DEVELOPMENT CONSTRUCTION SPECIFICATION

C247

MASS CONCRETE SUBBASE

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
Original	*Northern Rivers - Local Government Version*	*All*	*Original Edition*	*LCC*	*January 1999*
1	Major Revision as per Aus-Spec Bulletin Board Release 10	All	AMO	SPM	April 2003
2	Revisions as per Aus-Spec Bulletin Board releases 11 & 12	All	AMO	SPM	April 2003
3	Reference Documents	C247.04	M	MR	August 2013

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SPECIFICATION C247
MASS CONCRETE SUBBASE

GENERAL

C247.01 SCOPE

1. The work to be executed under this Specification consists of the construction, by mechanical or hand placement of mass concrete subbase including trial sections and subgrade beams to the dimensions and levels shown on the Drawings and in accordance with the provisions of the project.

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***

C247.02 THICKNESS AND LEVELS OF SUBBASE

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

C247.03 PROVISION FOR BASE SLAB ANCHORS

1. During construction of the subbase, in advance of concrete base construction the Contractor shall make provision to permit construction of base slab anchors at the locations and to the dimensions shown on the Drawings. 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	-	Methods of testing concrete - Sampling of fresh concrete.
AS 1012.3	-	Methods of testing concrete - Determination of properties related to the consistence of concrete.
AS 1012.4.2	-	Methods of testing concrete - Determination of air content of freshly mixed concrete. Measuring reduction in air pressure in chamber above concrete
AS 1012.8	-	Methods of testing concrete – Methods of making and curing concrete compression, indirect tensile and flexure test specimens, in the laboratory or in the field.
AS 1012.9	-	Methods of testing concrete - Determination of the compressive strength of concrete specimens.
AS 1012.13	-	Methods of testing concrete - Determination of the drying shrinkage of concrete for samples prepared in the field or laboratory.
AS 1012.14	-	Methods of testing concrete – Methods for securing and

testing cores from hardened concrete for compressive strength.

AS 1141.11 - Methods for sampling and testing aggregates - Particle size distribution by sieving.

AS 1141.14 - Methods for sampling and testing aggregate - Particle shape, by proportional calliper.

AS 1141.22 - Methods for sampling and testing aggregates - Wet/dry strength variation.

AS 1160 - Bitumen emulsions for construction and maintenance of pavements.

AS 1379 - Specification and supply of concrete

AS 1478.1 - Chemical admixtures for concrete, mortar and grout – Admixtures for concrete.

AS 2758.1 - Aggregates and rock for engineering purposes - Concrete aggregates.

AS 3582.1 - Supplementary cementitious materials for use with Portland and blended cement – Fly ash.

AS 3799 - Liquid membrane - forming curing compounds for concrete.

AS 3972 - General purpose and blended cements.

(c) RMS Test Methods

T 321 - Dry Shrinkage of 100 x 100 x 280mm Concrete Prisms.

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. ***NSW QA Scheme***

2. When submitting details of the nominated mix in accordance with Clause C247.15 the Contractor shall nominate the brand and source of the cement. On approval of a nominated mix by the P.C.A., the Contractor shall use only the nominated cement in the work. ***Nominated Brand and Source***

3. Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Superintendent upon request at any stage of the work. ***Proof of Quality***

4. If the Contractor proposes to use cement which has been stored for a period in excess of three months from the time of manufacture, the Superintendent 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 Contractor. ***Storage Time*** ***Contractor's Cost***

5. Cement shall be transported in watertight containers and shall be protected from moisture until used. Caked or lumpy cement shall not be used. ***Transport and Storage***

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. ***NSW QA Scheme***

2. When submitting details of the nominated mix in accordance with Clause C247.15, the Contractor shall nominate the powerhouse source of the flyash. On approval of a nominated mix by the P.C.A., the Contractor shall use only flyash from the nominated powerhouse. ***Source***

3. Documentary evidence of the quality and source of the flyash shall be furnished by the Contractor to the Superintendent 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 P.C.A., 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 Superintendent, 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 Contractor 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 Contractor shall nominate the proprietary source, type and name of each admixture to be used. Documentary evidence of the quality shall be furnished by the Contractor to the Superintendent 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 Contractor 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 37.5 mm 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 Contractor shall submit to the Superintendent 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 Contractor proposes to blend two or more aggregates to provide the Proposed Grading the Test Reports for each constituent material shall be submitted separately and the Superintendent 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 Superintendent, 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 Superintendent. ***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 AS1012.9. 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

Shrinkage Limit

1. The drying shrinkage of the nominated mix, determined by AS1012.13 shall not exceed 450 microstrain after three weeks air drying. The drying shrinkage at the nominated slump plus 10 mm shall be taken as the average of the reading or readings within 5 per cent of the median of the three readings obtained in accordance with AS1012.13.

C247.13 CONSISTENCY

Slump Tolerances

1. The Contractor's nominated slump, determined in accordance with AS 1012.3, Method 1, shall be neither less than 25 mm nor more than 40 mm for mechanically placed concrete and shall be neither less than 50 mm nor more than 65 mm for hand placed concrete.

C247.14 AIR CONTENT

Air Content Tolerances

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.

DESIGN AND CONTROL OF CONCRETE MIXES

C247.15 GENERAL

Nominated Mix

1. The Contractor shall submit, for approval by the P.C.A., 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'.

Certificate of Compliance with Specification

2. The Contractor 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 month period before the date of submission to the Superintendent.

Compressive Strength Determination

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 AS1012.9. Each of the results shall be based on three specimens of concrete produced from a batch of the nominated mix. The compressive strength shall be the average of individual results within 1.0 MPa of the median.

Submission of Details

4. These details shall be submitted at least 21 days before using the nominated mix in the work.

C247.16 VARIATIONS TO APPROVED MIXES

Approval required to vary mix

1. The Contractor 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 P.C.A..

Contractor's Responsibility

2. Where changes to an approved mix are proposed, the Contractor shall provide details of the nominated mix and materials, in accordance with Clause C247.15. If the variations to the quantities of the constituents in the approved mix are less than 10 kilograms for Portland cement, 20 kilograms for other cementitious material and 5 per cent by mass for each other constituent, except admixtures, per yielded cubic metre of concrete, the Superintendent may approve the changes without new trials being carried

out.

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. ***Minimum Constituent Quantities***

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 Contractor 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 Superintendent. ***Contractor's Responsibility***

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. ***Sampling***

3. The method of making and curing specimens shall be in accordance with AS 1012.8 with compaction by internal vibration.

4. The Contractor shall mark the specimens for identification purposes. ***Marking***

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 Contractor. ***Contractor's Costs***

(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 days.

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

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

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

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

For each lot of up to 50 cubic metres of concrete placed at the one time:	One 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 sample shall be the average compressive strength of the two specimens. ***Determination of Strength***

2. At the time of approving the mix design, the Superintendent 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

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. ***Limits***

2. The cost of removal of rejected concrete, including its disposal from the site, shall be borne by the Contractor. ***Contractor's Cost***

3. In case of non-conformance the Contractor may request permission of the Superintendent 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 Superintendent. 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 Contractor. 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. ***Non-conformance and Coring***

C247.19 SPECIMENS CUT FROM THE WORK

1. Specimens cut from the work shall be tested in a NATA registered laboratory nominated by the Contractor. Specimens shall be in the form of cylindrical cores of hardened concrete. ***Test Specimens***

2. Cores shall be secured, accepted, cured, capped and tested in accordance with AS 1012. 14 with the following amendments:- ***Specimen Characteristics***

(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.

(b) The preferred dimension for cores shall be 100 mm diameter but in no case shall the diameter be less than 75 mm or two and one half times the nominal size of the coarse aggregate, whichever is the greater.

(c) When inspected in the uncapped state, cores shall be rejected if any diameter departs by more than 5 mm 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.

Length/Diameter Ratio	Correction Factor
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 C248.5 - Correction Factors

3. Core cutting shall be carried out by the Contractor in the presence of and at the locations nominated by the Superintendent. 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 consecutive construction joints whichever is the lesser. The lot represented by each core shall be nominated by the Contractor 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 Contractor. The method of restoration shall be approved by the Superintendent. ***Cutting Cores Contractor's Cost***

6. The cost of core preparation for testing, curing and testing shall be borne by the Contractor. ***Testing Contractor'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 Contractor. ***Contractor'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 Superintendent 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 Superintendent 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 Contractor. ***Remove and Replace***

2. Subbase which is 20mm or less below the theoretical thickness may be accepted by the Superintendent providing that it represents isolated sections within a lot and such sections comprise less than 10 per cent of the area of the lot. ***Acceptance***

PRODUCTION, TRANSPORT AND CONSISTENCY OF CONCRETE

C247.22 PRODUCTION AND TRANSPORT OF CONCRETE

1. At least four weeks before commencing work under this Specification, the Contractor shall submit, for the information of the Superintendent, details of the proposed methods of handling, storing and batching materials for concrete, details of proposed mixers and methods of agitation, mixing and transport. ***Contractor'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 Superintendent, as evidence of the accuracy of the scales.

(b) Cementatious 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 Superintendent, except for liquids which may be measured by volume or flow rate meter.

C247.24 MIXERS AND AGITATION EQUIPMENT

Requirements

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.

C247.25 MIXING AND TRANSPORT

Methods

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

(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 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 hours, where transported by truck mixer or agitator

(ii) One hour, where transported by non-agitating trucks

Means of verification, satisfactory to the Superintendent, 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 Superintendent 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

Batch in Mixer

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 minutes except for split drum mixers where the maximum shall be five minutes.

Long Delays

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.

C247.27 CONSISTENCY

Requirements

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

Contractor shall cease paving until the consistency of the mix is adjusted to prevent flow or the mix is redesigned and approved by the Superintendent. The edge produced shall maintain its shape and shall not sag or tear.

2. The Contractor shall provide all equipment, materials and labour for consistency testing and shall carry out tests in the presence of the Superintendent. The cost of consistency testing shall be borne by the Contractor. ***Contractor's Cost***

3. The consistency of the concrete shall be checked by use of a slump cone in accordance with AS 1012.3, Method 1. The test shall be made on concrete samples obtained in accordance with AS 1012.1. ***Test Method***

4. Check tests shall be done on each truckload of concrete. ***Check Tests***

PLACING AND FINISHING CONCRETE SUBBASE

C247.28 GENERAL

1. At least four weeks before commencing work under this Specification, the Contractor shall submit as part of the Quality Plan, for the information of the Superintendent, 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. ***Contractor's Responsibility***

2. The Contractor shall give the Superintendent seven days written notice of the intention to commence construction of the subbase on any section of work (including the placement of the trial subbase in accordance with Clause C247.49). ***Written Notice***

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. ***Surface Conditions***

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. ***Air Temperature Limits***

5. The temperature of the concrete placed in the work shall be neither less than 10°C nor more than 32°C. ***Concrete Temperature Limits***

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 Contractor shall take precautionary measures, satisfactory to the Superintendent, for the prevention of excessive moisture loss. If, in the opinion of the Superintendent, such precautionary measures prove to be unsatisfactory, the Contractor shall cease work while the evaporation rate is in excess of 0.50 kilograms per square metre per hour. ***Evaporation Limit***

2. The cost of such precautionary measures shall be borne by the Contractor. ***Contractor's Cost***

3. Should the Contractor 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. ***Evaporation Retarder***

4. The Contractor 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 Contractor shall provide and maintain all equipment and shall provide suitable personnel necessary for all such measuring and recording. ***Contractor's Responsibility***

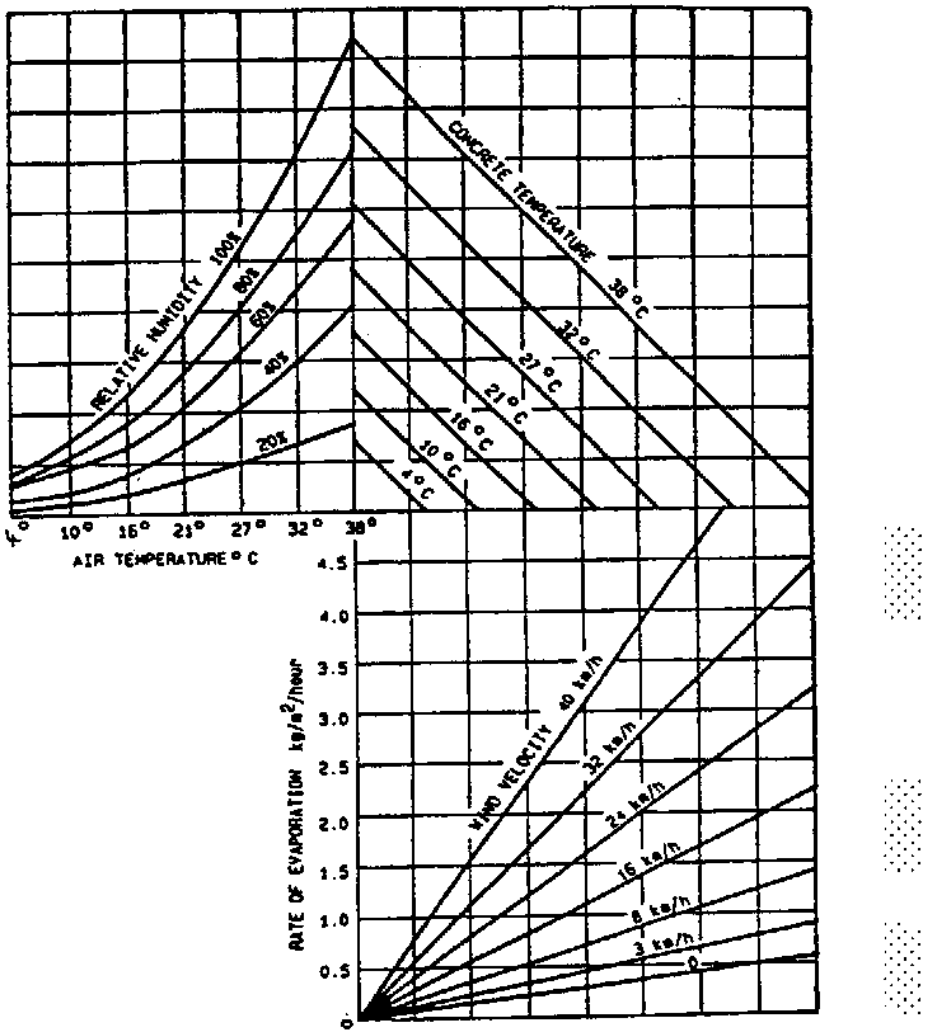

Figure C247.1 - Rate of Evaporation

5. The cost of providing and maintaining such equipment and providing such personnel shall be borne by the Contractor. ***Contractor's Costs***

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^2/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

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 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 ***Paving Machine Requirements***

following features:-

(a) An automatic control system with a sensing device to control line and level to the specified tolerances.

(b) Means of spreading the mix uniformly and regulating the flow of mix to the vibrators without segregation of the components.

(c) Internal vibrators capable of compacting the full depth of the concrete.

(d) Adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces.

(e) Capability of paving in the slab widths or combination of slab widths and slab depths shown on the Drawings.

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. ***Concrete Finish***

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.

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. ***Supporting Surface***

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 Superintendent 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 Contractor. ***Continuity of Paving Operation*** ***Contractor's Cost***

C247.31 HAND PLACING

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. ***Formwork***

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 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. ***Placing in Forms***

3. If disruptions occur for any reason, the Superintendent 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 Contractor. ***Disruption, Contractor's Cost***

4. A dense and homogeneous concrete with a surface exhibiting low permeability shall be provided. ***Concrete Finish***

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 ✂25mm. ***Outer Edge Location***

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 ***Longitudinal Construction Joint***

(b) Surface Tolerances

1. The level at any point on the top of the subbase shall not vary by more than 0 mm above or 20 mm below that shown on the Drawings or as directed by the Superintendent. 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. ***Surface Levels***

2. The top surface of the subbase shall also not deviate from a 3 m straightedge, laid in any direction, by more than 5 mm. ***Surface Levels***

C247.33 CURING

1. The subbase shall be cured by the use of one of the following: ***Curing Compounds***

   (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

   (b) White pigmented wax emulsion curing compound complying with AS 3799 Class A Type 2, if a concrete base is used, or

   (c) Bitumen emulsion Grade CRS/170 complying with AS 1160 for either asphalt or concrete base.

2. The Contractor shall submit, for the information of the Superintendent, a current Certificate of Compliance for the curing compound from an Australian Laboratory, approved by the Superintendent, showing an Efficiency Index of not less than 90 per cent when tested in accordance with Appendix B of AS 3799. ***Efficiency Index***

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. ***Application***

4. The average application rate shall be checked by the Contractor and certified to the Superintendent by calculating the amount of curing compound applied to a measured area representative of a lot and nominated by the Superintendent. ***Application Rate***

5. The curing membrane shall be maintained intact for seven days after placing the concrete. Any damage to the curing membrane shall be made good by handspraying of the affected areas. ***Curing Period***

6. The cost of making good such damaged curing membrane shall be borne by the Contractor. ***Contractor's Cost***

7. Equipment and materials for curing operations shall be kept on site at all times during concrete pours. ***Equipment on Site***

C247.34 PROTECTION OF WORK

1. The Contractor shall ensure that the temperature of the concrete does not fall below 5°C during the first twenty-four hours after placing. The Contractor shall provide, for the information of the Superintendent, 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 Contractor fails to maintain the temperature of the concrete at or above 5°C and if, in the opinion of the Superintendent, the concrete exhibits any ***Temperature Control***

deficiencies, due to failure to comply with this Specification, the concrete shall be rejected.

2. The Contractor shall protect the work from rain damage and shall provide, for the information of the Superintendent, detailed proposals fro procedures and equipment to be used for such protection. ***Rain Protection***

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 4.0 MPa. Thereafter, only construction equipment necessary for the following operations shall be permitted to traffic the subbase:- ***Traffic Restrictions***

(a) Bond-breaker and spall treatment and

(b) Concrete or asphalt paving.

4. Notwithstanding the above, any damage caused to the subbase by the Contractor's operations shall be rectified to the Superintendent's satisfaction. The cost of rectifying such damage to the subbase shall be borne by the Contractor. ***Damage Restoration Contractor's Cost***

JOINTS

C247.35 TRANSVERSE CONSTRUCTION JOINTS

1. Transverse construction joints shall:

- be provided only at discontinuities in the placement of concrete determined by the Contractor's paving operations.
- be constructed normal to the edge line and to the dimensions shown on the Drawings.
- not deviate from a 3 m straightedge placed along the joint by more than 10 mm.
- be smooth across the joint.

C247.36 LONGITUDINAL CONSTRUCTION JOINTS

1. Longitudinal construction joints shall:

- be formed no closer than 300mm of the base longitudinal joints as shown in the Drawings, unless directed otherwise by the Superintendent.
- not deviate from the plan or nominated position at any point by more than 20 mm.
- not deviate from a 3 m straightedge placed along the joint by more than 10 mm, having made due allowances for any planned curvature.
- 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 Superintendent, 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 Superintendent of all loose, foreign and deleterious material. ***Subbase Preparation***

C247.39 TREATMENT OF SPALLING

1. Where directed by the Superintendent, 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 working days before the application of the bond breaker. Treated spalled areas damaged by the Contractor or others shall be made good by the Contractor. ***Spalling Repair Time***

3. The cost of making good treated spalled areas which have been damaged shall be borne by the Contractor. ***Contractor'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 Superintendent 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 AUSTROADS 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 Contractor 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 Drawings or as directed by the Superintendent. They shall extend the full length of joints unless otherwise indicated on the Drawings. ***Scope***

C247.43 EXCAVATION

1. Excavation for subgrade beams shall be to the dimensions shown on the Drawings. 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 ***Excavation Standards***

consolidation of the adjacent undisturbed material.

2. Excavated material shall be legally disposed of by the Contractor. ***Disposal of Materials***

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 Drawings 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 recompacted to the correct level. If the contractor 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 Contractor. The cost of making good such damage to the subgrade beams shall be borne by the Contractor. ***Damage Protection***

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 hours nor more than seventy-two hours before placing of subbase concrete. ***Time of Placement***

TRIAL CONCRETE SUBBASE

C247.49 GENERAL

1. Before the commencement of paving, the Contractor shall construct a trial section of concrete subbase on the carriageway to demonstrate to the Superintendent the Contractor's capability of constructing subbase in accordance with the Specification. This section shall be constructed so that it may be incorporated in the finished work. ***Location***

2. The trial subbase shall be constructed using the same materials, concrete mix, equipment and methods the Contractor intends to use for the remaining subbase work. The Contractor shall demonstrate the methods proposed to be used for texturing, the application of curing compound and the construction of joints. ***Purpose***

3. The trial shall also be used to demonstrate that the Contractor's allowances for concrete strength, compaction and slab thickness are adequate to achieve the minimum ***Quality Parameters***

requirements specified.

4. A trial length of between 100m and 200m or lesser length in compliance with Council requirements for mechanical paving equipment or between 20m and 50m for hand placement is required. The trial length shall be the maximum width proposed to be laid, and shall be constructed in one continuous operation. ***Dimensions***

5. Unless advised by the Superintendent of any deficiencies in the trial concrete subbase, due to failure to comply with this Specification, the Contractor may proceed with placing concrete subbase from a time five working days after the completion of the trial concrete subbase or such earlier time as the Superintendent may allow. In the event of deficiencies in the trial concrete subbase, the Superintendent may order the Contractor to construct a further length of trial concrete subbase which shall be treated as the first. If, after three trials, the subbase still is deficient in some way, the Superintendent may require the Contractor to justify to the satisfaction of the Superintendent why the work should be allowed to continue using that method and/or equipment and/or materials and/or personnel. ***Deficiencies in Trial Section***

6. The Superintendent shall have the right to call for a new trial section at any stage of work under the contract when changes by the Contractor in the equipment, materials, mix, plant or rate of paving are deemed by the Superintendent to warrant such procedure or when concrete as placed does not comply with this Specification. ***New Trial Section***

7. Trial concrete subbase, which does not comply with the Specification, shall be rejected by the Superintendent and shall be removed and disposed from the site by the Contractor. ***Payment***

8. The cost of removal of rejected trial concrete subbase and the cost of making good any damage caused by such removal to the subgrade or subgrade beams shall be borne by the Contractor. ***Contractor's Cost***

LIMITS AND TOLERANCES

C247.50 SUMMARY OF LIMITS AND TOLERANCES

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

Item	Activity	Tolerances	Spec Clause
1.	**Materials for Concrete**		
	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.	**Concrete**		
	a. Shrinkage	Drying Shrinkage <450 microstrain	C247.12
	b. Consistency	Mechanically placed: >25mm<40mm Hand Placed: >50mm <65mm	C247.13

Item	Activity	Tolerances	Spec Clause
	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 hours where transported by truck mixer or agitator. (ii) One 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.	**Alignment and Surface Tolerances**		
	a. Horizontal Alignment	Outer edges not to deviate from plan position by more than ✂<25mm.	C247.32
	b. Surface	Level on top surface to be no more than +0mm or -20mm to that shown on the drawings.	C247.32
		The top surface shall not deviate from a 3m straightedge laid in any direction by more than 5mm.	C247.32
4.	**Joints**		
	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.	**Bond Breaker**		
	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