SECTION H

CONCRETE WORKS

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H.1 DESCRIPTION

All concrete used in the contract is to be ready mixed concrete, supplied and placed in accordance with this specification and in conformity with lines, grades and dimensions shown on the plans.

H.2 MATERIALS

Unless otherwise specified, the Contractor shall make arrangements to obtain all materials required to complete the work covered by this section.

(a) Concrete Materials

Concrete materials shall comply with the requirements of the following Australian Standards as applicable:

AS 3972	Portland and Blended Cements;
AS 2758	Concrete Aggregates;
AS 1478	Chemical Admixtures for Use in Concrete; and
AS 1479	

The quality of mixing water to be used in the concrete mix shall comply with the requirements of Clause 2.4 of AS.1379-1991. However, the amounts of chloride and chlorine in the water shall be not greater than 0.03%.

The maximum size of aggregate to be used shall be 20 mm.

(b) Ready Mixed Concrete

The mixing and delivery of ready mixed concrete or concrete mixed in a central plant shall comply with:

AS 1379	Ready Mixed Concrete

(c) Reinforcement

Unless otherwise specified or shown on the drawings or directed by the Superintendent reinforcement for concrete shall:

(i) Comply with the requirements of AS 4671 - 2001; and

(ii) be free from any coating which will reduce or prevent bonding of the concrete to the steel.

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H.3 STRENGTH

The concrete used shall be a dense uniformly graded mix, and when tested in a N.A.T.A. Registered Laboratory (unless otherwise specified), shall develop the following strengths:

At 7 days - Not less than 18 Megapascals.

At 28 days - Not less than 25 Megapascals.

Concrete used in kerb extrusion machines shall have a minimum cement content of 280 kg per cubic metre of finished concrete. Concrete kerb and channel shall develop the following strength:-

At 28 days using in place testing (cores) not less than 20 megapascals. Refer Clause H9.

The Contractor shall test specimens in conformance with the procedure below.

The test specimens shall consist of three 150 mm X 300 mm or equivalent meeting the requirements "AS 1012 - Part 8 - 1986. Method for making and curing concrete compression, indirect tensile and flexure test specimens". The specimen shall be made for any sample representative of the day's concrete.

Where more than 15 cubic metres of concrete is placed in one day, three test cylinders shall be made as required under the appropriate sections of AS.1379 and AS.1012.

One test cylinder of each set of three specimens shall be tested at 7 days, one at 28 days and the third when required by the Superintendent. Should any two test cylinders of a set fail to fulfil the compressive strength requirements specified, the Superintendent may reject the whole or part of the concrete represented by these specimens in which case it shall be removed and replaced in accordance with the Clause H14.

The method of making, curing and testing concrete compression cylinders shall be in accordance with AS 1012 Part 8 - 1973 Method of making and curing concrete compression, Indirect tensile and flexure test specimens and AS 1012 - Part 9 - 1973 Method for the determination of the Compressive strength of Concrete Specimens, except that, until despatched to the Laboratory, the cylinders shall be stored undisturbed at the site in a moist condition, sheltered from the sun and wind and protected from extremes or temperature. The Contractor shall be responsible for providing the necessary curing facilities and for curing the test cylinders on the site.

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H.4 CONSISTENCY

Concrete shall be of such consistency that it can be readily placed and compacted in the forms without segregation of the materials and without excess free water collecting on the surface.

The consistency of the concrete shall be determined by a slump test. Concrete with a slump exceeding 100 mm shall not be used. The Superintendent will determine the maximum slump to be used for each portion of the work.

Concrete for use in kerb extrusion machines shall contain the maximum amount of water which will produce such consistency that, after extrusion, the shape of the kerb will be maintained.

H.5 FORMWORK

Formwork shall conform to the shape, lines and dimensions required in the finished concrete. Formwork shall be rigid, watertight and braced and fixed so that it will maintain position and shape during casting of the concrete. Formwork shall be constructed so that it can be removed without damage to the concrete.

Formwork shall be constructed of one of the following:-

(a) Seasoned or kiln-dried timber.
(b) Metal shutters with joints flush fitting and adequately sealed.
(c) Pressed wood or plywood supported with timber of size and spacing approved by the Superintendent.

All exposed edges shall be chamfered not less than 20 mm X 20 mm to prevent mortar runs and to preserve smooth, straight lines. Internal angles shall be filleted where shown on the drawings.

Timber formwork shall be in long lengths free of loose knots and surface defects and uniform in thickness. Form materials before reuse shall have all protruding nails withdrawn, holes and surfaces to be in contact with concrete thoroughly cleaned. Forms shall not be reused if bulged or warped. All inside surfaces of formwork shall be coated with non-staining mineral oil, grease or other approved agent to ensure non-adhesion of the mortar.

All dirt, sawdust, shavings or other debris must be removed from the inside of forms before placing concrete.

HP Placing of concrete will not be permitted to commence until the formwork has been checked and approved by the Superintendent. Such approval will not relieve the Contractor of responsibility for any defects in the works which may become apparent during or after placing of concrete.

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H.6 REINFORCEMENT

Reinforcement shall be carefully formed to the dimensions and shapes shown on the drawings. For mild steel reinforcing bars, cold bends shall be made around a pin having a diameter of four or more times the nominal diameter of the bars. Reinforcement shall not be bent or straightened in a manner that will damage the material. Bars with kinks or bends not shown on the plans shall not be used. Heating of reinforcement will not be permitted.

Where practicable, all reinforcement shall be supplied in the full length shown in the drawings. Where not practicable, the Contractor shall splice the reinforcement by lapping where directed. The lap shall not be less than 40 times the nominal diameter of the bars.

All reinforcement shall be accurately placed in the positions shown on the plans, and shall be securely held during the depositing and compacting of the concrete by wiring together with annealed iron wire of diameter not less than 1.2 mm diameter, and by blocking and supporting from the forms with plastic or metal chairs, or by other approved methods.

Reinforcement supports shall be made of durable materials strong enough to withstand the imposed loads without movement of the reinforcement. They shall be positively attached to the reinforcement and of such size as to maintain the specified cover. Bars shall be tied at all intersections except where spacing is less than 300 mm in any direction when alternate intersections shall be tied.

Wooden supports shall not be used, nor shall metal supports or tie wires which extend to the surface of the concrete. Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted.

All reinforcement when placed shall be free from grease, tar, paint, oil, mud, loose mill scale, loose or thick rust and shall present a clean surface.

Unless otherwise shown on the drawings, the minimum clear cover to reinforcement shall be as designated in AS.3600 - Concrete Structures.

HP Placing and fastening of reinforcement in each section of the work shall be inspected and approved by the Superintendent before any concrete is deposited in the section.

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H.7 PLACING OF CONCRETE

HP Concrete shall not be placed until the Contractor has submitted details of the proposed method of placing and compaction to the Superintendent for review. After mixing, concrete shall be placed without delay. The methods of transport handling and placing shall be such as will prevent the segregation or loss of the ingredients. Dropping the concrete a greater height than 1.5 m will not be permitted.

Depositing large quantities of concrete at any point and moving or working it along the forms will not be permitted.

Any concrete which has developed its initial set, or which is not placed in the forms and compacted within 20 minutes after discharge from the mixer, shall not be used.

Concrete shall be placed in one continuous operation between ends of members and construction joints, thereby forming one unit of construction.

Concrete shall be placed in the forms within such intervals of time that the contact surface of the preceding concrete is still in a plastic condition.

Concrete shall not be placed under water.

HP Concrete shall not be placed without the approval of the Superintendent.

H.8 SPALLS

Sound spalls of tough durable rock, clean faced and free from honeycomb, weighing not more than 50 kg may be embedded in mass concrete. They shall be carefully placed and worked into the mass so that no air pockets remain. No spall shall be closer than 150 mm to another spall or to any concrete surface.

H.9 COMPACTION OF CONCRETE

During and immediately after placing, the concrete shall be thoroughly compacted by means of continuous tamping and vibration.

Care shall be taken to fill every part of the forms, to force the concrete under and around the reinforcement without displacing it, to work coarse aggregate back from the face and to remove air bubbles and voids.

Vibration shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms.

H.9 COMPACTION OF CONCRETE (cont'd)

Vibration shall be applied at the point of deposit and in the areas of freshly-deposited concrete. The vibrators shall be inserted and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any point to the extent that localised areas of grout are formed. Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visibly effective.

Vibration shall be supplemented by such hand tamping as is necessary to ensure smooth surface and dense concrete, along from surfaces and in corners and locations impossible to reach with the vibrators.

Vibrators (internal and external) shall have a minimum frequency of vibration such that the intensity of vibration will visibly affect a mass of concrete of 25 mm slump over a radius of at least 500mm.

Workers employed in compacting concrete shall be competent and experienced in this work. Any worker, who is deemed by the Superintendent to be unsatisfactory, shall be replaced immediately at the request of the Superintendent.

Concrete used in kerb extrusion machines shall have a density not less than 96% of the density achieved in a specimen cylinder moulded in accordance with AS1012.8 1986 Clause 1.7.5.

The Contractor shall carry out concrete core tests in accordance with AS1012.14-1991. Intervals of such tests shall be one (1) test per lot. A lot shall be the kerb and channel cast in one days production. The location for testing shall be in the kerb and channel tray or where there is no channel, the top of the kerb, on the steepest downhill grade on which the kerb machine is travelling.

On incidental, isolated, or works where the total length of kerb cast in one days production, is less than 150 linear metres, three (3) core tests shall be conducted. The Contractor shall request the Superintendent to nominate the position of each test.

The Contractor shall fill holes due to core sampling with a suitable concrete mix coloured to match the kerb and channel within 48 hours of testing.

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H.10 JOINTS

(a) **Construction Joints**

Wherever the work of placing concrete is stopped until the concrete has taken its initial set, this point shall be deemed a construction joint. The location and detail of construction joints shall be as shown on the plans or as required or approved by the Superintendent.

In the event of an emergency necessitating a construction joint, mixing and concreting shall proceed until an approved location for a construction joint is reached. The placing of concrete shall proceed continuously from joint to joint.

Before placing new concrete against concrete which has set, the forms shall be re tightened and the surface of the set concrete shall be roughened, cleaned of foreign matter, latent and loose or porous material. The surface shall be covered uniformly with a thin coat of cement ground of creamy consistency and concrete shall proceed immediately. This surface preparation work shall be completed to the satisfaction of the Superintendent before concreting proceeds.

(b) **Sawn Joints**

To prevent uncontrolled cracking in the concrete, sawn contraction joints shall be constructed.

Sawing shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without excessive ravelling, regardless of time or weather conditions.

The line of the joint shall be without any discontinuities. Neither edge shall deviate from a 3 m straight edge by more than 10 mm.

The joint surface shall not exhibit more than 5 mm of vertical or horizontal edge ravelling. The length of edge ravelling shall not be more than 300 mm in any one (1) metre length of joint on each edge. Saw debris shall be washed from the joint and pavement immediately after sawing.

Immediately after cleaning, a continuous UV - stabilised PVC spline seal 5 mm plus or minus 1 mm in diameter shall be installed in the sawcut, and where transverse joints cross longitudinal joints the transverse seal shall pass under any seal insert in longitudinal sawn joints. The seal shall not stretch in order to fit into the groove. Any increase in length of the seal after installation shall not exceed 10% of the original length. Joints in the seal shall not be less than 5 mm nor more than 7 mm below the surface of concrete.

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H.11 CURING

Concrete surfaces exposed to conditions causing premature drying shall be protected by covering as soon as possible with canvas, hessian, sand, plastic or other satisfactory material and kept moist; or if the surfaces are not covered they shall be kept moist by flushing or sprinkling. Curing shall continue for a period of not less than 7 days after placing the concrete.

When frosts and freezing temperatures are likely, special precautions shall be taken to maintain the concrete temperature of the surface of the setting concrete above 5 degrees Celsius.

Freshly finished concrete surfaces shall be effectively protected from rain or injury from other sources, until hard set has occurred.

If requested by the Contractor, consideration will be given to the use of a curing compound for curing purposes but, in general, moisture curing shall be adopted. Curing compounds shall be effective during the whole period of curing, and shall not be applied to surfaces which are to be bonded later to another surface.

Full details shall be submitted for the approval of the Superintendent and shall include the time and rate of application and the effectiveness of the curing compound as a curing agent. Such compounds may be colourless, or preferably white pigmented and shall not have a deleterious effect on the concrete. Compound which stain the surface of the concrete shall not be used, nor shall white compounds which cause the concrete to darken or yellow appreciably.

H.12 REMOVAL OF FORMS

HP Unless adequate supports are provided, forms shall not be removed until the concrete has achieved adequate strength. Forms shall not be removed without the permission of the Superintendent.

H.13 SURFACE FINISH

All concrete surfaces shall be true and even, free from honeycombed surfaces, depressions or projections. All unexposed surfaces not specified to be rendered shall be rendered.

As soon as the forms are removed, all mortar pins shall be tooled away to expose a face of dense sound concrete. Rough or porous areas and holes shall be filled with mortar consisting of three parts fine aggregate to one part of cement mixed with water to produce a mix of suitable consistency.

Bolts, wires or other appliances passing through the concrete to hold the forms shall be cut off or set back 50 mm below the surface and the ends covered with mortar mixed, as specified above.

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H.14 DEFECTIVE CONCRETE

The Contractor shall be fully responsible for employing effective methods of mixing, placing, protecting and curing concrete, and for the adequacy of forms. Approval of any such work or methods by the Superintendent will not relieve the Contractor of this responsibility.

Concrete not placed and completed in accordance with this specification or which, in the opinion of the Superintendent, is defective shall be removed and replaced by the Contractor at the Contractor's expense.