DEPARTMENT *of* INFRASTRUCTURE, ENERGY *and* RESOURCES, TASMANIA

BRIDGEWORKS SPECIFICATION

B10 – SUPPLY OF CONCRETE **October 2006**

Contents Page

B10.1 SCOPE

This specification sets out the requirements for the manufacture, delivery and testing of concrete for placement in reinforced, prestressed and mass concrete structures.

B10.2 OBJECTIVE

To provide dense, durable concrete which has the necessary strength for its designed purpose.

B10.3 REFERENCES

The following Australian Standards apply:

A.S. 1012 Methods for testing concrete

A.S. 1141 Methods for sampling and testing aggregates

A.S. 1379 Specification and supply of concrete

A.S. 1478 Chemical admixtures for concrete

A.S. 2758.1 Aggregates and rock for engineering purposes

A.S. 3582.1 Fly ash

A.S. 3582.2 Slag - Ground granulated iron blast furnace (GGBF Slag)

A.S. 3582.3 Silica fume

A.S. 3972 Portland and blended cements

A.S. HB 79 Alkali Aggregate Reaction Guidelines on minimising the risk of damage to concrete structures in Australia

National Guidelines on Alkali Aggregate Reactivity. National Building Research Institute, South Africa

ASTM C642 Standard Test Method for Specific Gravity, Absorption and Voids in Hardened Concrete

Specifications

G2 Contract Management Plan

G6 Quarried Materials

B4 Precast Concrete Piles

B11 Reinforced, Prestressed and Mass Concrete

B12 Prestressed Concrete Beams

B14 Precast Concrete Units

B10.4 DEFINITIONS

Cementitious Binder Portland cement or a mixture of portland cement with one or more supplementary cementitious Binders

Supplementary Cementitious Binder Silica Fume, Fly Ash or Ground Granulated Blast Furnace Slag (GGBF Slag)

Water Cementitious Binder Ratio The ratio of the amount of water to the total amount of cementitious Binders by mass in the freshly mixed concrete.

VPV % Volume of Permeable Voids as determined by the ASTM Test Method C642.

No Fines Concrete Concrete made without fine aggregate.

B10.5 MATERIALS

B10.5.1 Cement

Cement shall be general purpose Portland cement Type GP or blended cement Type GB, complying with the requirements of AS 3972 "Portland and Blended Cements".

B10.5.2 Supplementary Cementitious Binders

Supplementary Cementitious Binder shall be Silica Fume complying with the requirements of AS 3582.3, or Fly Ash complying with the requirements of AS 3582.1, or Ground Granulated Blast Furnace Slag (GGBF Slag) complying with the requirements of AS 3582.2

B10.5.3 Aggregate Reactivity

The aggregate shall be assessed for alkali-reactivity risk in accordance with the Australian Standard Guidelines. Petrographic examination shall be included in this assessment.

B10.5.4 Fine and Coarse Aggregate

Fine aggregate shall consist of clean, hard, durable uncoated grains, uniform in quality, and shall conform to the requirements of AS 2758.1. The sand equivalent of the mixed fine aggregate shall be not less than 60 percent.

Coarse aggregate shall consist of clean, hard, durable crushed stone or gravel, quarried from a source that complies with Specification G6, and shall comply with the material requirements given in Table B10.1. It shall be free from coatings of clay, dust, organic and other harmful materials. If necessary the coarse aggregate shall be washed to comply with this Specification. For properties other than those listed in Table B10.1 coarse aggregate shall conform to the requirements of AS 2758.1.

The maximum coarse aggregate size shall not exceed the least of:

(i) 26.5 mm or

(ii) 60% of the minimum reinforcing bar spacing or

(iii) 60% of the cover to the reinforcement.

TABLE B10.1 COARSE AGGREGATE MATERIALS REQUIREMENT

TEST	TEST METHOD	SPECIFICATION LIMITS
Los Angeles Test	AS 1141 – Section 23	30 percent max.
Flakiness Index	AS 1141 – Section 15	30 percent max.
Misshapen Particle	AS 1141 – Section 14	30 percent max. at 3:1 ratio

B10.5.5 Water ♦

The water to be used in the concrete mix shall be potable and shall comply with the quality requirements of Clause 2.4 of AS 1379. However, the amounts of chloride and chlorine in the water shall be not greater than 300 mg/l. Notwithstanding this limit the total acid soluble chloride ion content of the concrete from all mix sources shall not exceed 0.4 kg/m^3 of concrete. Test results shall be provided for the batch plant water prior to use.

B10.5.6 Chemical Admixtures

Chemical admixtures shall comply with the requirements of AS 1478. They shall be used in accordance with the requirements of Clause 2.5 of AS 1379, the manufacturer's recommended method of use and in full compliance with Occupational Health and Safety Regulations. Admixtures shall not reduce the strength of concrete below that specified.

Chemical admixtures shall not contain calcium chloride, calcium formate, chlorine, sulphur, sulphides or sulphites.

Where two or more chemical admixtures are proposed for incorporation in a concrete mix, the manufacturers shall certify their compatibility.

Where an air-entraining admixture is used, the air content of the concrete delivered on site shall not exceed the nominal value of 5% by volume. The concrete shall be deemed to comply with the approved air content if the measured air content is within 1.5 percent of the approved air content.

B10.5.7 Storage of Materials

Storage of all materials shall comply with AS 1379 Clause 2.6.

B10.5.8 Testing of Aggregates

During the progress of the work the Contractor shall supply samples of the aggregates to the Superintendent for audit testing as required.

B10.6 SUPPLY

All concrete shall be Special Class Performance concrete in accordance with Appendix C Clause C4.2 of AS 1379.

The Superintendent shall be given 24 hours notice of all concrete deliveries.

The Contractor shall not change Supplier without the prior approval of the Superintendent.

B10.7 CONCRETE

B10.7.1. Concrete Properties ♦

Standard grades are shown in Table B10.2.

The characteristic compressive strength of concrete (F'c) shall be determined at 28 days after placing by tests carried out on standard test specimens made, cured and tested in accordance with AS 1379 Appendix B Clause 3.4 and AS 1012:8 and 9.

The design slump shall be 60 mm ± 15.

B10.7.2 Design of Concrete Mix ♦

B10.7.2.1 Mix Constituents

The concrete shall consist of a mixture of cementitious binder, fine aggregate, coarse aggregate and water. If any aggregate is potentially alkali silicate reactive then some supplementary cementitious material shall be included in the design mix.

The concrete may also contain chemical admixtures, details of which shall be submitted with the mix design.

If the coarse aggregate or fine aggregate is composed of more than one material or size of material, the mix proportions for each shall be specified separately.

B10.7.2.2 Mix Design Details

The Contractor shall submit the concrete mix design details for acceptance by the Superintendent not less than 14 days prior to the placement of concrete. Concrete shall not be placed until the Superintendent has accepted the mix design. The concrete mix design details shall include the following:

(i) Supplier and batch plant location;

(ii) The source, type and proportions of the constituent materials;

(iii) Aggregate grading and saturated surface-dry densities;

(iv) Test results for strength, durability and other properties of aggregates;

(v) Chemical admixtures details and manufacturer's recommended method of use;

(vi) The nominated slump and where a super plasticiser is used the final slump range;

(vii) The maximum water content and maximum water / cementitious binder ratio;

(viii) Documentary evidence of previous performance including relevant strength test results for 3, 7 and 28 day compressive strengths consistent with the specified compressive strength requirements as well as the standard deviation of the test results;

(ix) Documentary evidence of any durability related testing of the concrete including VPV, resistance to carbonation, chloride ingress, alkali aggregate reactivity, sulphate attack, acid attack and freeze thaw damage.

Where required by the Project Specification samples of concrete design mix shall be taken and tested in accordance with the relevant standard test methods for VPV. The maximum VPV values at 28 days for each concrete grade are shown in Table 10.2

The concrete mix design shall be strictly adhered to by the Contractor. In the event of proposed changes to the agreed concrete mix design, the Contractor shall submit a new concrete mix design to the Superintendent for acceptance.

In the absence of satisfactory documentary evidence that an existing concrete mix design complies with the requirements of this specification, a trial mix shall be undertaken in accordance with AS 1012 Part 2. Test results for slump, water cement ratio, VPV and air content shall be reported.

B10.7.2.3 Cementitious Binder Content and Water/Cementitious Binder Ratio

The minimum mass of total cementitious binder per cubic metre of finished concrete and the corresponding maximum water/cementitious binder ratio shall be as shown in Table B10.2.

TABLE B10.2 CONCRETE PROPERTIES

GRADE F'c	MINIMUM CEMENTITIOUS BINDER (in kg/m^3 of concrete)	MAXIMUM WATER/ CEMENTITIOUS BINDER RATIO by MASS	Max VPV @ 28 days % Test cylinders
S15	200	0.9	
S20	260	0.75	
S25	350	0.55	
S32	400	0.5	15
S40	440	0.45	14
S50	470	0.4	13
S55	500	0.36	12

The cementitious binder content of concrete to be placed under water shall not be less than 400 kg/m^3, with a maximum water / cementitious Binder ratio of 0.45.

B10.7.2.4 Minimum Cementitious Binder Content

The minimum mass of Portland cement in concrete mixes containing either GGBF Slag or Fly Ash shall be 60% or 75% respectively, of the total mass of cementitious Binder in the concrete mix. The inclusion of GGBF Slag, Fly Ash or Silica Fume in concrete mixes shall be in binary or ternary combination with Portland cement.

In no case shall more than 40 kg/m^3 of Silica Fume be added.

B10.7.3 No-Fines Concrete

Where No-Fines Concrete is specified then the concrete mix shall be designed using no fine aggregate with a cement / aggregate ratio of 1:10.

B10.7.4 Mixing and Delivery

Concrete shall not be mixed or agitated when the air temperature is greater than 35^0C. Note Specification B11 temperature requirements for concrete placement.

The moisture content of the aggregates shall be determined at least daily on days of supply.

Water may be added to the freshly mixed concrete provided a means of accurately measuring the volume of water is used to ensure that the maximum water cementitious binder ratio is not exceeded. The amount added shall be shown on the delivery docket.

High range water reducers may be utilised to aid workability of concrete. The dosage shall be recorded on the delivery docket. Concrete that has begun to stiffen shall not be used in the works.

Prior to the discharge of concrete at the site, the transit mixer shall be operated at mixing speed until the concrete achieves uniformity, but for not less than a period of one minute.

Concrete shall be placed and compacted within 90 minutes of the commencement of mixing. This time may be extended provided the Contractor submits, as part of the concrete mix design submission, details of measures to be undertaken to ensure compliance with this Specification.

B10.8 CONTROL, SAMPLING AND TESTING

B10.8.1 General

Sampling and testing of concrete delivered to the site shall be carried out by a NATA registered laboratory. The Superintendent may also sample and audit test concrete delivered to the site.

B10.8.2 Sampling ♦

Sampling of fresh concrete shall be carried out in accordance with AS 1012, Part 1.

The frequency of sampling shall be in accordance with Table B10.3.

TABLE B10.3 SAMPLING FREQUENCY

VOLUME CAST IN ONE OPERATION (CUBIC METRES)	MINIMUM NO. OF SAMPLES
0 to 15	1
15 to 40	2
40 to 75	3
Each additional 75, or part thereof	Additional 1

Additional sampling and test specimen requirements for prestressed beams and other precast components are given in Specifications B12, and B14.

Each sample of concrete shall be tested for slump, temperature, compressive strength, and (where specified) air entrainment.

The frequency of testing may be reduced if the Superintendent is satisfied by documentary evidence that the mix history consistently complies with this specification.

B10.8.3 Slump Test ♦

The consistency of the concrete shall be determined by slump tests in accordance with AS 1012:3. Prior to the slump test the water / cement ratio on the delivery docket shall be verified as compliant.

The slump shall be 60 mm ± 15 or within the range nominated in the Mix Design for concrete containing super plasticiser.

The consistency of each truckload of concrete delivered shall be visually assessed and a slump test, made in accordance with AS 1012, Part 3, taken at the time of taking a test sample. A sample shall be obtained from the load immediately after completion of discharge of not less than 0.2 cubic metres. The Superintendent may require further slump tests if the visual assessment is inconsistent with previous loads.

If the measured slump fails to comply, by being too low, water may be added up to the maximum allowable for site addition shown on the delivery docket and a retest may be carried out under AS 1379 Clause 5.2. If this second test also fails to comply then the load sampled shall be rejected at no cost to the Principal. Water shall not be added if super plasticiser has been added.

B10.8.4 Compressive Strength Tests

The compressive strength of the concrete shall be determined by compression tests on standard test specimens made, cured and tested in accordance with AS 1012, Parts 8 and 9.

Unless additional specimens are specified three test specimens shall be made from each sample, one for test at 7 days, and the other two for test at 28 days unless otherwise specified.

B10.8.5 Supplier's Certificate

The Contractor shall furnish to the Superintendent, a copy of the Supplier's certificate of compliance for each load. The certificate shall be in the form of a delivery docket on which is printed, stamped or written, the following information concerning the batch of concrete:

(i) Job Site,

(ii) Name of pre-mix batch plant,

(iii) Serial number of docket,

(iv) Date and truck number,

(v) Concrete strength grade,

(vi) Volume of concrete (cubic metres),

(vii) Time batched and time of arrival on site,

(viii) Cementitious Binders type and kg/cubic metre

(ix) Total water content (litres/cubic metre) detailed as: Batch, Slump adjustment and maximum allowable site addition

(x) Specified slump,

(xi) High range water reducer type and dosage

(xii) Admixtures (type and dosage),

(xiii) Any other details required by the Superintendent.

The Contractor shall note on the certificate the time delivery of concrete is completed to verify compliance with this Specification.

B10.9 CONFORMANCE CRITERIA

The Conformance Criteria for the results of cylinder compressive strength tests shall be in accordance with AS 1379, Clause 6.3.5.2. The standard deviation for calculations shall be not less than 3 MPa.

A lot shall comprise that concrete of the same strength grade and characteristics placed continuously on any one day of the Contract. The production period shall be considered to be the contract period plus any results submitted under Clause 10.7.2.2.

The Contract Completion Report shall include control charts, including all test results, for each grade of concrete used in the contract.

B10.10 HOLDPOINTS

The following hold points have been identified in this Specification:

- Prior to change of Supplier (B10.6)
- Acceptance of mix design prior to placement (B10.7.2)
- Prior to change of accepted mix design. (B10.7.2)

B10.11 INFORMATION TO BE INCLUDED IN CONTRACT MANAGEMENT PLAN

The following information to be included in the Contract Management Plan has been identified in this Specification:

- Mix design details including admixtures and supplementary cementitious Binders (B10.7.2)
- Sampling and testing regime (B10.8)