FNQROC DEVELOPMENT MANUAL

SPECIFICATION

S3

SEGMENTAL PAVING

Version No. 11/19

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GENERAL

S3.01 SCOPE

1. This specification details all matters pertaining to the construction of both clay and concrete segmental paving for road pavements, medians, traffic islands, driveways, cycleways, footpaths and other pedestrian areas.

2. Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

S3.02 REFERENCE DOCUMENTS

Note: Where *Acts* or reference documents are updated, reference should be made to the current version.

Australian Standards

- AS 1012 Methods of Testing Concrete
- AS 1141.11 Particle size distribution by dry sieving
- AS/NZS 4455 Masonry units and segmental pavers
- AS/NZS 4456 Masonry units and segmental pavers - Methods of test - General introduction and list of methods

Concrete Masonry Association of Australia Specifications

- PA03 - Concrete Segmental Pavements - Guide to Specifying
- PA02 - Concrete Segmental Pavements - Design Guide for Residential Access Ways and Roads
- PA01 - Concrete Segmental Pavements - Detailing Guide

Think Brick Australia

- Clay Paving Manual
- Construction Guidelines for Clay Masonry

MATERIALS

S3.03 CONCRETE SEGMENTAL PAVERS

1. Concrete segmental pavers are units of not more than 0.10 square metres in gross plan area, manufactured from concrete, with plain or dentated sides, with top and bottom faces parallel and with or without chamfered edges.

2. Concrete pavers are identified by shape as being one of the following types:

   Shape Type A

   Dentated chamfered units which key into each other on four sides, are capable of being laid in herringbone bond, and by their plan geometry, when interlocked, resist the spread of joints parallel to both the longitudinal and transverse axes of the units.

   Shape Type B

   Dentated units which key into each other on two sides, are not (usually) laid in herringbone bond, and by their plan geometry, when keyed together, resist the spread of joints parallel to the longitudinal axes of the units and rely on their dimensional accuracy and accuracy of laying to interlock on the other faces.

   Shape Type C

   Units which do not key together and which rely on their dimensional accuracy and accuracy of laying to develop interlock.

3. Figure S3.1 shows examples of some of the more common shapes.

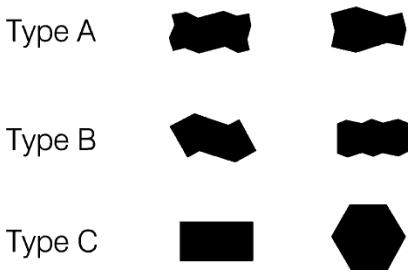


Figure S3.1 Paver Shape Types

4. Concrete segmental pavers shall comply with the requirements of PA03, PA02, PA01, and AS/NZS 4455 for each area of application.

5. The material requirements for concrete pavers for each application, derived from PA03, are shown in Table S3.1.

6. The pavers shall meet the requirements for the relevant application given in Table S3.1 when tested in accordance with the test methods outlined in AS/NZS 4456.

Table S3.1 Material Requirements for Concrete Segmental Pavers

Application	Characteristic breaking load [2] (kN)	Characteristic flexural strength[2] (MPa)	Minimum Thickness (mm)	Shape[3] (Type)	Dimensional deviations (Category - AS 4455)	Abrasion resistance (mean abrasion index)
Residential Driveways						
Light Traffic	3	2	No limit	Any	DPA1 or DPB1	7
Medium Traffic[1]	5	3	No limit	Any	DPA1 or DPB1	7
Public Footpaths						
Low Volume	5	3	No limit	Any	DPB2	5
High Volume and Pedestrian Malls[1]	5	3	No limit	Any	DPB2	3.5
Roads[3]						
All Roads	5	3	80	A	DPB2	5

Notes:

1. Capable of taking occasional 8.2-t axle loads.
2. At 28 days.
3. Interlocking shapes offer superior performance in road applications.

S3.04 CLAY SEGMENTAL PAVERS

1. Clay pavers are manufactured from clay, shale or argillaceous materials, which may be mixed with additives. Clay pavers may have square, bevelled (chamfered), rounded or rumbled edges. They are generally rectangular in shape, with the length twice the width, plus 2mm.

2. Clay segmental pavers shall comply with the requirements of Clay Paving Manual and Construction Guidelines for Clay Masonry and with the requirements of AS/NZS 4455.

3. Laying patterns of pavers are identified as being Herringbone, Basket weave, or Stretcher as shown in Annexure A. Each of these may be laid at either 90^{o} or 45^{o} to the line of edge restraints. A variation of Stretcher is the Zig Zag Running Bond, also shown in Annexure A.

S3.05 BEDDING SAND

1. The bedding sand shall be well graded sand, consisting of clean, hard, uncoated grains uniform in quality, generally passing a 4.75mm sieve and shall conform with the grading limits specified in Table S3.2.

Table S3.2 Bedding Sand – Grading Limits

AS Metric Sieve (mm)	% Passing
9.52	100
4.75	95 - 100
2.36	80 - 100
1.18	50 - 85
0.600	25 - 60
0.300	10 – 30
0.150	5 – 15
0.075	0 -10

2. The sand shall be of uniform moisture content when spread. It shall be covered when stored on site to protect it from rain penetration.

3. The bedding sand shall be free of deleterious soluble salts or other contaminants, which may cause, or contribute to, efflorescence.

S3.06 JOINT FILLING SAND

1. The joint filling sand shall be well graded passing a 2.36mm sieve, and shall conform with the grading limits specified in Table S3.3.

Table S3.3 Joint Filling Sand – Grading Limits

AS Metric Sieve (mm)	% Passing
2.36	100
1.18	90 - 100
0.600	60 - 90
0.300	30 - 60
0.150	15 - 30
0.075	5 - 10

2. The sand shall be dry when spread. It shall be covered when stored on site to protect it from rain penetration.

3. The sand shall be free of deleterious soluble salts or other contaminants, which may cause, or contribute to, efflorescence.

4. Sand used for bedding is not suitable for joint filling.

S3.07 CONCRETE FOR EDGE RESTRAINTS

1. Concrete supplied and placed for the construction of edge strips shall comply with the Specification for S7 CONCRETE WORKS.

2. Unless otherwise indicated on the Project Drawings, or where the edge restraint is provided by kerb and / or channel, the concrete used for edge restraints shall have a minimum 28-day characteristic compressive strength of 25MPa for edge restraints to pavers on road pavements and 20MPa for edge restraints to pavers on footpaths, bikeways, and medians.

CONSTRUCTION

S3.08 PAVER TYPE, SHAPE, CLASS AND LAYING PATTERN

1. The choice of concrete or clay segmental pavers, the paver class (for clay pavers), shape type (for concrete pavers), shape name, colour, thickness and laying pattern shall be as shown on the Project Drawings for each area of application.

S3.09 SUBGRADE PREPARATION

1. For road pavements and areas subject to vehicle loads (ie. delivery traffic areas to pedestrian malls) the subgrade shall be trimmed and compacted to the required depth below finished surface level as shown on the approved Project Drawings and in accordance with Specification S2 ROAD PAVEMENTS.

2. Following completion of subgrade compaction and trimming, the whole of the subgrade area shall be inspected by proof rolling with a fully loaded single rear axle truck with a minimum axle load of 8 tonnes (or acceptable equivalent). Acceptable proof rolling shall be taken to be no visible signs of deformation or instability in the subgrade.

3. For pedestrian and light traffic areas (ie. footpaths, bikeways, medians and driveways) all soft, yielding or other unsuitable material shall be replaced with sound material and the subgrade shall be compacted to provide a minimum of 95 per cent standard compaction as determined by AS 1289.5.4.1 for standard compactive effort. The subgrade shall be trimmed to be ± 30mm of the design subgrade level.

S3.10 SUBBASE / BASE

1. Base course for pedestrian and light traffic areas (ie. footpaths, bikeways, medians and driveways) shall be as shown on the Project Drawings, where not otherwise specified the base course shall be a 125mm thick compacted to 95 per cent standard compaction as determined by AS 1289.5.4.1 for standard compactive effort. Base course material shall be minimum of Type 2.3 Pavement Material in accordance with the Specification for S2 ROAD PAVEMENTS.

2. For road pavements and areas subject to vehicle loads the subbase and base shall be constructed to the specified thickness and depth below finished surface level, and to the design grade and crossfalls of the finished surface, as shown on the approved Project Drawings in accordance with Specification S2 ROAD PAVEMENTS.

3. The base course shall extend in width to at least the rear face of all new edge restraints.

4. Notwithstanding the finished level tolerances contained within Specification S2 ROAD PAVEMENTS for base of ± 10mm of design levels, the level on the finished surface of the base course for road pavements to be overlain with segmental paving shall be trimmed to within + 10mm or - 0mm of design levels. The deviation from a 3m long straight edge placed anywhere and laid in any direction on the top surface of the base course for all segmental paving shall not exceed 10mm. Sand bedding material shall not be used as a levelling material to compensate for base finishing outside the above tolerances.

5. The finished surface of the base shall drain freely without ponding.

S3.11 EDGE RESTRAINTS

1. Edge restraints in the form of kerb and / or channel or edge strips shall be constructed along the perimeter of all segmental paving as shown on the approved Project Drawings. Concrete kerb and / or channel and edge strips shall be constructed in accordance with Specifications S2 ROAD PAVEMENTS and S7 CONCRETE WORKS.

2. Faces of edge restraints abutting pavers shall be vertical.

3. Edge restraints shall be supported on compacted base and / or subbase of the thickness as shown on the approved Project Drawings. Where not otherwise specified or indicated, the minimum thickness of compacted base beneath the edge restraints shall be 100mm adjacent to road pavements and medians, and 50mm adjacent to footpaths, bikeways and driveways.

4. Unless otherwise shown on the Project Drawings, expansion and contraction joints shall be provided in accordance with Specification S7 CONCRETE WORKS.

5. After the concrete has hardened and not earlier than three days after placing, the spaces at the back of the edge restraint shall be backfilled with earth, compacted in layers not greater than 150mm thick, then topsoiled to meet surrounding of design levels.

6. Hidden edge restraints may be used as an alternative for pedestrian and light traffic areas and shall be as detailed on the approved Project Drawings.

S3.12 SAND BEDDING COURSE

1. The sand bedding course shall be spread in a single uniform layer and screeded in a loose condition to the nominated design profile and levels plus that necessary to achieve a uniformly thick nominal 25-35mm layer following final compaction of the segmental paving.

2. Any depressions in the screeding sand exceeding 5mm shall be loosened, raked and rescreeded before laying pavers.

3. Screeded sand left overnight if subject to rain shall be checked for level and rescreeded where necessary before pavers are placed. The sand shall not be screeded more than two metres in advance of the laying face at the completion of work on any day.

4. Drainage of the bedding course shall be as detailed on the approved Project Drawings.

S3.13 LAYING PAVERS

1. Unless otherwise specified, concrete pavers for road pavements shall be placed in herringbone laying pattern.

2. Pavers shall be uniformly placed on the screeded sand bedding to the nominated laying pattern. Pavers shall be placed so that they are not in direct contact with each other and shall have uniform 3mm nominal joint widths.

3. The first row shall be located next to an edge restraint or an established straight line, and laid at a suitable angle to achieve the required orientation of pavers in the completed pavement.

4. In each row, full units shall be laid first. Edge or closer units shall be neatly cut using a paver scour, or mechanical or hydraulic guillotine, and fitted subsequently. Cut pieces of pavers which are smaller in size than one quarter of a full block shall not be used.

5. Manholes, drainage gullies and similar penetrations through the pavement shall be finished against the paving with a concrete surround or apron designed to suit and fit the laying pattern, otherwise complying with the requirements for edge restraints.

6. Any foot or barrow traffic shall use boards overlaying paving to prevent disturbance of units prior to compaction. No other construction traffic shall be allowed on the pavement prior to compaction and provision of joint filling sand.

7. On completion of subsequent bedding compaction and joint filling operations, no more than 10 per cent of joints along any 10 metre line along a major axis of the laying pattern shall have widths outside the range of 2 - 4mm.

S3.14 BEDDING COMPACTION

1. After laying the pavers, the sand bedding shall be fully compacted and the surface brought to design levels and surface profiles by not less than two passes of a high frequency low amplitude plate compactor, which covers at least 12 units. Compaction shall continue until lipping between adjoining units has been eliminated.

2. Any units which are structurally damaged during bedding compaction shall be removed and replaced. The pavement shall then be recompacted for at least one metre surrounding each replacement unit.

3. The paving operations shall be arranged so that the use of the plate compactor proceeds progressively behind the laying face without undue delay, and such that compaction is completed prior to cessation of construction activity on any day. Compaction shall not be attempted within one metre of the laying face except on completion of the pavement against an edge restraint.

4. The finished surface level shall not vary from the design level at any point laid in any direction, by more than 6mm for all road pavements and 8mm for all other areas of segmental paving. Notwithstanding this, the finished surface of the segmental paving, including where the paving abuts an edge restraint other than a drainage inlet, shall not deviate from the bottom of a 3m straight edge laid in any direction, except at grade changes, by more than 6mm for road pavements and 8mm for all other areas of segmental paving.

5. The abutting edges of two adjacent pavers should match, but in no circumstances should they differ by more than 2mm.

6. The surface level of pavers immediately adjacent to surface drainage channels shall finish not less than 5mm nor more than 10mm above the channel edge.

7. All compaction shall be complete and the pavement shall be brought to design profiles before spreading or placing sand filling in the joints.

S3.15 FILLING JOINTS

1. As soon as practicable after bedding compaction, and in any case prior to termination of work on any day, dry sand for joint filling shall be spread over the pavement and the joints filled by brooming.

2. To ensure complete filling of the joints, both the filling sand and pavers shall be as dry as practicable when sand is spread and broomed into the joints.

3. The pavement shall then receive one or more passes of a plate compactor and the joints then refilled with sand, with the process then repeated sufficiently to ensure that the joints are completely filled.

S3.16 PROTECTION OF WORK

1. Other than wheeled trolleys, forklifts and cluster-clamp vehicles, construction and other traffic shall not use the pavement until bedding compaction and joint filling operations have been completed.

S3.17 OPENING TO TRAFFIC

1. As soon as practicable after the filling of joints, construction vehicles may use the pavement, and should be encouraged to traverse the greatest possible area of pavement to assist in the development of 'lock-up'.

2. Excess joint filling sand shall be removed prior to opening to traffic.

3. The pavement shall then be inspected by the Contractor at regular intervals up until the expiration of the Defects Liability Period to ensure that all joints remain completely filled.

S3.18 TOLERANCES

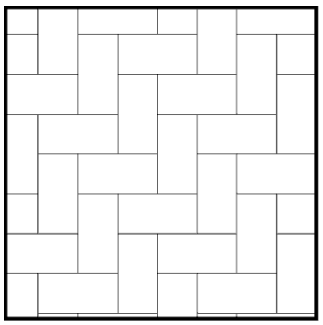
1. Where tolerances for individual components and associated dimensions are not specified on the Project Drawings, deviations from established lines, grades and dimensions in the completed work shall not exceed the values stated herein.

2. The dimensional tolerances as shown in Table S3.3

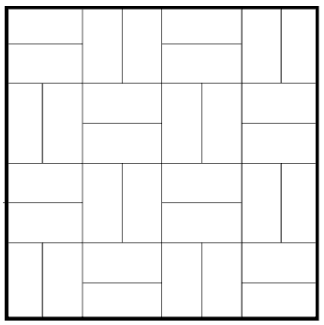
Table S3.3 Summary of Limits and Tolerances

Description	Limits / Tolerances
Base	Finished level of base for road pavements to be within +10mm or -0mm of design levels.
	Finished level of base other than for road pavements, to be within ± 10mm of design levels.
	The top surface of the base for all segmental paving shall not deviate from a 3m straight edge, laid in any direction, by more than 10mm.
Segmental Paving Units (Joint widths)	No more than 10% of joints along any 10 metre line of joints along a major axis of the laying pattern shall have widths outside the range 2 - 4mm.
Segmental Paving Units (Surface level)	Finished surface level of pavers shall not vary from design levels by more than ± 6mm for road pavements and ± 8mm for other than road pavements.
	Finished surface of pavers shall not deviate from a 3m straight edge, laid in any direction, by more than 6mm for road pavements and 8mm for other than road pavements.
	The abutting edges of two adjacent pavers shall not differ by more than 2mm.
	Finished surface level of pavers adjacent to surface drainage channels shall be not less than 5mm and not more than 10mm above the level of adjacent channel edge.

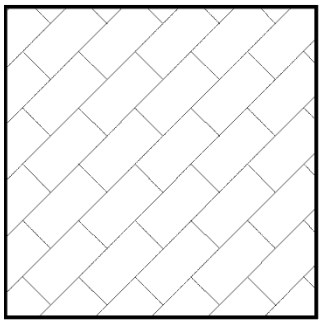
APPENDIX A - PAVER LAYING PATTERNS



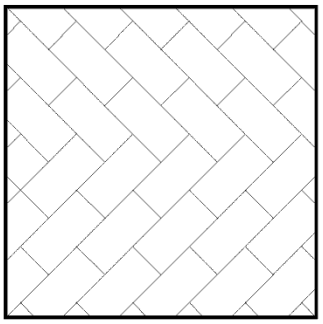
Herringbone



Basketweave



Stretcher



Zig Zag Running Bond