

# TWEED SHIRE COUNCIL

## DEVELOPMENT CONSTRUCTION SPECIFICATION

C247

# MASS CONCRETE SUBBASE

VERSION 1.2

**SPECIFICATION C247 - MASS CONCRETE SUBBASE**

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## DEVELOPMENT CONSTRUCTION SPECIFICATION C247

### MASS CONCRETE SUBBASE

#### GENERAL

##### C247.01 SCOPE

1. This Specification is for the construction, by mechanical or hand placement of mass concrete subbase and subgrade beams to the dimensions and levels shown on the approved design plans.
2. Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in the Specification Part for Quality Requirements. **Quality**
3. Concrete manufactures may apply to Council for approval of their standard mix designs and must satisfy the requirements of this specification, prior to use in subdivision works. Such standard mix designs, of appropriate strength, may be used on subdivision works without separate testing being required for each subdivision. **Standard mix designs**

##### C247.02 THICKNESS AND LEVELS OF SUBBASE

1. The subbase thickness and levels shall be as shown on the design plans. **Levels**

##### C247.03 PROVISION FOR BASE SLAB ANCHORS

1. During construction of the subbase, in advance of concrete base construction the Subdivider shall make provision to permit construction of base slab anchors at the locations and to the dimensions shown on the design plans. Excavation of material, trimming of trenches, compacting of the bottom of the trench, disposal of surplus material and construction of the concrete anchors shall be carried out in accordance with the Specification for PLAIN OR REINFORCED CONCRETE BASE as part of the concrete base construction. **Base Slab Anchors**

##### C247.04 REFERENCE DOCUMENTS

1. Documents referenced in this Specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. **Documents Standards Test Methods**

###### (a) Council Specifications

- C248 - Plain or Reinforced Concrete Base
- C271 - Minor Concrete Works

###### (b) Australian Standards

- AS 1012.1 - Sampling of fresh concrete.
- AS 1012.3.1 - Determination of properties related to the consistence of concrete - Slump test.
- AS 1012.4.2 - Determination of air content of freshly mixed concrete - Measuring reduction in air pressure in chamber above concrete.

AS 1012.8	-	Making and curing concrete compression, indirect tensile and flexure test specimens, in the laboratory or in the field.
AS 1012.9	-	Determination of the compressive strength of concrete specimens.
AS 1012.13	-	Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory.
AS 1012.14	-	Securing and testing cores from hardened concrete for compressive strength.
AS 1141.11	-	Particle size distribution by sieving.
AS 1141.14	-	Particle shape, by proportional calliper.
AS 1141.22	-	Wet/dry strength variation.
AS 1160	-	Bitumen emulsion for construction and maintenance of pavements.
AS 1289.4.2.1	-	Methods of testing soils for engineering purposes - Soil chemical tests - Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method
AS 1379	-	The specification and supply of concrete.
AS 1478.1	-	Chemical admixtures for concrete, mortar and grout – Part 1: Admixtures for concrete.
AS 2758.1	-	Concrete aggregates.
AS 3582.1	-	Supplementary cementitious materials for use with portland cement - Flyash.
AS 3583.13	-	Methods of test for supplementary cementitious materials for use with portland cement - Determination of chloride ion content
AS 3799	-	Liquid membrane - forming curing compounds for concrete.
AS 3972	-	General purpose and blended cements.

**MATERIALS FOR CONCRETE**

**C247.05 CEMENT**

- |    |  |   |
|----|--|---|
| 1. | Cement shall be Type GP Portland cement or Type GB blended cement complying with AS 3972. Cement shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme.  | <b>NSW QA Scheme</b>                      |
| 2. | When submitting details of the nominated mix in accordance with Clause C247.15 the Subdivider shall nominate the brand and source of the cement. On approval of a nominated mix by the Certifying Engineer, the Subdivider shall use only the nominated cement in the work.  | <b>Nominated Brand and Source</b>         |
| 3. | Documentary evidence of the quality and source of the cement shall be furnished by the Subdivider to the Certifying Engineer upon request at any stage of the work.  | <b>Proof of Quality</b>                   |
| 4. | If the Subdivider proposes to use cement which has been stored for a period in excess of three (3) months from the time of manufacture, the Certifying Engineer may require a retest to ensure the cement complies with AS 3972, before the cement is used in the work. The cost of retesting cement shall be borne by the Subdivider. | <b>Storage Time<br/>Subdivider's Cost</b> |
| 5. | Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used.   | <b>Transport and Storage</b>              |

**C247.06 FLYASH**

- |    |  |                      |
|----|--|----------------------|
| 1. | Flyash shall be from a source included in the New South Wales Government Cement Quality Assurance Scheme. The use and the quality of flyash shall comply with AS 3582.1.   | <b>NSW QA Scheme</b> |
| 2. | When submitting details of the nominated mix in accordance with Clause C247.15, the Subdivider shall nominate the powerhouse source of the flyash. On approval of a nominated mix by the Certifying Engineer, the Subdivider shall use only flyash | <b>Source</b>        |

## MASS CONCRETE SUBBASE

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from the nominated powerhouse.

3. Documentary evidence of the quality and source of the flyash shall be furnished by the Subdivider to the Certifying Engineer upon request at any stage of the work. **Documentary Evidence**

### C247.07 WATER

1. Water used in the production of concrete shall be potable, free from materials harmful to concrete or reinforcement, and be neither salty nor brackish. **Quality**

### C247.08 ADMIXTURES

1. Chemical admixtures and their uses 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. An air-entraining agent may be included in the mix. If an air-entrainer is used, the air content of the fresh concrete shall comply with Clause C247.14. **Quality**
2. Fresh concrete with an air content not complying with Clause C247.14 shall be rejected. **Excess Air Content**
3. 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 Certifying Engineer, shall be used to control slump within the limits stated in Clause C247.13. 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 Certifying Engineer, together with the proposed 'dosage chart' in accordance with Clause C247.15. **Retarder for Warm Season**
4. During the cool season (April to September inclusive), only a lignin or lignin-based set retarding admixture containing not more than 6 per cent reducing sugars (Type WRRe complying with AS 1478.1) may be used in the mix or, alternatively, omitted altogether. If the Subdivider proposes to vary the admixture between the warm and cool seasons such variation shall constitute a proposed change to an approved mix for the purposes of Clause C247.16. **Retarder for Cool Season**
5. When submitting details of the nominated mix in accordance with Clause C247.15, the Subdivider shall nominate the proprietary source, type and name of each admixture to be used. Documentary evidence of the quality shall be furnished by the Subdivider to the Certifying Engineer upon request at any stage of the work. **Source and Type**

### C247.09 AGGREGATES

#### (a) General

1. When submitting details of the nominated mix in accordance with Clause C247.15, the Subdivider shall nominate the sources of aggregate to be used and shall submit details of the geological type of each aggregate. **Source and Type**
2. Aggregates shall all pass the 37.5mm AS sieve and shall comply with AS 2758.1 in respect of bulk density, water absorption (maximum 5 per cent), material finer than 75 micrometres, impurities and reactive materials. The proportion of misshapen particles (2:1 ratio) determined by AS 1141.14 shall not exceed 35 per cent. **Quality**
3. When submitting details of the nominated mix, the Subdivider shall submit to the Certifying Engineer a NATA Certified Laboratory Test Report on the quality and grading of the aggregate proposed to be used. The grading shall be known as the **Proposed Grading**



"Proposed Grading".

4. If the Subdivider proposes to blend two (2) or more aggregates to provide the Proposed Grading the Test Reports for each constituent material shall be submitted separately and the Certifying Engineer advised of the proportions in which the various sizes and constituents are to be combined. The aggregate from each source and the combined aggregate shall comply with the requirements of this clause. **Blending of Aggregates**
5. All aggregate used in the production of concrete shall be clean, hard, durable rock fragments free from the inclusion of mineral salts, oils, organic matter or other materials deleterious to the performance of concrete.

**(b) Grading**

1. The grading of the combined aggregate used in the work, determined by AS 1141.11, shall not deviate from that of the Proposed Grading by more than the amounts shown in Table C247.1.

Australian Standard Sieve	Maximum Deviation Per Cent Passing by Mass of Total Sample
37.5 mm	-5
19.0 mm	+ or -10
4.75 mm	+ or -10
1.18 mm	+ or -5
600 µm	+ or -5
150 µm	+ or -2

**Table C247.1 - Aggregate Grading Deviation Limits**

**(c) Durability**

1. Any fraction of any constituent and any fraction of combined aggregate shall conform to the following requirements:- **Tolerances**
- (a) Wet Strength - AS 1141.22 - Shall not be less than 50 kN.
- (b) 10 per cent Fines Wet/Dry Variation - AS 1141.22 - Shall not exceed 35 per cent.

**(d) Storage**

1. Storage and handling facilities shall be such as to prevent the aggregates becoming intermixed or mixed with foreign materials, and to prevent segregation occurring. **Facilities Required**
2. The area surrounding the storage facilities and mixing plant shall be so constructed that delivery vehicles, loaders and trucks shall not be capable of introducing foreign matter to the aggregates at any time. If foreign matter is introduced or the area reaches a condition where, in the opinion of the Certifying Engineer, foreign matter may be introduced to the aggregates, production of concrete and delivery of materials shall cease until the condition is corrected to the satisfaction of the Certifying Engineer. **Introduction of Foreign Matter**

## **QUALITY REQUIREMENTS OF CONCRETE**

### **C247.10 CEMENT AND FLYASH CONTENT**

1. When a cement and flyash blend is nominated the minimum Portland cement content shall be 90 kilograms per yielded cubic metre of concrete and the minimum flyash content shall be 100 kilograms per yielded cubic metre of concrete. **Minimum Content**

### **C247.11 COMPRESSIVE STRENGTH**

1. The compressive strength of concrete shall be determined in accordance with AS 1012.9. The minimum compressive strength at 7 days shall be 4MPa and at 28 days shall not be less than 5MPa for flyash blended cement. The maximum compressive strength at 28 days shall be less than 15MPa, with the exception that where the nominated mix demonstrates a 28 day shrinkage less than 400 microstrains, then the concrete achieving a strength less than 20MPa shall be accepted. **Compressive Strength**

### **C247.12 SHRINKAGE**

1. The drying shrinkage of the nominated mix, determined by AS 1012.13 shall not exceed 450 microstrain after three (3) weeks air drying. The drying shrinkage at the nominated slump plus 10mm shall be taken as the average of the reading or readings within 5 per cent of the median of the three (3) readings obtained in accordance with AS 1012.13. **Shrinkage Limit**

### **C247.13 CONSISTENCY**

1. The Subdivider's nominated slump, determined in accordance with AS 1012.3.1, shall be neither less than 25mm nor more than 40mm for mechanically placed concrete and shall be neither less than 50mm nor more than 65mm for hand placed concrete. **Slump Tolerances**

### **C247.14 AIR CONTENT**

1. If an air entraining agent is used, the air content of the fresh concrete, determined in accordance with AS 1012.4.2, shall be neither less than 3 per cent nor more than 7 per cent when discharged from the transport vehicle ready for placement. **Air Content Tolerances**

## **DESIGN AND CONTROL OF CONCRETE MIXES**

### **C247.15 GENERAL**

1. The Subdivider shall submit, for approval by the Certifying Engineer, details of the concrete mix or mixes and the materials, including source, to be used for each of mechanically placed and hand placed subbase, including nominated slump and moisture condition of the aggregates (oven dry, saturated surface dry, or other specified moisture content) on which the mix is based. Each such mix shall be known as a 'nominated mix'. **Nominated Mix**

- |    |  |  |
|----|--|--|
| 2. | The Subdivider shall provide a Certificate from a laboratory with appropriate NATA registration stating that each nominated mix and its constituents meet the requirements of this Specification. All relevant test results shall accompany the Certificate. All phases of any particular test must be performed at one laboratory. The certificate shall confirm that the required testing has been carried out in the twelve (12) month period before the date of submission to the Certifying Engineer. | <b><i>Certificate of Compliance with Specification</i></b> |
| 3. | In the tests supporting the above certification, the compressive strength gain curve shall be submitted showing the compressive strengths at ages 3, 7, 10 and 28 days determined in accordance with AS 1012.9. Each of the results shall be based on three (3) specimens of concrete produced from a batch of the nominated mix. The compressive strength shall be the average of individual results within 1.0MPa of the median.   | <b><i>Compressive Strength Determination</i></b>           |
| 4. | These details shall be submitted at least 7 days before using the nominated mix in the work.   | <b><i>Submission of Details</i></b>                        |

**C247.16 VARIATIONS TO APPROVED MIXES**

- |    |  |  |
|----|--|--|
| 1. | The Subdivider shall not make any changes to the approved mix, its method of production or source of supply of constituents without the prior written approval of the Certifying Engineer.                     | <b><i>Approval required to vary mix</i></b>  |
| 2. | Where changes to an approved mix are proposed, the Subdivider shall provide details of the nominated mix and materials, in accordance with Clause C247.15.   | <b><i>Subdivider's Responsibility</i></b>    |
| 3. | Notwithstanding these tolerances, the minimum cement content shall be 90 kilograms per yielded cubic metre of concrete, the minimum flyash content shall be 100 kilograms per yielded cubic metre of concrete. | <b><i>Minimum Constituent Quantities</i></b> |

**CONFORMANCE FOR CONCRETE STRENGTH AND THICKNESS****C247.17 CONCRETE CYLINDERS****(a) Test Specimens**

- |    |  |   |
|----|--|---|
| 1. | Test specimens for determining the compressive strength of concrete shall be standard cylinders complying with AS 1012.8. The Subdivider shall supply a sufficient number of moulds to meet the requirements for the frequency of testing specified in this Clause and shall also arrange for a laboratory with appropriate NATA registration to conduct the sampling of fresh concrete and the making, curing, delivery and testing of specimens. Copies of test results shall be forwarded to the Certifying Engineer. | <b><i>Subdivider's Responsibility</i></b> |
| 2. | Samples of concrete for testing shall be taken in accordance with AS 1012.1. The selection of the batches to be sampled shall be taken randomly. The specimens shall be moulded from each sample so that they are as identical as practicable.   | <b><i>Sampling</i></b>                    |
| 3. | The method of making and curing specimens shall be in accordance with AS 1012.8 with compaction by internal vibration.   |   |
| 4. | The Subdivider shall mark the specimens for identification purposes.   | <b><i>Marking</i></b>                     |
| 5. | Specimens shall be inspected, capped and crushed in accordance with AS 1012.8 and AS 1012.9.   |   |
| 6. | The cost of all work and material required in the making, curing, delivery and testing of specimens shall be borne by the Subdivider.  | <b><i>Subdivider's Costs</i></b>          |

**(b) Frequency of Moulding of Test Specimens**

1. Test specimens shall be moulded as follows:-

***Moulding of  
Cylinders***

(i) For the determination of the compressive strength at twenty-eight (28) days.

For each lot of up to 50 cubic metres  
of concrete placed at the one time: One (1) pair of specimens

(ii) For the determination of the compressive strength at seven (7) days.

For each lot of up to 50 cubic metres  
of concrete placed at the one time: One (1) pair of specimens

(iii) For the determination of compressive strength for any early testing as deemed necessary by the Subdivider.

For each lot of up to 50 cubic metres  
of concrete placed at the one time: One (1) pair of specimens

2. A lot is defined as a continuous pour of up to 50 cubic metres of concrete placed in the subbase.

***Lot Size***

**C247.18 COMPRESSIVE STRENGTH OF CONCRETE**

**(a) General**

1. The compressive strength of the concrete represented by a pair of specimens moulded from one (1) sample shall be the average compressive strength of the two (2) specimens.

***Determination  
of Strength***

2. At the time of approving the mix design, the Certifying Engineer shall nominate whether 7 day or 28 day compressive strength or both shall be the acceptance criteria for strength.

**(b) Adjustment of Test Compressive Strength for Age of Specimen**

1. Should any specimen be tested more than 28 days after moulding the equivalent 28 day compressive strength shall be the test compressive strength divided by the factor applying to the age of the specimen at the time of the test shown in Table C247.2. For intermediate ages the factor shall be determined on a pro-rata basis.

***Strength Age  
Factor***

Age of Specimen at time of test (days)	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 or greater	1.25

**Table C247.2 - Concrete Age Conversion Factors**

**(c) Conformance for Compressive Strength**

- |  |                                   |
|--|-----------------------------------|
| <p>1. If the compressive strength of test cylinders for any lot is less than the criteria specified in Clause C247.11, the lot represented by the test cylinders shall be removed and replaced.</p>  | <b>Limits</b>                     |
| <p>2. The cost of removal of rejected concrete, including its disposal from the site, shall be borne by the Subdivider.</p>  | <b>Subdivider's Cost</b>          |
| <p>3. In case of non-conformance the Subdivider may request permission of the Certifying Engineer to core the in situ subbase for testing of the actual compressive strength to represent the particular lot. The locations for testing shall be nominated by the Certifying Engineer. Such locations may be determined by the use of a nuclear density meter, or any alternative method. Testing shall be carried out at the request of the Subdivider. Subbase concrete failing to reach the required in situ compressive strength shall not be retested for at least 72 hours after the determination of the value of the in situ compressive strength.</p> | <b>Non-conformance and Coring</b> |

**C247.19 SPECIMENS CUT FROM THE WORK**

- |   |                                 |
|---|---------------------------------|
| <p>1. Specimens cut from the work shall be tested in a NATA registered laboratory nominated by the Subdivider. Specimens shall be in the form of cylindrical cores of hardened concrete.</p>  | <b>Test Specimens</b>           |
| <p>2. Cores shall be secured, accepted, cured, capped and tested in accordance with AS 1012.14 with the following amendments:-</p> <p>(a) The requirement that the concrete shall be at least 28 days old before the core is removed shall not apply. However, concrete must have hardened enough to permit removal without disturbing the bond between the mortar and the coarse aggregate.</p> <p>(b) The preferred dimension for cores shall be 100mm diameter but in no case shall the diameter be less than 75mm or two (2) and one (1) half times the nominal size of the coarse aggregate, whichever is the greater.</p> | <b>Specimen Characteristics</b> |

- (c) When inspected in the uncapped state, cores shall be rejected if any diameter departs by more than 5mm from the mean diameter.
- (d) Cores shall be rejected where the length of the core when ready for capping is less than the diameter. The test strength determined shall be adjusted for form by a factor in accordance with Table C247.3.
- (e) Wet Conditioning only shall be used.

<b>Length/Diameter Ratio</b>	<b>Correction Factor</b>
2.00	1.00
1.75	0.98
1.50	0.96
1.25	0.93
1.00	0.89

NOTE: For intermediate form ratios, the factor shall be determined by interpolation.

**Table C247.3 - Core Strength Factor**

- 3. Core cutting shall be carried out by the Subdivider in the presence of and at the locations nominated by the Certifying Engineer. The frequency of coring shall be such that a core is taken to represent each lot or the area of subbase placed between any two (2) consecutive construction joints whichever is the lesser. The lot represented by each core shall be nominated by the Subdivider at the time of sampling and duly recorded prior to testing. **Frequency of Coring**
- 4. Cores shall be despatched to arrive at the testing laboratory within 24 hours of the core being cut from the subbase. Wet curing shall commence within 24 hours of the receipt of the cores. **Curing of Cores**
- 5. The cost of cutting and transporting the cores to the testing laboratory and restoring all holes in the subbase shall be borne by the Subdivider. The method of restoration shall be approved by the Certifying Engineer. **Cutting Cores Subdivider's Cost**
- 6. The cost of core preparation for testing, curing and testing shall be borne by the Subdivider. **Testing Subdivider's Cost**

**C247.20 ACCEPTANCE OF CORED CONCRETE FOR COMPRESSIVE STRENGTH**

- 1. Concrete shall achieve an in situ compressive strength of 5MPa within 28 days of placement. **Strength Requirement**
- 2. If the specimen cut from the subbase reaches 4MPa for in situ compressive strength, base paving may proceed. **Core Strength**
- 3. No payment shall be made for the rejected concrete nor any bond breaker placed. **Rejected Concrete**
- 4. The cost of removal of rejected concrete, including its legal and responsible disposal from the site, shall be borne by the Subdivider. **Subdivider's Cost**

**C247.21 CONFORMANCE FOR THICKNESS****(a) General**

1. No thickness measurements will be carried out if the surface of the subbase is within the level tolerances as specified in Clause C247.32(b). **Conforming Tolerances**
2. If scabbling is required to achieve the level tolerance limits, the Certifying Engineer may order thickness checks to be carried out. Where the survey ground model of the subgrade is available, subbase thickness shall be calculated from levels taken on a 5m grid on the plan area. Alternatively, the Certifying Engineer may authorise coring and measurement at the edges of the layer. **Thickness Measurement**
3. Thickness measurements shall be rounded off to the nearest 5mm.

**(b) Thickness Below Specification**

1. After making due allowance for the tolerances, subbase which is more than 20mm below the theoretical thickness shall be rejected and removed from the site. The cost of removal and disposal from the site shall be borne by the Subdivider. **Remove and Replace**
2. Subbase which is 20mm or less below the theoretical thickness may be accepted by the Certifying Engineer providing that it represents isolated sections within a lot and such sections comprise less than 10 per cent of the area of the lot and the non-conformance will not adversely impact on the operation, life expectancy and maintenance costs of the structure. **Acceptance**

**PRODUCTION, TRANSPORT AND CONSISTENCY OF CONCRETE****C247.22 PRODUCTION AND TRANSPORT OF CONCRETE**

1. At least one (1) week before commencing work under this Specification, the Subdivider shall submit, for the information of the Certifying Engineer, details of the proposed methods of handling, storing and batching materials for concrete, details of proposed mixers and methods of agitation, mixing and transport. **Subdivider's Responsibility**

**C247.23 HANDLING, STORAGE AND BATCHING MATERIALS**

1. The methods of handling, storing and batching materials for concrete shall be in accordance with AS 1379, with the following additional requirements:- **Methods**
  - (a) Certificates of Calibration issued by a recognised authority shall be made available for inspection by the Certifying Engineer, as evidence of the accuracy of the scales.
  - (b) Cementitious material shall be weighed in an individual hopper, with the cement weighed first.
  - (c) The moisture content of the aggregates shall be determined at least daily immediately prior to batching. Corresponding corrections shall be made to the quantities of aggregates and water.
  - (d) Where a continuous type mixer is employed, the components shall be measured by a method of continuous weighing approved by the Certifying Engineer, except for liquids which may be measured by volume or flow rate meter.

**C247.24 MIXERS AND AGITATION EQUIPMENT**

1. Details of proposed mixers and agitation methods shall be in accordance with the plant and equipment sections of AS 1379, with the following additional requirement that in Appendix A of AS 1379 the maximum permissible difference in slump shall be 10mm. **Requirements**

**C247.25 MIXING AND TRANSPORT**

1. Mixing and transport methods shall be in accordance with the production and delivery sections of AS 1379, with the following additional requirements:- **Methods**

- (a) The mixer shall be charged in accordance with the manufacturer's instructions.
- (b) For the purpose of conducting mixer uniformity tests in accordance with Appendix A of AS 1379 on a split drum mixer producing centrally mixed concrete, the whole of the batch shall be discharged into the tray of a moving vehicle. The concrete shall then be sampled from the tray of the vehicle at points approximately 15 per cent and 85 per cent along the length of the tray.

- (c) For truck-mixed concrete, addition of water in accordance with the batch production section of AS 1379 shall be permitted only within ten (10) minutes of completion of batching and within 200m of the batching facilities. The delivery docket must clearly indicate the amount of water added, but in no circumstance shall the water : cement ratio be exceeded. Mixing of the concrete shall be completed at that location.

- (d) After addition of the cement to the aggregate, concrete shall be incorporated into the work within:-

- (i) One and a half (1.5) hours, where transported by truck mixer or agitator
- (ii) One (1) hour, where transported by non-agitating trucks

Means of verification, satisfactory to the Certifying Engineer, of the times of addition of cement to the aggregate shall be provided.

The times within which the concrete shall be incorporated into the work may be reduced if the Certifying Engineer considers the prevailing weather, mix type, or materials being used warrant such a change.

- (e) The size of the batch in an agitator vehicle shall not exceed the manufacturer's rated capacity nor shall it exceed 80 per cent of the gross volume of the drum of the mixer

**C247.26 MAXIMUM MIXING TIME**

1. Where by reason of delay, it is necessary to hold a batch in the mixer, mixing may be continued for a maximum of ten (10) minutes except for split drum mixers where the maximum shall be five (5) minutes. **Batch in Mixer**

2. For longer periods, the batch may be held in the mixer and turned over at regular intervals, subject to the time limits specified for incorporation of the concrete into the work not being exceeded. **Long Delays**



**C247.27 CONSISTENCY**

- |    |   |                          |
|----|---|--------------------------|
| 1. | The consistency of the concrete shall be such as to allow the production of a dense, non-segregated mass with bleeding limited so as to prevent bleed water flowing over the slab edge under the conditions of placement. If bleed water does so flow, the Subdivider shall cease paving until the consistency of the mix is adjusted to prevent flow or the mix is redesigned and approved by the Certifying Engineer. The edge produced shall maintain its shape and shall not sag or tear. | <b>Requirements</b>      |
| 2. | The Subdivider shall provide all equipment, materials and labour for consistency testing and shall carry out tests in the presence of the Certifying Engineer. The cost of consistency testing shall be borne by the Subdivider.  | <b>Subdivider's Cost</b> |
| 3. | The consistency of the concrete shall be checked by use of a slump cone in accordance with AS 1012.3.1. The test shall be made on concrete samples obtained in accordance with AS 1012.1.   | <b>Test Method</b>       |
| 4. | Check tests shall be done on each truckload of concrete.  | <b>Check Tests</b>       |

**PLACING AND FINISHING CONCRETE SUBBASE**

**C247.28 GENERAL**

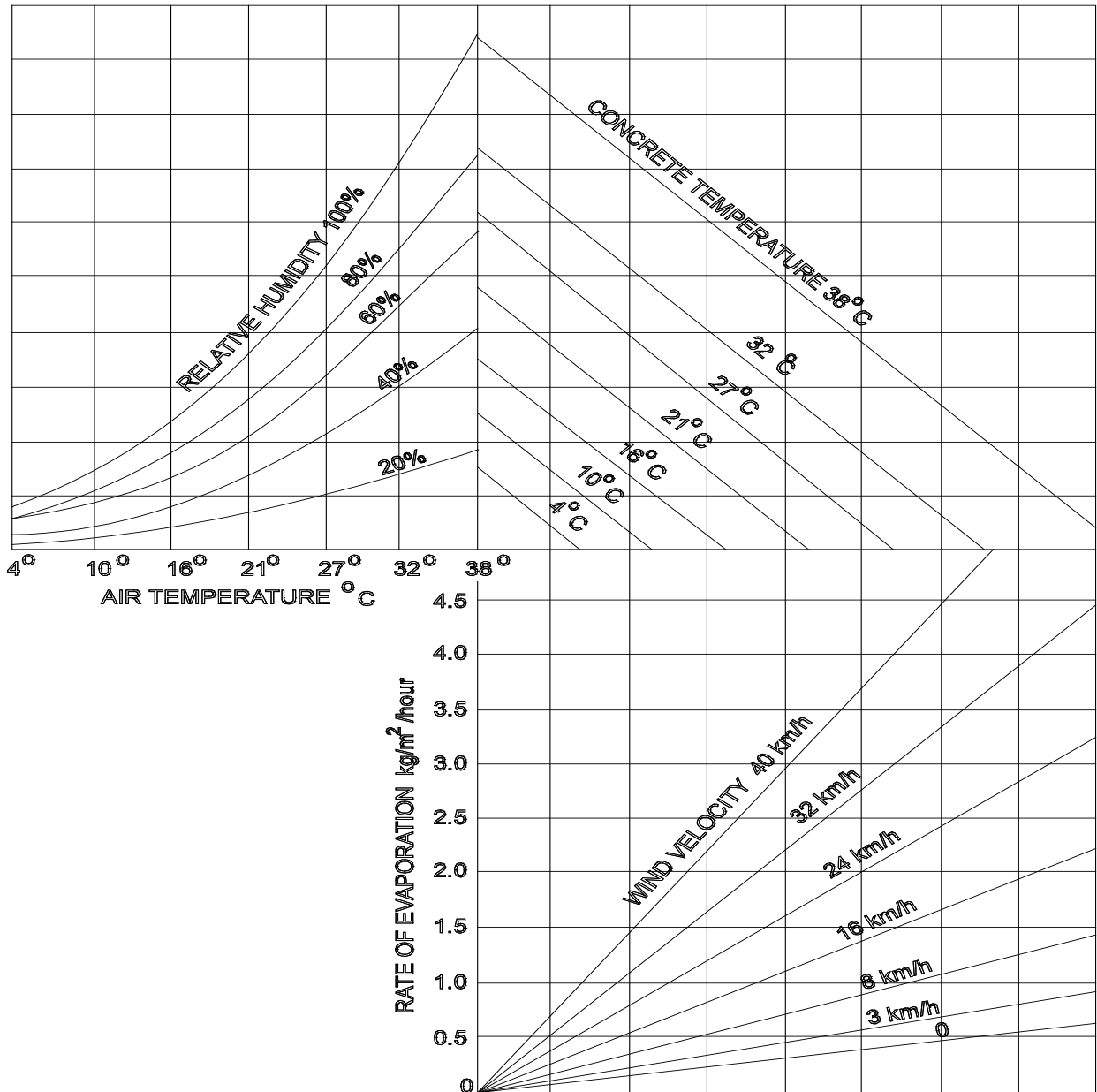
- |    |   |                                    |
|----|---|------------------------------------|
| 1. | At least one (1) week before commencing work under this Specification, the Subdivider shall submit as part of the Quality Plan, for the information of the Certifying Engineer, full details of the equipment and methods proposed for placing and finishing the concrete subbase together with a paving plan showing proposed paving widths, sequence and estimated daily outputs. | <b>Subdivider's Responsibility</b> |
| 2. | The Subdivider shall give the Certifying Engineer seven (7) days written notice of the intention to commence construction of the subbase on any section of work.  | <b>Written Notice</b>              |
| 3. | The surface on which concrete subbase is to be placed shall be clean and free of loose or foreign matter and in damp condition.   | <b>Surface Conditions</b>          |
| 4. | Concrete shall not be placed either during rain or when the air temperature in the shade is below 5°C or above 38°C.  | <b>Air Temperature Limits</b>      |
| 5. | The temperature of the concrete placed in the work shall be neither less than 10°C nor more than 32°C.  | <b>Concrete Temperature Limits</b> |

**C247.29 RATE OF EVAPORATION**

- |    |   |                             |
|----|---|-----------------------------|
| 1. | When the value of Rate of Evaporation, determined from the graph in Figure C247.1, exceeds 0.50 kilograms per square metre per hour the Subdivider shall take precautionary measures, satisfactory to the Certifying Engineer, for the prevention of excessive moisture loss. If, in the opinion of the Certifying Engineer, such precautionary measures prove to be unsatisfactory, the Subdivider shall cease work while the evaporation rate is in excess of 0.50 kilograms per square metre per hour. | <b>Evaporation Limit</b>    |
| 2. | The cost of such precautionary measures shall be borne by the Subdivider.   | <b>Subdivider's Cost</b>    |
| 3. | Should the Subdivider elect to use an evaporation retarder to prevent excessive moisture loss, application shall be by fine spray after all finishing operations, except minor manual bull-floating, are complete.  | <b>Evaporation Retarder</b> |

**MASS CONCRETE SUBBASE**

- 4. The Subdivider shall be responsible for measuring and recording concrete temperature and wind velocity at the point of concrete placement, and for continuously measuring and recording air temperature and relative humidity daily, at the site throughout the course of the work. The Subdivider shall provide and maintain all equipment and shall provide suitable personnel necessary for all such measuring and recording. **Subdivider's Responsibility**
  
- 5. The cost of providing and maintaining such equipment and providing such personnel shall be borne by the Subdivider. **Subdivider's Costs**



**Figure C247.1 - Rate of Evaporation**

The graph shows the effects of air temperature, humidity, concrete temperature and wind velocity together on the rate of evaporation of water from freshly placed and unprotected concrete.

Example:

- with air temperature at 27°C
- with relative humidity at 40%
- with concrete temperature at 27°C
- with a wind velocity of 26km/h the rate of evaporation would be 1.6 kg/m<sup>2</sup>/hour.

To determine the evaporation rate from the graph, enter the graph at the air temperature (in this case 27°C), and move vertically to intersect the curve for relative humidity encountered - here 40%. From this point move horizontally to the respective line for concrete temperature - here 27°C. Move vertically down to the respective wind velocity curve - in this case interpolating for 26km per hour - and then horizontally to the left to intersect the scale for the rate of evaporation.

**C247.30 MECHANICAL PAVING**

- |  |  |
|--|--|
| <p>1. The mechanical paver shall be a self-propelled machine with a gross operating mass of not less than 4 tonnes per lineal metre of paved width. It shall be capable of paving at a speed of one (1) metre per minute or less as required to enable the continuous operation of the paver and obtain the required degree of compaction. It shall include the following features:-</p> <p>(a) An automatic control system with a sensing device to control line and level to the specified tolerances.</p> <p>(b) Means of spreading the mix uniformly and regulating the flow of mix to the vibrators without segregation of the components.</p> <p>(c) Internal vibrators capable of compacting the full depth of the concrete.</p> <p>(d) Adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces.</p> <p>(e) Capability of paving in the slab widths or combination of slab widths and slab depths shown on the design plans.</p> | <p><b>Paving<br/>Machine<br/>Requirements</b></p>  |
| <p>2. The mechanical paver shall spread, compact, screed and finish the freshly placed concrete in such a manner that a minimum of finishing by hand will be required. A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.</p>  | <p><b>Concrete<br/>Finish</b></p>  |
| <p>3. Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.</p>  |  |
| <p>4. The supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train shall be in a smooth and firm condition.</p>   | <p><b>Supporting<br/>Surface</b></p>   |
| <p>5. Once spreading commences, the concrete paving operation shall be continuous. The mechanical paver shall be operated so that its forward progress shall not be stopped due to lack of concrete. If disruptions occur for any reason, the Certifying Engineer may direct that a construction joint be formed before the recommencement of paving operations. The cost of forming such construction joint shall be borne by the Subdivider.</p>   | <p><b>Continuity of<br/>Paving<br/>Operation</b></p> <p><b>Subdivider's<br/>Cost</b></p> |

**C247.31 HAND PLACING**

- |  |                        |
|--|------------------------|
| <p>1. Forms shall be so designed and constructed that they can be removed without damaging the concrete and shall be true to line and grade and braced in a substantial and unyielding manner. Forms shall be mortar tight and debonded to ensure non-adhesion of concrete to the forms.</p> | <p><b>Formwork</b></p> |
|--|------------------------|

## MASS CONCRETE SUBBASE

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|----|--|---|
| 2. | Concrete shall be delivered in agitator trucks and shall be deposited uniformly in the forms without segregation. The concrete shall be compacted by poker vibrators and by at least two (2) passes of a hand-guided vibratory screed traversing the full width of the slab on each pass. Any buildup of concrete between the forms and vibratory screed shall be prevented. | <b><i>Placing in Forms</i></b>              |
| 3. | If disruptions occur for any reason, the Certifying Engineer may direct that a construction joint be formed before the recommencement of paving operations. The cost of forming such construction joint shall be borne by the Subdivider.  | <b><i>Disruption, Subdivider's Cost</i></b> |
| 4. | A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided.   | <b><i>Concrete Finish</i></b>               |
| 5. | Surface texture shall be steel screed or float finish except that a hessian dragged finish shall be provided where the subbase is to be overlain by asphaltic concrete.  |   |

### C247.32 ALIGNMENT AND SURFACE TOLERANCES

#### (a) Horizontal Alignment Tolerance

- |    |  |   |
|----|--|---|
| 1. | The outer edges of the subbase shall be square to the subgrade and shall be constructed 50mm wider than the plan position of the base formation with a tolerance of $\pm 25$ mm. | <b><i>Outer Edge Location</i></b>             |
| 2. | Where an edge of a slab is to form a longitudinal construction joint line, the allowable horizontal alignment tolerances shall comply with Clause C247.36                        | <b><i>Longitudinal Construction Joint</i></b> |

#### (b) Surface Tolerances

- |    |   |                              |
|----|---|------------------------------|
| 1. | The level at any point on the top of the subbase shall not vary by more than 0mm above or 20mm below that shown on the design plans or as directed by the Certifying Engineer. Where the concrete is found to be above the level tolerance, it shall be removed. Where the concrete is found to be below level tolerance, it shall be made up with base concrete. | <b><i>Surface Levels</i></b> |
| 2. | The top surface of the subbase shall also not deviate from a 3m straightedge, laid in any direction, by more than 5mm.  | <b><i>Surface Levels</i></b> |

### C247.33 CURING

- |    |  |                                |
|----|--|--------------------------------|
| 1. | The subbase shall be cured by the use of one of the following:<br><br>(a) Chlorinated rubber curing compound complying with AS 3799 Class C Type 1D or resin-based curing compound complying with AS 3799 Class B, Type 1D or Type 2, if an asphalt base is used, or<br><br>(b) White pigmented wax emulsion curing compound complying with AS 3799 Class A Type 2, if a concrete base is used, or<br><br>(c) Bitumen emulsion Grade CRS/170 complying with AS 1160 for either asphalt or concrete base. | <b><i>Curing Compounds</i></b> |
| 2. | The Subdivider shall submit, for the information of the Certifying Engineer, a current Certificate of Compliance for the curing compound from an Australian Laboratory, approved by the Certifying Engineer, showing an Efficiency Index of not less than 90 per cent when tested in accordance with Appendix B of AS 3799.  | <b><i>Efficiency Index</i></b> |

- |    |  |                                 |
|----|--|---------------------------------|
| 3. | The curing compound shall be applied using a fine spray immediately following texturing at the rate stated on the Certificate of Compliance or at a minimum of 0.2 litres per square metre, whichever rate is the greater. Bitumen emulsion shall be applied at a minimum rate of 0.35 litres of residual bitumen per square metre. When applied with a hand lance the rates should be increased by 25 per cent. | <b><i>Application</i></b>       |
| 4. | The average application rate shall be checked by the Subdivider and certified to the Certifying Engineer by calculating the amount of curing compound applied to a measured area representative of a lot and nominated by the Certifying Engineer.   | <b><i>Application Rate</i></b>  |
| 5. | The curing membrane shall be maintained intact for seven (7) days after placing the concrete. Any damage to the curing membrane shall be made good by handspraying of the affected areas.  | <b><i>Curing Period</i></b>     |
| 6. | The cost of making good such damaged curing membrane shall be borne by the Subdivider.   | <b><i>Subdivider's Cost</i></b> |
| 7. | Equipment and materials for curing operations shall be kept on site at all times during concrete pours.  | <b><i>Equipment on Site</i></b> |

**C247.34 PROTECTION OF WORK**

- |    |   |  |
|----|---|--|
| 1. | The Subdivider shall ensure that the temperature of the concrete does not fall below 5°C during the first twenty-four (24) hours after placing. The Subdivider shall provide, for the information of the Certifying Engineer, details of procedures and equipment proposed to be used for the protection of sections recently placed in the event of low air temperatures. If the Subdivider fails to maintain the temperature of the concrete at or above 5°C and if, in the opinion of the Certifying Engineer, the concrete exhibits any deficiencies, due to failure to comply with this Specification, the concrete shall be rejected. | <b><i>Temperature Control</i></b>                  |
| 2. | The Subdivider shall protect the work from rain damage and shall provide, for the information of the Certifying Engineer, detailed proposals for procedures and equipment to be used for such protection.   | <b><i>Rain Protection</i></b>                      |
| 3. | Neither traffic nor construction equipment, other than that associated with testing, shall be allowed on the subbase until the strength of the subbase has reached at least 4.0MPa. Thereafter, only construction equipment necessary for the following operations shall be permitted to traffic the subbase:-  | <b><i>Traffic Restrictions</i></b>                 |
|    | (a) Bond-breaker and spall treatment and  |  |
|    | (b) Concrete or asphalt paving.   |  |
| 4. | Notwithstanding the above, any damage caused to the subbase by the Subdivider's operations shall be rectified to the Certifying Engineer's satisfaction. The cost of rectifying such damage to the subbase shall be borne by the Subdivider.  | <b><i>Damage Restoration Subdivider's Cost</i></b> |

## **JOINTS**

### **C247.35 TRANSVERSE CONSTRUCTION JOINTS**

1. Transverse construction joints shall:
  - (a) be provided only at discontinuities in the placement of concrete determined by the Subdivider's paving operations.
  - (b) be constructed normal to the edge line and to the dimensions shown on the design plans.
  - (c) not deviate from a 3m straightedge placed along the joint by more than 10mm.
  - (d) be smooth across the joint.

### **C247.36 LONGITUDINAL CONSTRUCTION JOINTS**

1. Longitudinal construction joints shall:
  - (a) be formed no closer than 300mm of the base longitudinal joints as shown in the design plans, unless directed otherwise by the Certifying Engineer.
  - (b) not deviate from the plan or nominated position at any point by more than 20mm.
  - (c) not deviate from a 3m straightedge placed along the joint by more than 10mm, having made due allowances for any planned curvature.
  - (d) be smooth across the joint.

## **BOND BREAKER AND SPALL TREATMENT**

### **C247.37 GENERAL**

1. Subbase to be covered by concrete base shall be provided with a wax emulsion bond breaker. The wax emulsion shall comply with AS 3799 Class A Type 2. ***Bond Breaker***
2. Where the base consists of asphaltic concrete, no bond breaker shall be used. In this case bond is essential and wax emulsion curing compounds shall not be permitted. ***No Bond Breaker***
3. Subbase with spalled areas shall be treated, where directed by the Certifying Engineer, prior to application of the bond breaker or asphaltic concrete. ***Spalled Areas***

### **C247.38 PREPARATION OF SUBBASE**

1. Immediately prior to any spalled area treatment and the application of bond breaker, the subbase surface shall be cleaned to the satisfaction of the Certifying Engineer of all loose, foreign and deleterious material. ***Subbase Preparation***

**C247.39 TREATMENT OF SPALLING**

1. Where directed by the Certifying Engineer, spalled areas shall be treated before the application of the bitumen bond breaker or asphaltic concrete by infilling with 6:1 sand/cement mortar to provide a surface flush with the surrounding concrete. The area shall be wetted and sprinkled with neat cement before screeding the mortar into the patches. **Method**
2. A spalled area, if directed to be treated, shall have such treatment completed no earlier than five (5) working days before the application of the bond breaker. Treated spalled areas damaged by the Subdivider or others shall be made good by the Subdivider. **Spalling Repair Time**
3. The cost of making good treated spalled areas which have been damaged shall be borne by the Subdivider. **Subdivider's Cost**

**C247.40 APPLICATION OF BOND BREAKER**

1. The wax emulsion used as bond breaker should be the same as used for curing compound. This second application shall be applied at a minimum rate of 0.2 litres per square metre and not earlier than 72 hours before the placement of the base concrete. **Wax Emulsion**
2. The method of application shall conform to the requirements of Clause C247.33.

**C247.41 TREATMENT OF UNPLANNED CRACKS**

1. The Certifying Engineer shall direct treatment of unplanned cracks whose width exceeds 0.3mm. This may take the form of applying an approved 300mm minimum width geotextile backed polymer modified bitumen strip (reference AUSTRROADS Guide to Geotextiles) over the crack prior to placement of the first asphalt base layer or concrete base, or an extra application of wax emulsion for a width of 300mm along the crack when a concrete base is required.
2. The Subdivider shall install the Stress Alleviating Membrane strip in accordance with the manufacturer's instructions.

**SUBGRADE BEAMS****C247.42 GENERAL**

1. Subgrade beams shall be provided below the subbase at expansion joints and isolation joints in the concrete base as shown in the design plans or as directed by the Certifying Engineer. They shall extend the full length of joints unless otherwise indicated on the design plans. **Scope**

**C247.43 EXCAVATION**

1. Excavation for subgrade beams shall be to the dimensions shown on the design plans. All loose material shall be removed and the vertical faces trimmed to neat lines. The bottom of the trench shall be recompacted, where required, to the degree of consolidation of the adjacent undisturbed material. **Excavation Standards**
2. Excavated material shall be legally disposed of by the Subdivider. **Disposal of Excavated Materials**

## MASS CONCRETE SUBBASE

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### C247.44 CONCRETE

1. Concrete in subgrade beams shall comply with the requirements of the Specification for MINOR CONCRETE WORKS. The minimum compressive strength at 28 days shall be 32MPa. **Compressive Strength**

### C247.45 STEEL REINFORCEMENT

1. Steel reinforcement shall be of the type and size shown on the design plans and shall be supplied and installed in accordance with the Specification for PLAIN OR REINFORCED CONCRETE BASE. **Type and Size**

### C247.46 CONSTRUCTION AND PROTECTION

1. Subgrade beams shall be constructed before construction of the subbase. The top surface of the subgrade beam shall be level with the top of the subgrade. Any loose subgrade material shall be recompact to the correct level. If the Subdivider elects to remove any loose material, the voids shall be filled with mortar or concrete and screeded to provide a surface flush with the top of the subgrade beam and the surrounding subgrade. **Timing and Type of Finish**
2. A steel float shall be used to produce a smooth surface finish, free of any texture.
3. The subgrade beams shall be protected from damage by plant, motor vehicles and the paving operation. Any damage shall be made good by the Subdivider. The cost of making good such damage to the subgrade beams shall be borne by the Subdivider. **Damage Protection Subdivider's Cost**

### C247.47 CURING

1. The top surface of the subgrade beam shall be cured in accordance with Clause C247.33 before placing the subbase. **Curing**

### C247.48 BOND BREAKER

1. The top surface of the subgrade beam shall be treated with a bond breaker which shall consist of a further application of curing compound neither less than twenty-four (24) hours nor more than seventy-two (72) hours before placing of subbase concrete. **Time of Placement**

### C247.49 RESERVE



**LIMITS AND TOLERANCES**

**C247.50 SUMMARY OF LIMITS AND TOLERANCES**

1. The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C247.4 below:

<b>Item</b>	<b>Activity</b>	<b>Limits/Tolerances</b>	<b>Spec Clause</b>
1.	<b>Materials for Concrete</b>		
	a. Misshapen Particles	2 : 1 ratio < 35 percent	C247.09a
	b. Aggregates Grading	Deviation from submitted sample not greater than Table C247.1	C247.09b
	c. Durability	Wet Strength > 50 kN 10% Fines < 35 percent	C247.09c
2.	<b>Concrete</b>		
	a. Shrinkage	Drying Shrinkage <450 microstrain	C247.12
	b. Consistency	Mechanically placed: >25mm<40mm Hand Placed: >50mm <65mm	C247.13
	c. Air Content	≥3, ≤7 percent	C247.14
	d. Thickness	Concrete shall be removed if thickness >20mm below specified thickness.	C247.21
	e. Mixing and Transport	After addition of cement to the aggregate, concrete shall be incorporated into the work within: (i) One and a half (1.5) hours where transported by truck mixer or agitator. (ii) One (1) hour where transported by non agitating trucks.	C247.25
	f. Placing	Concrete shall not be placed when the air temperature in the shade is less than 5°C or >38°C. Temperature of concrete shall be >10°C but <32°C.	C247.28
		Concrete shall not be placed when the Rate of Evaporation exceeds 0.5kg per square metre per hour.	C247.29
3.	<b>Alignment and Surface Tolerances</b>		
	a. Horizontal Alignment	Outer edges not to deviate from plan position by more than ±25mm.	C247.32

## MASS CONCRETE SUBBASE

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Item	Activity	Limits/Tolerances	Spec Clause
	b. Surface	Level on top surface to be no more than +0mm or -20mm to that shown on the design plans.	C247.32
		The top surface shall not deviate from a 3m straightedge laid in any direction by more than 5mm.	C247.32
4.	<b>Joints</b>		
	a. Transverse Construction	Shall not deviate from a 3m straight-edge placed along the joint by more than 10mm.	C247.35
	b. Longitudinal Joint	(i) Shall not deviate from the plan or nominated position at any point by more than 20mm.  (ii) Shall not deviate from a 3m straightedge placed along the joint by more than 10mm after allowing for any curvature.	C247.36
5.	<b>Bond Breaker</b>		
	a. Wax Emulsion	Minimum 0.2 litres per square metre, not earlier than 72 hours before placement of base.	C247.40

**Table C247.4 - Summary of Limits and Tolerances**

### SPECIAL REQUIREMENTS

**C247.51 RESERVED**

**C247.52 RESERVED**

**C247.53 RESERVED**

**C247.54 RESERVED**

**C247.55 RESERVED**

**C247.56 RESERVED**