or bolts extending to the surface of the concrete shall not be permitted except where shown on the Drawings or approved by the Superintendent.

Edge treatment

Forms for edges of concrete shall be filleted and for re-entrant angles chamfered as shown on the Drawings.

Cleaning and inspection

Temporary openings shall be provided where necessary for cleaning out of formwork and inspection before concreting.

3.2 APPROVAL OF FORMWORK DESIGN

For box culverts and reinforced concrete retaining walls, detailed drawings, design calculations, description and/or samples of materials proposed for use shall, if required by the Superintendent, be submitted for the Superintendent's concurrence before manufacture of the formwork is commenced.

This action constitutes a HOLD POINT.

The Superintendent's approval of the submitted details, or direction that they are not required, is necessary prior to the release of the hold point.

3.3 PROVISION FOR DRAINAGE

Where shown on the Drawings, or where directed by the Superintendent, weepholes of 50 mm diameter shall be provided in retaining walls and wingwalls.

3.4 CONSTRUCTION

Formwork material

The type and quality of material selected for formwork and the workmanship used in construction shall be such that the surface finish specified shall be obtained. Construction shall be such that the erection tolerances shall be obtainable.

Timber requirements

Timber for formwork shall be well seasoned, free from defects and, where in contact with fresh concrete, free from loose knots.

Timber forms for exposed surfaces shall be constructed from plywood or particle board with hardwood or approved softwood studs and wales.

Dressed timber may be used only with the approval of the Superintendent.

The plywood used for forms shall comply with AS 2271, the hardwood shall comply with AS 2082 and the particle board with AS/NZS 1859.

Formwork panels for exposed surfaces

Formwork for exposed surfaces shall be made from panels having uniform widths of not less than 1 m and uniform lengths of not less than 2 m, except where the dimensions of the member formed are less than the specified panel dimensions.

Plywood panels shall be placed with the grain of the outer plies perpendicular to the studding or joists.

Where form panels are attached directly to the studding or joists the panel shall be not less than 15 mm thick.

Form panels less than 15 mm thick, otherwise conforming to these requirements may be used with a continuous backing of dressed material of 20 mm minimum thickness.

All form panels shall be placed in a neat, symmetrical pattern.

Hidden surfaces

Forms for all surfaces which will be completely enclosed or permanently hidden below the ground may be constructed from dressed or undressed timber, steel, plywood or particle board.

Mild steel form surfaces

Mild steel form surfaces in contact with concrete shall have all bolt and rivet heads counter-sunk and all welds ground back to even and smooth surfaces.

3.5 ERECTION

Formwork position tolerances

Dimensions and position of forms, shall be carefully checked after the forms are erected. Forms shall be aligned accurately and the location of all fittings, hold formers, etc. checked prior to placing concrete.

Departure of the forms from the surfaces shown on the drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work.

For tolerances in plan position and levels, refer to **Placing and compacting concrete** and **Removal of forms**.

Mortar tight

Joints as erected shall be mortar tight.

Coating of internal surface

The interior surface of the forms shall be treated to ensure non-adhesion of the mortar.

Commercial quality form oil or grease will be acceptable, but the oil or grease used on forms against surfaces to be exposed shall not stain or discolour the concrete surface.

The coating shall be uniformly spread in a thin film and any surplus shall be removed prior to placing concrete.

In the case of unlined timber forms, the timber shall be thoroughly wetted before oiling. Forms shall be treated before placing reinforcement to ensure that the form release agent will not contaminate the surface of the reinforcing steel or construction joints.

Release agent

Formwork hardware shall be treated with a form release agent and so arranged that it may be removed from the concrete without excessive jarring or hammering.

Reinforcement placement

The formwork shall be inspected by the Superintendent, and the placing of reinforcement in the spaces formed, where specified, shall not commence until the formwork is approved by the Superintendent.

Concrete placement

Placing of concrete shall not commence until the reinforcement, where specified, has been accepted by the Superintendent, and all dirt, chips, hardened concrete, mortar and all foreign matter removed from the forms.

Notice of inspection

When an inspection is requested by the Contractor, notice of not less than 24 hours, excluding Saturdays, Sundays and Public Holidays, shall be given to the Superintendent.

This action constitutes a HOLD POINT.

The Superintendent's approval of the formwork and reinforcement placement is required prior to the release of the hold point.

4 MATERIALS FOR CONCRETE

4.1 CEMENT

Type

Cement shall be Type GP Portland Cement, or as nominated by the Superintendent, complying with AS 3972.

Nominated brand and source

In NSW cement shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme.

When submitting details of the nominated mix in accordance with **Testing of materials**, the Contractor shall nominate the brand and source (including works) of the cement.

On approval of the nominated mix by the Superintendent, the Contractor shall only use the nominated cement for the work.

Proof of quality

Documentary or other acceptable evidence of the quality of the cement shall be furnished by the Contractor if required by the Superintendent.

Storage time

If the Contractor proposes to use cement which has been stored for a period in excess of 3 months from the date of testing, the Superintendent may require a re-test at the Contractor's expense before the cement is used.

Transport and storage

All cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.

4.2 WATER

Water shall be free from injurious amounts of materials harmful to concrete and to its reinforcement and neither salty nor brackish.

Water which is not potable for human beings shall not be used in reinforced concrete.

4.3 FINE AGGREGATE

Fine aggregates shall consist of clean, hard, tough, durable uncoated grains, uniform in quality, and shall conform to the requirements of AS 2758.1 in respect of bulk density, water absorption (maximum 5%) material finer than 2 micrometres, impurities and reactive materials.

Fine aggregates shall be evenly graded within the absolute limits shown in Table 4.1, and shall not deviate from the proposed grading by more than the amounts in Table 4.1.

Table 4.1 Fine aggregate grading

Australian Standard sieve	Proportion passing (% of mass)	Deviation from proposed grading (% of mass of sample)
9.50 mm	100	
4.75 mm	90–100	±5
1.18 mm	40–85	±10
300 µm	8–30	±10
150 µm	2–10	±5
75 µm	0–4	±3

4.4 COARSE AGGREGATE

General

Coarse aggregate shall consist of clean, hard, durable, crushed stone, crushed river gravel, screened river gravel or metallurgical furnace slag and shall conform to the requirements of AS 2758.1 in respect of particle density, bulk density, water absorption (maximum 2.5%), material finer than 75 micrometres, weak particles, light particles, impurities and reactive materials, iron unsoundness and falling or dusting unsoundness.

In all other respects, the coarse aggregate shall comply with this Worksection.

If required, coarse aggregate shall be washed to satisfy these requirements.

Wear test

The percentage of wear shall be determined by AS 1141.23, and the loss of weight shall not exceed 30%.

Standard tests

When required by the Superintendent, coarse aggregate shall be tested for conformance for any or all of the properties set out below:

- Crushing Value—AS 1141.21 The aggregate crushing value shall not exceed %.
- Soundness—AS 1141.24 The loss of mass when tested with sodium sulphate shall not exceed 12%.
- Particle Shape—AS 1141.14 The proportion of mis-shapen particles (2:1 ratio) shall not exceed 35%.

Grading requirements

Coarse aggregate shall be evenly graded within the absolute limits shown in Table 4.2 and shall not deviate from the grading of the samples submitted under **Testing of materials** by more than shown.

Table 4.2 Coarse aggregate gradings

Australian Standard sieve (mm)	Proportion passing (% of mass)			Deviation proposed grading (% of mass of sample)
	40 mm Nominal	20 mm Nominal	Extrusion concrete	
	For walls exceeding 150 mm thickness	For all other structures		
53.0	100			
37.5	95–100			±10
26.5		100		
19.0	30–70	95–100		±10

Australian Standard sieve (mm)	Proportion passing (% of mass)			Deviation proposed grading (% of mass of sample)
	40 mm Nominal	20 mm Nominal	Extrusion concrete	
	For walls exceeding 150 mm thickness	For all other structures		
13.2			100	
9.50	10–35	25–35		±5
4.75	0–10	0–10		±5
2.36	0–2	0–2		

4.5 ADMIXTURES

Quality and use

Chemical admixtures and their use shall comply with AS 1478.1.

Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator.

Admixtures or combinations of admixtures other than specified below, shall not be used.

Retarder for warm season

During the warm season, (October to March inclusive), a lignin or lignin-based ('ligpol') set-retarding admixture (Type Re or Type WRRe) approved by the Superintendent shall be used to control slump within the limits stated in **Measuring by volume, on-site mixing**.

The dosage shall be varied to account for air temperature and haul time in accordance with the manufacturer's recommendations.

A copy of the NATA endorsed Certificate of Compliance with AS 1478.1 for Type Re or Type WRRe shall be submitted to the Superintendent, together with the proposed 'dosage chart' in accordance with **Testing of materials**.

Retarder for cool season

During the cool season, (April to September inclusive), only a lignin or lignin based set-retarding admixture containing not more than 6% reducing sugars (Type WRRe complying with AS 1478.1) may be used in the mix.

4.6 TESTING OF MATERIALS

The Contractor shall submit to the Superintendent a copy of a NATA Certified Laboratory Test Report on the quality and gradings of the aggregates proposed to be used in the work.

This action constitutes a HOLD POINT.

The Superintendent's approval of the submitted report is required prior to the release of the hold point.

4.7 USE OF MATERIALS ONLY AFTER ACCEPTANCE

The materials shall only be used after receipt of the Superintendent's notification of acceptance, and then only so long as the materials accord with the Worksection.

5 HANDLING AND TREATMENT OF CONCRETE

5.1 ENVIRONMENTAL BEST PRACTICE MANAGEMENT

When handling and treating concrete on-site, the Contractor should comply with the principals outlined in the Environmental Best Management Practice Guideline (BPM) For Concreting Contractors (refer references).

These activities shall include taking delivery of fresh concrete, placing, transfer and/or finishing the concrete into its final position.

5.2 MEASUREMENT OF MATERIALS

All materials shall be measured by weight, except that:

- Water may be measured by volume with an approved adjustable water-measuring and discharging device, and,
- Cement may be measured by bags as packed by the manufacturer in which case batches shall be proportioned on the basis of one or more unbroken bags of cement, and for this purpose one bag of cement shall be assumed to weigh 40 kg.
- Bulk cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the components of the batch are discharged from the batching hopper.
- Measurement by volume for smaller works may be undertaken with the prior approval of the Superintendent.

5.3 MEASURING BY WEIGHT, ON-SITE MIXING

Mixing by weight on site

Where concrete is to be mixed on site, and where mix control is likely to be less efficient than at a central batching plant, the weights of cement, fine and coarse aggregate shown in Table 5.1 may be used as a guide to produce the classes of concrete specified.

Small changes in the proportions of fine and coarse aggregate may be required to improve density or workability of the concrete.

The use of proportions shown in Table 5.1 shall not relieve the Contractor of the Contractor's obligation to provide concrete of the specified compressive strength.

Table 5.1 Materials in batch containing 1 bag (40 kg) cement

MPa	Cement kg	Fine aggregates kg	Coarse aggregates kg	Total aggregates kg
10	40	130	250	380
15	40	100	190	290
20	40	88	126	214

Variation in aggregate moisture content

The proportions set out in Table 5.1 make allowance for moisture contents of aggregates of 6% for fine aggregates and 1% for coarse aggregates.

Where the moisture content of aggregates exceeds 8% or 3% respectively, the proportions of the mix shall be changed to compensate for the excess water in the aggregate.

5.4 MEASURING BY VOLUME, ON-SITE MIXING

Mixing by volume on site

Where measurement by volume is approved, the proportions of the materials shall be such as are required to produce a mix free of voids and having the specified strength at 28 days.

Volume batching

The nominal proportions given in Table 5.2 may be used as a guide for volume batching.

Table 5.2 Volume batching

MPa	Parts by volume		
	Cement	Fine aggregate	Coarse aggregate
10	1	3	6
15	1	2.25	4.5
20	1	2	3

Fine aggregate bulking

If, in the opinion of the Superintendent, the fine aggregate contains sufficient moisture to produce 'bulking' in excess of 10%, a corresponding increase in the volume of fine aggregate shall be made.

Batch measurement

The volumes of fine and coarse aggregates for each batch shall be measured in boxes or bins, the details of which shall be subject to the approval of the Superintendent.

The aggregates shall be measured loose (i.e. without compaction) in the boxes and shall be struck off level.

Measurements by shovels or like methods will not be permitted.

Batch proportions shall be so arranged that each batch contains 1 bag of cement. One 40 kg bag of cement shall be assumed to have a volume of 27.5 litres.

5.5 CONSISTENCY

Fixed form mould

A sufficient quantity of water shall be added to the mix so that the consistency of the concrete is such that it can be placed in the forms, compacted and worked into all corners without permitting the ingredients to segregate, or excess free water to collect on the surface.

If required by the Superintendent, the Contractor shall determine the consistency of the concrete in accordance with AS 1012.3.1.

Except for extruded concrete, the slump shall not exceed 75 mm for concrete compacted by vibrators.

Extrusion machine

In the case of concrete placed by an extrusion machine, the water in the mix shall be only sufficient to produce a slump of 10 mm to 15 mm.

5.6 MIXING AND DELIVERY

General

Mechanical mixing and segregation of concrete shall comply with the following:

- Mechanical mixing – Concrete may be mixed either at the site or at a central mixing plant, as approved by the Superintendent. All concrete shall be mixed with mechanically operated mixers. In an emergency, hand mixing may be permitted.
- Segregation of concrete – Any concrete which exhibits signs of segregation may be rejected by the Superintendent.

Machine mixing at site

Machine mixing at site shall comply with the following:

- Mixer requirements—The mixing of concrete shall be done in a batch mixer which will ensure a uniform distribution of the materials throughout the batch.
- Mixer capacity—The mixer shall be of such capacity that one or more whole bags of cement may be used per batch of concrete. The volume of the mixed material shall not exceed the manufacturer's rated capacity of the mixer.
- Mixing time—The mixing time for each batch shall not be less than 1.5 minutes after all ingredients are assembled in the mixer, and prior to any portion of the batch being removed.
- Total mix discharge—The entire contents of a batch shall be discharged from the mixer before any materials are placed therein for the succeeding batch.

Mixing in an emergency

Mixing in an emergency shall comply with the following:

- Hand mixing—In the case of breakdown of the mechanical mixing equipment, the Superintendent may give approval to hand mixing in small quantities so as to complete a section of the work or reach a suitable construction joint.
- Hand mixing conditions—Hand mixing shall be done on an approved water-tight platform of sufficient size to allow the mixing of at least two batches simultaneously. The amount of cement used shall be 10% more than the amount specified for machine mixed concrete.
- Hand mixing procedure—The fine aggregate and cement shall first be mixed until a uniform colour is obtained, and then spread on the mixing platform in a thin layer.
- The coarse aggregate, which shall have been previously drenched with water, shall then be spread over the fine aggregate and cement in a uniform layer, and the whole mass turned over as further water is added with a rose sprinkler.
- After the water is added, the mass shall be turned at least three times, not including shovelling into barrows or forms, until the mixture is uniform in colour and appearance.

Hand-mixed batches shall not exceed 0.25 cubic metres each.

Ready-mixed concrete

The concrete shall be mixed and delivered in accordance with the requirements of AS 1379, relating to:

- Mixing and delivery; and
- Use of non-agitating equipment,

with the exception that in a) the time taken from the introduction of water until the concrete is completely discharged shall be not more than 1.5 hours, and in b) not more than 30 minutes.

Discharge of cleaning water

The water used for flushing the chutes and for cleaning shall be discharged in an area acceptable to the Superintendent.

Positioning of chutes

The chutes shall be long enough to permit delivery to the whole of the area enclosed by the forms.

5.7 PLACING AND COMPACTING CONCRETE**Air temperature requirements**

No concrete shall be mixed or placed, without the approval of the Superintendent, while the air temperature is, or is likely to be within 24 hours, below 5°C or while the shade temperature exceeds 38°C.

All concrete shall be placed in the dry.

Prior to placing concrete the area shall be clean and moist but free from any ponding of water.

Placement within time limit

The concrete shall be mixed in the quantities required for immediate use and shall be placed in position as rapidly as possible.

Any concrete which has developed initial set, or which does not reach the forms within 30 minutes after the water has been added (except when transported in agitator trucks) shall not be used.

Placement in forms and vibration

The concrete shall be deposited in the forms, without separation of the aggregates. Concrete shall not be dropped freely from a height greater than 1.2 metres, or be deposited in large quantities at any point and moved or worked along the forms.

Conveying equipment, including open troughs and chutes, where used, shall be made of metal, or have metal linings.

Where used on steep slopes, troughs and chutes shall be equipped with baffles, or be placed in short lengths in such a way that the direction of flow of the concrete is changed.

The concrete shall be placed in horizontal layers in one continuous operation between the ends of the work and/or construction joints. Care shall be taken to fill every part of the forms and to work the coarser aggregate back from the face.

The freshly placed concrete shall be compacted by continuous spading, slicing or by vibrator units.

Vibrators shall not be left in one position for more than 30 seconds, and shall not be permitted to rest on reinforcement.

Exposed surfaces

Exposed surfaces of the concrete shall be struck off and finished with a wooden float. Where shown on the Drawings corners and edges shall be left neatly rounded or chamfered. Re-entrant angles shall be neatly filleted.

Initial set

Concrete shall not be moved after it has been in the forms for more than 10 minutes.

Slurry for extruded concrete

In the case of concrete placed by an extrusion machine, small quantities of cement-sand slurry, comprised of two parts of plasterer's sand and one part of cement (by volume), together with sufficient water to bring it to a semi-fluid condition, shall be placed in the special receptacle in the machine, if the machine is so equipped and shall be fed onto the surface of the concrete at a rate sufficient to produce a smooth and uniform finish.

5.8 FINISHING OF UNFORMED SURFACES

Surfaces other than wearing surfaces

Unformed surfaces shall be compacted and tamped so as to flush mortar to the surface, screeded off and finally dressed with a wooden float to an even surface.

Care shall be taken to drain or otherwise remove promptly any water which comes to the surface.

A capping of mortar will not be permitted.

All future contact surfaces shall be left rough, with the coarse aggregate at the surface firmly embedded but not forced below the surface.

Wearing surfaces

Finish for wearing surfaces: Where a concrete wearing surface is shown on the Drawings the concrete shall be thoroughly compacted and the surface screeded off by a vibrating screed, or hand screeded where the distance between forms perpendicular to the direction of screed is no greater than 2 metres.

Immediately following compaction and screeding the concrete shall be tested for high or low spots and any necessary corrections made.

The surface shall be finished true and uniform and free from any glazed or trowelled finish and shall be finally dressed with a wooden template or float, or by the use of belting in an approved manner.

The departure from grade shall not exceed 5 mm in any 3 metre length.

Surface to receive asphalt: Where an asphaltic concrete wearing surface is specified, the surface of the concrete, after being compacted, screeded and corrected, shall be dressed with a wooden float and finally broomed to produce a rough surface.

Textured patterned surface: Concrete wearing surfaces shown on the Drawings to be coloured, textured or patterned shall be finished as directed by the Superintendent.

Finished levels and locations

The finished surfaces of concrete structures not adjacent to road pavements shall not vary more than 25 mm in plan position and not more than 25 mm from the specified levels.

In the case of drainage pits and other structures adjacent to road pavements, the finished concrete shall not vary more than 10 mm from the specified levels and alignment.

Longitudinal surfaces greater than 10 metres in length shall not deviate from level or alignment by more than 5 mm from a straight-edge 3 metres long, subject to any necessary allowances on vertical and horizontal curves.

5.9 CURING AND PROTECTION

All exposed surfaces of the freshly placed concrete shall be kept moist either by the use of plastic sheeting, damp sand or commercial curing compounds in accordance with AS 3799 for a minimum period of 3 days and to a maximum of 14 days if so directed by the Superintendent.

During this time the work must be adequately protected from the effects of excessive surface evaporation, rain, running water, vandalism and other causes likely to damage the concrete.

All costs involved in making good or replacing any work that has been damaged due to the above mentioned factors shall be borne by the Contractor.

Curing for concrete shall generally be in accordance with the appropriate surface exposure classification in AS 3600.

5.10 REMOVAL OF FORMS

Walls, sumps etc.

All forms shall remain in place, after placement of concrete, for minimum periods specified hereinafter. These periods may be extended by the Superintendent if the air shade temperature falls below 10 °C during the following periods:

- Mass retaining walls, headwalls, wingwalls, gully pits, sumps and similar drainage structures: 48 hours.
- Footpaths, driveways and similar: 48 hours.
- Sides of reinforced concrete walls when height of each day pour is:
 - . under 0.6 metres: 1 day.
 - . 0.6 m to 3 m: 2 days.
 - . 3 m to 6 m: 3 days.

- . 6 m to 9 m: 5 days.
- Supporting forms under deck slabs of culverts: 10 days.

Concrete containing special additives

In case of concrete containing special additives, stripping times shall be as determined by the Superintendent.

Protection of concrete during form removal

Care shall be taken in removing forms so that the concrete will not be cracked, chipped or otherwise damaged. The use of crowbars or other levering devices exerting pressure on the fresh concrete to loosen the forms will not be permitted.

Superimposed load

No superimposed load shall be allowed on any part of a structure until the concrete has reached at least 70% of the design strength.

Removal of hole formers

Hole formers such as pipes and bars shall be removed as soon as the concrete has hardened sufficiently for this to be done without damage to the concrete.

5.11 TREATMENT OF FORMED SURFACES

Quality of surfaces

All concrete surfaces shall be true and even, free from stone pockets, depressions or projections beyond the surface. All arrises shall be sharp and true, and mouldings shall be evenly mitred or rounded. Care shall be exercised in removing forms to ensure this result.

Formed concrete surfaces shall have finishes in accordance with the classes of surface finish in AS 3610 as follows:

- Non-visible surfaces: Class 4.
- Visible surfaces: Class 2.

Repair of defects

As soon as the forms are removed from mass or reinforced concrete work, all rough places, holes and porous spots shall be repaired by removing defective work and filling with stiff cement mortar having the same proportions of cement and fine aggregate as used in the concrete, and shall be brought to an even surface with a wooden float.

Removal of the wires

Any tie wires or other fitments extending to outside surfaces, shall be cut back after removal of forms, to a depth of at least 40 mm with sharp chisels or cutters.

All cavities caused by removal of fitments or tie wires shall be wetted and carefully packed with cement mortar, as above.

Coating with bonding agent

If required by the Superintendent, the surfaces of bolt cavities, tie wire holes, and all defects in concrete shall be coated prior to the placing of mortar, grout, or fresh concrete, with an approved bonding agent, in lieu of wetting with water.

The method of application of such agent and the conditions in which it is to be used shall generally be as laid down by the manufacturer and shall be approved by the Superintendent.

Surface tolerance

The formed surfaces of concrete structures not adjacent to road pavements shall not vary more than 25 mm in plan position and not more than 25 mm from the specified levels.

In the case of drainage pits and other structures adjacent to road pavements, the finished concrete shall not vary more than 10 mm from the specified levels and alignment.

5.12 JOINTS

Horizontal construction joint

Where horizontal construction joints are found to be necessary in walls, or cast-in-situ drainage structures the joints may be made at the base of walls and at other locations in the walls where approved by the Superintendent.

In order to provide for bond between the new concrete and the concrete which has already set, the surface on which the new concrete is to be placed shall be thoroughly cleaned of loose material, foreign matter and laitance.

The surface shall be roughened or keyed and saturated with water.

After any excess water has been removed, the surface shall be thinly coated with a neat cement grout.

Vertical expansion joints

Retaining walls shall be provided with vertical expansion joints as shown on the Drawings.

The expansion joints shall consist of jointing material of approved quality, and of thickness shown on the drawings, and a depth sufficient to fill the joint.

The jointing material shall be neatly cut to fit the surface of the concrete.

Footpaths, medians, driveways

In footpaths, median toppings and driveways, unless otherwise shown on the Drawings, expansion joints, 15 mm in width for the full depth of paving, shall be constructed at intervals not exceeding 15 m and where the pavement abuts against gutters, pits and structures.

Expansion joints shall consist of a preformed jointing material of bituminous fibreboard or equivalent approved by the Superintendent.

Unreinforced paving

All unreinforced paving shall be provided with narrow vertical grooves, 20 mm deep to induce contraction joints for the control of cracking.

The joints shall be formed in the freshly placed concrete in a neat regular pattern to form 'slabs' no bigger than 2 m².

The ratio of the longest side to the shortest side shall not exceed 1.6.

5.13 STRENGTH OF CONCRETE

Strength requirement

When tested in accordance with AS 1012.9, the concrete shall have a compressive strength not less than that shown on the Drawings or if not shown shall have a compressive strength not less than that specified in Table 5.3 for the particular class of work.

The cement content restrictions shown in Table 5.3 refer to Portland cement.

Where General Purpose Blended cements are utilised the acceptable minima are indicated in brackets.

When Works are expected to experience extreme exposure or in other special circumstances, departure from the minimum cement content requirements and specific blended cements may be recommended.

Departure from the minimum requirements cited in Table 5.3 shall require a specific minimum cement content as shown on the Drawings, or the written approval of the Superintendent.

Table 5.3 Concrete strength requirements

Use	MPa	Minimum portland cement per cu metre (Minimum GP blended cement)	Coarse aggregate nominal size	Cylinder strength required	
				7 days	28 days
				MPa	MPa
Foundations, mass retaining walls	20	270 (330)	40	15	20
Mass concrete footings, pitching, linings etc.	20	270 (330)	20	15	20
Drainage structures, driveways, footpaths, miscellaneous minor concrete work	20	270 (330)	20	15	20
Reinforced concrete culverts, headwalls, base slabs, sign structure large footings, retaining walls	32	320 (380)	20	24	32
Safety Barriers	40	330 (380)	20	24	40
Extruded concrete	20	270	14	15	20

Use	MPa	Minimum portland cement per cu metre (Minimum GP blended cement)	Coarse aggregate nominal size	Cylinder strength required	
				7 days	28 days
		Kg	mm	MPa	MPa
		(330)			

Note: The total cement and Portland cement quantities indicated as minima are aimed at providing suitably durable concrete for exterior public works under normal circumstances.

Determination of strength

The strength shall be determined from the average of not less than two specimens, moulded from each class of concrete being used in the work, and selected to represent the whole of the concrete placed at the time of moulding.

Moulding of cylinders

In general, two pairs of test specimens shall be moulded for each 15 cubic metres of concrete, or part thereof, one pair being intended for the 7 day test if required and the other pair for a 28 day test.

Cores and test acceptance

If the test specimens fail to achieve the specified strength, the Contractor may, with the approval of the Superintendent, arrange for cores to be taken from the work.

If the average strength of such cores complies with the specified requirements nominated in Table 5.3, the concrete will be accepted.

Strength age factor

The strengths specified at 28 days shall be increased as shown in Table 5.4 for tests at ages in excess of 28 days.

Failure of cores

If cores taken fail to satisfy the strength requirements, the deduction provisions of **Limits and tolerances** will apply.

Table 5.4 Concrete age conversion factors

*Age of test specimen in days of date of testing	Factor
28	1.00
35	1.02
42	1.04
49	1.06
56	1.08
70	1.10
84	1.12
112	1.14
140	1.16
168	1.18
196	1.20
224	1.22
308	1.24
365 and greater	1.25

*For intermediate ages the factor shall be determined on a pro-rata basis

5.14 SAMPLING CONCRETE

Moulding of test cylinders

Concrete test specimens shall be cylinders 300 mm long and 150 mm diameter, moulded concurrently in the presence of the Superintendent or Superintendent's representative, in accordance with AS 1012.8, from samples taken in accordance with AS 1012.1.

Testing

Test specimens shall be tested only by laboratories with appropriate NATA registration. Copies of test results shall be forwarded to the Superintendent immediately upon receipt.

Contractor's responsibility

Equipment and facilities shall be provided by the Contractor for the taking and storage of samples of any materials or concrete being used, or intended to be used in the work.

The costs of all work and material required in the taking, handling, delivery and testing of specimens shall be borne by the Contractor.

6 STEEL REINFORCEMENT FOR CONCRETE

6.1 MATERIAL**General**

Steel reinforcement shall comply with AS/NZS 4671. The type and size of bars shall be as shown on the Drawings.

Evidence of compliance

The Contractor shall supply evidence satisfactory to the Superintendent that steel reinforcement complies with AS/NZS 4671, as appropriate. Test certificates shall show the results of mechanical tests and chemical analysis.

This action constitutes a HOLD POINT.

The Superintendent's approval of the supplied details is required prior to the release of the hold point.

Material not identified with a test certificate

Where the material cannot be identified with a test certificate, samples shall be taken and testing arranged by the Contractor.

The samples shall be selected randomly and consist of three specimens each at least 1.2 m in length.

The cost of all samples and tests shall be borne by the Contractor.

Surface of reinforcement

Steel reinforcement shall be free from loose or thick rust, grease, tar, paint, oil, mud, millscale, mortar or any other coating, but shall not be brought to a smooth polished condition.

Bar chairs

Plastic bar chairs or plastic tipped wire chairs shall be capable of withstanding a load of 200 kg mass on the chair for one hour at $23 \pm 5^\circ\text{C}$ without malfunction.

The Contractor shall demonstrate that the proposed chairs conform with these requirements.

6.2 BENDING

Reinforcement shall be formed to the dimensions and shapes shown on the Drawings.

It shall not be bent or straightened in a manner that will injure the material, and bars with kinks or bends not shown on the Drawings will not be accepted.

Heating of reinforcement for purposes of bending will only be permitted if uniform heat is applied.

Temperature shall not exceed 450°C and the heating shall extend beyond the portion to be bent.

Heated bars shall not be cooled by quenching.

6.3 SPLICING**Plan lengths**

All reinforcement shall be furnished in the lengths indicated on the Drawings. If splicing is required, it shall be in accordance with the provisions of AS/NZS 4671.

Testing of splices not shown on the drawings

The cost of any test ordered in connection with splices not shown on the drawing shall be borne by the Contractor.

Lapped splices

Laps in reinforcing bars, wire or fabric shall be as shown on the Drawings. Laps not shown on the Drawings shall be as follows for unhooked bars:

- Plain bars, Grade 250: Minimum 40 bar diameters.

- Deformed bars, Grade 400: Minimum 35 bar diameters.
- Hard-drawn wire: Minimum 50 bar diameters.

Splicing in reinforcing fabric

Splices in reinforcing fabric shall be so made that the overlap, measured between outermost transverse wires of each sheet of fabric is not less than the spacing of those wires plus 25 mm.

6.4 MARKING

Bars of identical shape shall be made up in bundles of three and securely tied together by soft iron wire.

Each bundle shall have a stout metal label of not less than 40 mm diameter attached to it.

Each metal label shall be punched with the appropriate marking in accordance with the steel list shown on the drawings.

If called for on the Drawings the marking shall incorporate a prefix, and bars with different prefixes shall be stored separately.

6.5 STORAGE

Reinforcement shall be stored above the surface of the ground and shall be protected from damage and from deterioration by exposure.

6.6 DELIVERY AND RECEIPT OF REINFORCEMENT

Test before delivery

Unless the Contractor elects to have the reinforcement inspected at the site, no reinforcement shall be delivered to the site until permission to deliver has been granted by the Superintendent.

Notice to test

The Contractor shall give 10 working days notice to the Superintendent for carrying out the inspection. This action constitutes a HOLD POINT.

The Superintendent's inspection and approval of the reinforcement is required prior to the release of the hold point.

The Superintendent will carry out, or waive, the inspection with reasonable expediency, however the Contractor shall not be entitled to an extra payment as a result of any delays incurred.

6.7 PLACING

Reinforcement position

Reinforcement shall be accurately placed as shown on the Drawings and shall be securely held by blocking from the forms, by supporting on concrete or plastic chairs, or metal hangers, and by wiring together at all intersections or at 0.5 m centres, whichever is the greater distance, using annealed iron wire of diameter not less than 1.25 mm.

Steel shall not be supported on metal supports which extend to the surface of concrete, on wooden supports, or on pieces of coarse aggregate.

Reinforcement shall have the minimum cover shown on the Drawings.

Tack welding

The Superintendent may approve the use of tack welding instead of wire ties on reinforcing wire.

All welding of reinforcing steel shall be in accordance with AS 1554.3.

Tack welding of cold-worked and hard grade bars shall not be permitted.

Approval of reinforcement before concrete placement

The reinforcement in each section of the work shall be approved by the Superintendent before any concrete is deposited in the section and adequate time shall be allowed for inspections and any corrective work which may be required. Notice for inspection shall not be less than four normal working hours.

This action constitutes a HOLD POINT.

The Superintendent's approval of the reinforcement is required prior to the release of the hold point.

Splices

Splices shall be staggered where practicable and when not shown on the drawings they shall be arranged as directed by the Superintendent.

Lapped splice

Bars forming a lapped splice shall be securely wired together in at least two places, unless welded.

Bar cover

The clear cover of any bar, including stirrups, to the nearest concrete surface shall be as shown on the Drawings. Where not so indicated it shall be as stated below:

- Concrete normally in contact only with air:
 - . Slabs: 40 mm.
 - . Other than slabs: 45 mm.
- Concrete in contact with earth or fresh water:
 - . Slabs of box culverts: 50 mm.
 - . Other than culverts: 50 mm.

In no cases shall the cover be less than 1½ times the diameter of the bar.

7 BACKFILLING

7.1 GENERAL

Backfilling at paving and minor concrete works shall not commence until after the concrete has hardened and not earlier than three days after placing.

Adjacent to walls

No filling shall be placed against retaining walls, headwalls or wingwalls within 21 days after placing of the concrete, unless the walls are effectively supported by struts to the satisfaction of the Superintendent, or when the Contractor can demonstrate that 95 per cent of the design strength of the concrete has been achieved.

Selected backfill

Selected backfill shall be placed against retaining walls and cast-in-place box culverts for a horizontal distance equal to one-third of the height of the wall.

It shall consist of granular material, free from clay and stone larger than 50 mm gauge.

The Plasticity Index of this selected backfill material shall not be less than 2 or more than 12 when tested in accordance with AS 1289.3.3.1.

The material shall be placed in layers not exceeding 150 mm and shall be compacted to provide a relative compaction of not less than 92% below 1.5 m of the finished surface and 100% within 1.5 m of the finished surface as determined by AS 1289.5.4.1 for modified compactive effort.

7.2 TREATMENT AT WEEPHOLES**Size and type of material**

Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50 mm to 10 mm such that:

The maximum particle dimension shall not exceed 50 mm

No more than 5 per cent by mass shall pass the 9.5 mm A.S. sieve.

Extent of material

The broken stone or river gravel, enclosed in a filter fabric approved by the Superintendent, shall be continuous in the line of the weepholes, extend at least 300 mm horizontally into the fill and extend at least 450 mm vertically above the level of the weepholes.

Synthetic membrane

Alternatively the Contractor may provide a synthetic membrane of equivalent drainage characteristics at no extra cost to the Principal.

It shall be stored and installed in accordance with Manufacturer's instructions. The use of a synthetic membrane shall be subject to the Superintendent's approval.

8 SPRAYED CONCRETE

8.1 GENERAL

Definition

Sprayed concrete is concrete pneumatically applied at high velocity on to a surface. Application may be either a wet or dry process. A sound homogeneous product shall be provided with surface finish reasonably uniform in texture and free from blemishes.

Depth

The minimum depth of sprayed concrete to be applied shall be 75 mm.

Colour

Sprayed concrete lining in open drains shall be coloured to match the adjoining rock colour.

Strength

Sprayed concrete shall have a minimum cement content of 380 kg/m³ as discharged from the nozzle and shall have a minimum compressive strength of 25 MPa at 28 days when tested by means of 75 mm diameter cores taken from in-place sprayed concrete.

Test cores

Cores shall be secured, accepted, cured, capped and tested in accordance with AS 1012.14.

Equipment and facilities shall be provided by the Contractor for the taking of cores from the work.

The Contractor shall arrange for a laboratory with appropriate NATA registration for the curing and testing of the cores.

Copies of test results shall be forwarded to the Superintendent.

The cost of all work and material required in the taking, handling, delivery and testing of cores shall be borne by the Contractor.

Method statement

At least 14 days prior to applying any sprayed concrete the Contractor shall submit to the Superintendent details of his proposed procedure, plant, materials and mix proportions. Materials shall comply with AS 3600.

This action constitutes a HOLD POINT.

The superintendent's approval of the submitted details is required prior to the release of the hold point.

8.2 TEST PANELS

Number and dimensions of panels

Not less than 10 days before applying concrete, the Contractor shall prepare at least 3 test panels for each mix proposed, in conditions similar to those in the works and in the presence of the Superintendent.

The test panels shall be made by applying a 75 mm thickness of sprayed concrete to a hardboard panel approximately 750 mm square.

The sprayed concrete shall be applied to the panels in the same manner, using materials including steel reinforcing fabric, equipment, pressures and curing that will be used in the Works.

The panels shall be submitted to the Superintendent for examination.

Cores

The Contractor shall cut four 75 mm diameter cores from one test panel for each proposed mix approximately 48 hours after the panel has been sprayed.

The cores shall be tested as for cores from in-place sprayed concrete. One core shall be compression tested at 3 days, one core at 7 days and the remaining two cores at 28 days.

Defective core

Should any of the cores reveal defects such as lack of compaction, dry patches, voids or sand pockets or should the test panel exhibit an unacceptable surface finish, the Contractor shall modify the mix design and/or method of placement and prepare fresh test panels for testing and inspection.

Approval of panels

Sprayed concrete shall not be applied to the Works until the Contractor produces test panels for the approval of the Superintendent.

This action constitutes a HOLD POINT.

The Superintendent's approval of the test panels is required prior to the release of the hold point.

8.3 SURFACE PREPARATION

Earth

Earth surfaces shall be graded, trimmed and compacted and shall be dampened prior to applying the sprayed concrete.

The Contractor shall take any precautions necessary to prevent erosion when the sprayed concrete is applied.

Rock

Rock surfaces shall be cleaned of loose material, mud and other foreign matter that might prevent bonding of the sprayed concrete onto the rock surface.

The rock surface shall be dampened prior to applying the sprayed concrete.

Steel pipes

Corrugated steel pipes shall be cleaned of loose material, mud and any other foreign matter.

Water flow

The Contractor shall remove free water and prevent the flow of water which could adversely affect the quality of the sprayed concrete.

8.4 APPLICATION OF SPRAYED CONCRETE

Procedure

Application shall begin at the bottom of the area being sprayed and shall be built up making several passes of the nozzle over the working area.

The nozzle shall be held so that the stream of material shall impinge as nearly as possible perpendicular to the surface being coated.

The velocity of discharge from the nozzle, the distance of the nozzle from the surface and the amount of water in the mix shall be regulated so as to produce a dense coating with minimum rebound of the material and no sagging.

Rebound material shall be removed after the initial set by air jet or other suitable means from the surface as work proceeds and disposed of.

Wind problems

Spraying shall be discontinued if wind causes separation of the nozzle stream.

Air temperature

Concrete shall not be sprayed in air temperatures less than 5°C.

Construction joints

Construction joints shall be kept to a minimum.

A joint shall be formed by placing or trimming the sprayed concrete to an angle between 30° and 45° to the sprayed concrete surface.

The joint edge shall be cleaned and wetted by air-water jet before recommencing concrete spraying.

Spraying around reinforcement

When spraying around reinforcement, concrete is to be sprayed behind the reinforcement before concrete is allowed to accumulate on the face of the reinforcement.

Protection of adjoining surfaces

Adjoining surfaces not requiring sprayed concrete shall be protected from splash and spray rebound.

Splash or rebound material on these adjoining surfaces shall be removed by air-water jet or other suitable means as work proceeds.

8.5 CURING

Commencement

Curing shall commence within one hour of the application of sprayed concrete and may be by water or by colourless wax emulsion curing compound complying with AS 3799 and applied in accordance with manufacturer's specifications.

Water curing

In water curing, the surface of the sprayed concrete shall be kept continuously wet for at least seven days.

9 LIMITS AND TOLERANCES

The limits and tolerances applicable to the various clauses in this worksection are summarised in Table 9.1.

Table 9.1 Summary of limits and tolerances

Activity	Limits/Tolerances	Worksection Clause Reference
Subgrade		
-Relative compaction	≥ 95% (standard compactive effort)	Foundations
Driveways, footpaths		
-Finished subbase	To be trimmed and compacted so that the levels do not vary more than 15 mm under a straight-edge 3 metres long. ≥ 97% (modified compactive effort)	Driveways and footpaths
-Relative compaction of subbase	≥100% (standard compactive effort)	Driveways and footpaths
Formwork		
-Position of forms	Forms shall be aligned accurately so that departure of the forms from the surfaces specified on the Drawings shall not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work.	Erection
Fine aggregate		
-Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table 4.1.	Fine aggregate
Coarse aggregate		
-Percentage of wear	Loss of weight shall not exceed 30%	Coarse aggregate
-Crushing value	Crushing value shall not exceed 25%	Coarse aggregate
-Soundness	The loss of mass when tested with sodium sulphate shall not exceed 12%	Coarse aggregate
-Particle shape	The proportion of mis-shapen particles (2:1 ratio) shall not exceed 35%	Coarse aggregate
-Grading	To be evenly graded within the absolute limits and shall not deviate from the grading of sample aggregate as per Table 4.2.	Coarse aggregate
Aggregate moisture content	Where moisture content of fine aggregate exceeds 8%, or moisture content of coarse aggregate exceeds 3%, the proportion of mix shall be changed.	Measuring by weight, on-site mixing
Bulking of fine aggregate	Where bulking of the fine aggregate exceeds 10%, a corresponding increase in volume of fine aggregate shall be made.	Measuring by volume, on-site mixing
Consistency	In accordance with AS 1012.3 Method 1, the slump shall not exceed 75 mm for concrete compacted by vibrators.	Consistency
	In the case of concrete placed by extrusion machine, the slump will be between 10 mm and 15 mm.	Consistency
Ready-mixed concrete		
-Mixing and delivery	The time taken from the introduction of water until the concrete is completely discharged shall be not more	Mixing and delivery

Activity	Limits/Tolerances	Worksection Clause Reference
	than 1.5 hours.	
	Where non-agitating equipment is used the concrete shall be completely discharged not more than 30 minutes after the addition of water.	
Placing and compacting of concrete	Concrete shall not be placed without the approval of the Superintendent if the air temperature within 24 hours is likely to be below 5°C or the shade temperature is likely to exceed 38°C.	Placing and compacting concrete
Finishing of unformed/ formed concrete surfaces		
- Wearing surface	To be finished true and uniform so that departure from designed grade shall not exceed 5 mm in any 3 metre length.	Finishing of unformed surfaces
Finished surfaces		
- Not adjacent to roads	≤25 mm plan position ≤25 mm Level	Finishing of unformed surfaces
- Adjacent to roads	≤10 mm Alignment ≤10 mm Level	Finishing of unformed surfaces

10 MEASUREMENT AND PAYMENT

10.1 MEASUREMENT

Payment shall be made for all the activities associated with completing the work detailed in this Worksection and the associated activity specific worksection on a schedule of rates basis in accordance with Pay Items 0310.1 to 0310.5 inclusive.

A lump sum price for any of these items shall not be accepted.

The pay items applicable to particular activities are listed in the Worksection for these activities

If any item, for which a quantity of work is listed in the Schedule of Rates, has not been priced by the Contractor, it shall be understood that due allowance has been made in the prices of other items for the cost of the activity which has not been priced.

10.2 CONCRETE

Payment shall be made at the scheduled rates provided the concrete meets the strength requirements shown in Table 5.3 or as shown on the Drawings.

Where any concrete does not reach the strength specified in Table 5.3, the scheduled rate of payment shall be reduced by 2% for each 1%, or fraction thereof, by which the strength of the specimen fails to reach the specified strength, up to a maximum deficiency of 10%.

If the deficiency in strength exceeds 10%, the concrete represented by the specimens may be rejected, in which case no payment will be made for the work nor for any remedial work to rectify the deficiency.

10.3 PAY ITEMS

0310.1 Excavation

The unit of measurement shall be the cubic metre measured as bank volume of the excavation.

This pay item applies to works included in pay items C0301.2 and C0301.3.

The disposal of surplus material shall be included in the excavation rates.

No additional payment shall be made for drying out wet excavated material or replacement of over excavation for any reason.

The schedule rate for excavation shall allow for excavation and backfilling of all types of material. Separate rates shall not be included for earth and rock.

The control of stormwater runoff shall be included in the rate for excavation.

0310.2 Footpaths, driveways, median toppings and works of similar nature

The unit of measurement shall be the square metre, measured as the horizontal surface area of the concrete footpath, driveways, median topping, or similar as constructed.

The schedule rate under this Pay Item shall include all operations involved in the forming, compaction of foundations, subbase, concreting, finishing, curing and backfilling.

Where specified on the Drawings, this Pay Item shall include the supply and placement of reinforcing steel.

0310.3 Sprayed concrete

The unit of measurement shall be the square metre of sprayed concrete in place.

The schedule rate under this Pay Item shall include all the operations involved in the surface preparation, spraying, jointing, removal of splash and rebound material, curing and testing.

0310.4 20 MPa Concrete for miscellaneous minor concrete work

The unit of measurement shall be the cubic metre of concrete supplied and placed.

0310.5 32 MPa Concrete for miscellaneous minor concrete work

The unit of measurement shall be the cubic metre of concrete supplied and placed.