

1145 SEGMENTAL PAVING

1 GENERAL**1.1 RESPONSIBILITIES****Objectives**

General: Provide segmental paving, as documented.

Performance

~~Requirements: [complete/delete]~~

~~Authority requirements: [complete/delete]~~

1.2 CROSS REFERENCES**General**

Requirement: Conform to the following worksection(s):

- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 0319 Minor concrete works.
- 1101 Control of traffic.
- 1112 Earthworks (Roadways).
- 1113 Stabilisation.
- 1121 Open drains, including kerb and channel (gutter).
- 1132 Lean mix concrete subbase.
- 1133 Plain and reinforced concrete base.
- 1141 Flexible pavement base and subbase.

~~[complete/delete]~~

1.3 REFERENCED DOCUMENTS**Standards**

General: The following documents are incorporated into this worksection by reference:

Australian standards

AS 1141	Methods for sampling and testing aggregates
AS 1141.11.1.1-2009	Particle size distribution — Sieving method
AS 2876-2000	Concrete kerbs and channels (gutters) – Manually or machine placed.
AS 3705-2012	Geotextiles-Identification, marking and general data
AS/NZS 4455	Masonry units, pavers, flags and segmental retaining wall units
AS/NZS 4455.2:2010	Pavers and flags
AS/NZS 4456	Masonry units and segmental pavers — Methods of test
AS/NZS 4456.3:2003	Determining dimensions
AS/NZS 4456.5:2003	Determining the breaking load of segmental pavers and flags
AS/NZS 4456.9:2003	Determining abrasion resistance
AS/NZS 4456.10:2003	Determining resistance to salt attack
AS/NZS 4586:2004	Slip resistance classification of new pedestrian surface materials
AS/NZS 4663:2004	Slip resistance measurement of existing pedestrian surfaces

Austroads

AGPT04G-2009	Guide to pavement technology: Part 4G Geotextiles and geogrids
--------------	--

Other publications*Concrete Masonry Association of Australia*

CMAA MA56-2010	Guide to permeable interlocking concrete pavements
CMAA MA57-2010	Guide to concrete segmental and flag pavements - guide to specifying

CMAA T45-1997	Concrete segmental pavements - Design guide for residential access ways and roads
CMAA T46-1997	Concrete segmental pavements - Detailing guide
<i>Clay Brick and Paver Institute</i>	
CBPI Manual 1: 2003	Clay paving design and construction

1.4 INTERPRETATION

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- CBPI: Clay Brick and Paver Institute, now known as Think Brick Australia.
- CMAA: Concrete Masonry Association of Australia.

Definitions

General: For the purposes of this worksection the following definitions apply:

- Clay pavers: 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 2 mm.
- Concrete segmental pavers: Units of not more than 0.10 square metres in gross plan area, manufactured from concrete, with top and bottom faces parallel, with or without chamfered edges and identified by the following shape 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 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 plan geometry, when keyed together, resist the spread of joints parallel to the longitudinal axes of the units and rely on dimensional accuracy and accuracy of laying to interlock on the other faces.
 - . Shape Type C: Units which do not key together rely on dimensional accuracy and accuracy of laying to develop interlock.
- Laying patterns: Herringbone, Basketweave, stretcher, or zig zag running bond.
- Lippage: Height deviation between adjacent pavers.

1.5 SUBMISSIONS

Approvals

Submissions: To the Superintendent's approval. Submit the following for approval:

- Drawings.

~~Manuals: [complete/delete]~~

~~Prototypes: [complete/delete]~~

~~Samples: [complete/delete]~~

~~Warranties: [complete/delete]~~

1.6 HOLD POINTS AND WITNESS POINTS

Notice

General: Give notice so that the documented inspection and submissions may be made to the **HOLD POINT table** and the **WITNESS POINT table**.

HOLD POINTS table

Clause title/Item	Requirement	Notice for inspection	Release by
MATERIALS			
GENERAL – Nominated materials	Submit segmental paving materials and supplier.	2 weeks before ordering	<i>Principal Certifying Authority</i>
EXECUTION			
SUBGRADE PREPARATION – Dimensions and	Present the finished subgrade for approval	1 working day before proceeding	<i>Principal Certifying Authority</i>

Clause title/Item	Requirement	Notice for inspection	Release by
specification			
SUBBASE – Dimensions and specification	Present finished subbase for approval	1 working day before proceeding	<i>Principal Certifying Authority</i>
BASE – Dimensions and specification	Present the finished base for approval	2 working days before proceeding	<i>Principal Certifying Authority</i>

WITNESS POINTS table

Item	Requirement	Notice for inspection
EXECUTION		
SAND BEDDING COURSE - Screeding	Re-inspect screed left more than 1 day	Progressive
COMPLETION - Inspection	Regularly inspect joints after completion	Progressive

2 PRE-CONSTRUCTION PLANNING**2.1 SCHEDULING****Program for the works**

Planning: Conform to the following:

- Provide planning resources to allocate plant and personnel for the contract period.
- Program the work to meet the constraints of **HOLD POINTS** and **WITNESS POINTS**.

3 MATERIALS**3.1 GENERAL****Nominated materials**

Submissions: Submit details of all proposed segmental paving materials, including the following:

- Sand: Provide certification of the grading and quality to AS 1141.11.1.
- Segmental pavers: Submit the following type test results from NATA registered laboratory:
 - . Characteristic breaking load and flexural strength: To AS/NZS 4456.5.
 - . Dimensional deviations: To AS/NZS 4456.3.
 - . Abrasion resistance: To AS/NZS 4456.9.
 - . Salt attack resistance grade: To AS/NZS 4456.10.
 - . Slip resistance type test: To AS/NZS 4586.
- Slip resistance site test of completed paving: To AS/NZS 4663.
- The source of supply.

Testing authority: NATA registered laboratory.

Approval: Do not deliver materials until the Superintendent has approved the nominated materials. Inspection type: **HOLD POINT**.

3.2 CONCRETE AND CLAY SEGMENTAL PAVERS**Standards**

General: To AS/NZS 4455.2.

Concrete segmental paving: To CMAA MA57, CMAA T45 and CMAA T46.

Permeable interlocking concrete pavers: To CMAA MA56.

Clay segmental paving: To CPBI Manual 1.

Dimensional deviations: To AS/NZS 4455.2 Table 2.2(A) and AS/NZS 4455.2 Table 2.2(B).

Properties

Minimum material and dimensional requirements: To AS/NZS 4455.2 Table 2.8.

Salt attack resistance grade: to AS/NZS 4455.2 Table 2.7.

Slip resistance classification: To AS 4586.

Proprietary product: Conform to the **SELECTIONS** schedule.

3.3 SAND

General

Quality: Provide well-graded, clean, hard sand, with uncoated grains of uniform quality and free of soluble salts or other contaminants which may cause efflorescence.

Storage: Cover sand on site to protect from rain.

Cement: Do not use cement bound material.

Bedding sand

Grading: Obtain material from a single source or blend to conform to the **Bedding sand grading table**.

Bedding sand grading table

AS Sieve	% Passing
9.52 mm	100
4.75 mm	95–100
2.36 mm	80–100
1.18 mm	50–85
600 µm	25–60
300 µm	10–30
150 µm	5–15
75 µm	0–10

Grading for permeable pavements: To CMAA MA56 Section 9.

Moisture content: 4 – 8% and uniform when spread.

Joint filling sand

Grading: Conform to the **Joint filling sand grading table**.

Joint filling sand grading table

AS Sieve	% Passing
2.36 mm	100
1.18 mm	90–100
600 µm	60–90
300 µm	30–60
150 µm	15–30
75 µm	5–10

Grading for permeable pavements: To CMAA MA 56 Section 9.

Moisture content: Dry when spread.

3.4 GEOTEXTILE MATERIALS

General

Standard: To AS 3705 and AGPT04G.

Type: ~~[complete/delete]~~

3.5 CONCRETE FOR EDGE RESTRAINTS

Properties

General: To *0319 Minor concrete works*.

Strength: If not shown on the drawings, or provided by kerb and/or gutter (channel), provide concrete edge restraints for pavers with the following minimum 28-day characteristic compressive strength:

- Edge restraints for pavers on road pavements: 32 MPa.
- Edge restraints for pavers on medians, traffic islands and driveways: 25 MPa.

3.6 SELECTIONS

Pavers

Restraints: Select pavers to the **Paver Schedule**.

Paver schedule

Property	PAV1	PAV2	PAV3
Material			
Shape type / shape name.			
Colour			
Thickness			
Laying pattern			
Minimum characteristic breaking load			
Dimensional deviation category			
Abrasion resistance			
Salt attack resistance grade			
Slip resistance classification			
Product			

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General

Requirement: Conform to *1101 Control of traffic*.

4.2 SUBGRADE PREPARATION

Dimensions and specification

General: Prepare subgrade to the required depth below the finished surface level as shown on the drawings and conform to *1112 Earthworks (Roadways)*.

Inspection type: **HOLD POINT**.

4.3 SUBBASE

Dimensions and specification

Construction: If shown on the drawings, construct a subbase or working platform, to conform to the following:

- *1113 Stabilisation*.
- *1132 Lean mix concrete subbase* or *1141 Flexible pavements base and subbase* as appropriate.

Inspection type: **HOLD POINT**.

4.4 BASE

Dimensions and specification

Construction: To *1133 Plain and reinforced concrete base* or *1141 Flexible pavements base and subbase*, as appropriate.

Inspection type: **HOLD POINT**.

Extent: Extend the base course in width to at least the rear face of all new edge restraints.

Tolerances

Deviation from a 3 m long straightedge: ± 6 mm.

Remedial work: Do not use sand bedding material as a levelling material to compensate for base finishing outside the above tolerances.

Base surface drainage: Free without ponding.

4.5 EDGE RESTRAINTS

General

Extent: Provide edge restraints along the perimeter of all segmental paving as shown on the drawings. Make sure the faces of edge restraints abutting pavers are vertical.

Edge restraint support: On compacted base and/or subbase.

Joints

Contraction joints: Provide contraction joints 20 mm deep at maximum spacing of 3 m.

Kerbs and/or gutters, and edge strips

General: To AS 2876.

Construction: To *1121 Open drains including kerb and channel (gutter)* and *0319 Minor concrete works*.

Backfilling

Timing: Backfill at least 3 days after placing concrete.

Compaction: Backfill behind the edge restraint with earth, compacted in layers not greater than 150 mm thick, and complete with topsoil to finished design levels.

4.6 SAND BEDDING COURSE

Geotextile

Position: Place fabric over prepared base course before laying the sand bedding course.

Screeding

General: Spread the sand bedding course in a single uniform layer and screed in a loose condition to the nominated design profile and levels to achieve a uniformly thick nominal 20 mm to 30 mm layer following final compaction of the segmental paving.

Progressive screeding: Do not screed more than 2 m in advance of the laying face at the completion of work on any day.

Depressions: Before laying pavers, loosen, rake and re-screed any depressions in the screeding sand exceeding 5 mm.

Remediation: If screeded sand left overnight is subject to rain, check for level and re-screed where necessary before pavers are placed.

Inspection type: **WITNESS POINT**.

Drainage

Bedding course drainage: If water ponding occurs at edge restraint, drain bedding course to existing subsurface drain or drainage pit using geotextile and 20 mm diameter PVC pipe.

Compaction

Moisture content: Prepare a trial section to establish the moisture content limits which will allow paver system compaction to be achieved.

Manual placing of pavers: Maintain the bedding sand at a uniform loose density.

Mechanised laying: Provide firm, uniform but not full compaction.

4.7 LAYING PAVERS

Manual laying

Placement and jointing: Uniformly place pavers on the screeded sand bedding to the documented laying pattern. Lay the pattern at either 90° or 45° to the line of edge restraints.

Joints: Lay pavers with uniform 3 mm nominal joint widths to provide a finished 2 mm to 4 mm joint range after bedding compaction and joint filling operations.

Variation: Mix the pavers between pallets to evenly distribute colour variation between pallets over the paved area.

Sequence: Lay first row next to edge restraint or established straight line.

Odd shapes: In each row, first lay the full units and follow with cut closer units. Do not use cut pieces smaller in size than one quarter of a full block.

Laying around obstacles

Concrete surround: Finish public utility access pits, drainage pits and similar penetrations in the pavement with a concrete surround, conforming to the following:

- Minimum thickness between the utility pit and adjacent pavers: 100 mm.
- Strength grade: N32.
- Plan shape: Square or rectangular.

Pit covers: Adjust the levels of the pit covers before paving around them. Make sure the water drains away from closed pits.

Precast access chamber: Lay pavers to suit specific dimensions of authority access chambers.

Patterns around obstacles: Lay up both sides of the feature from the main or original laying face.

Control joints

Location: If pavers are placed over an isolation, contraction or expansion joint in an underlying concrete base, provide a control joint in the segmental paving.

Joint: 10 mm thick preformed jointing material of bituminous fibreboard.

Protection

Foot or barrow traffic: Provide boards overlaying paving to prevent disturbance of pavers before compaction.

Construction traffic: Do not allow construction traffic on the pavement before compaction and joint filling.

4.8 BEDDING COMPACTION

Method

Compactor: Compact the sand bedding after laying the pavers with not less than two passes of a high frequency low amplitude plate compactor which covers at least 12 units.

Lippage: Maximum 2 mm level difference between the adjoining edges of any two pavers.

Damage: Replace any pavers which are damaged during bedding compaction and re-compact the pavement for at least 1 m surrounding each replacement unit.

Progressive compaction: Arrange the paving operations as follows:

- Progressively compact behind the laying face.
- Complete compaction of laid paving at end of each day.
- Do not compact within 1 m of laying face except where adjacent to edge restraint.

Finished levels

Maximum deviation of finished surface level from the design level: ± 6 mm.

Finished level of edge restraints and drainage inlets: Minimum 5 mm below the finished paving level.

4.9 FILLING JOINTS

Timing

Compaction: Complete all compaction before filling joints. Complete joint filling of laid paving at the end of each day.

Method

Spreading: Spread the joint filling sand over the pavement and fill the joints by brooming. Compaction: After spreading, make one or more passes of a plate compactor and refill the joints. Repeat the process until the joints are completely filled.

4.10 COMPLETION

Protection

Restrictions: Do not allow traffic to use the pavement until compaction and joint filling operations have been completed.

Exceptions: Foot and barrow traffic, wheeled trolleys, forklifts and cluster-clamp vehicles.

Opening to traffic

Excess sand: Remove excess joint filling sand before opening to traffic.

Inspection

Joint filling: Inspect the pavement at regular intervals during the Defects Liability Period to make sure that all joints remain completely filled.

Inspection type: **WITNESS POINT**.

4.11 LIMITS AND TOLERANCES

Application

Summary: The limits and tolerances applicable to the various clauses in this worksection are summarised in the **Summary of limits and tolerances table**.

Summary of limits and tolerances table

Activity	Limits/tolerances	Worksection clause reference
Base		
Maximum deviation from a 3 mm straightedge.	± 6 mm.	BASE
Laying paving units		
Joint widths	2 mm - 4 mm	LAYING PAVERS
Completed segmental paving		
Maximum deviation of surface level from design level for roads.	± 6 mm	BEDDING COMPACTION
Level adjacent to drainage inlets	Minimum 5 mm below the finished paving level.	BEDDING COMPACTION
Lippage - Difference in level of adjacent pavers	≤ 2 mm	BEDDING COMPACTION

5 MEASUREMENT AND PAYMENT

5.1 MEASUREMENT

General

Payments made to the Schedule of Rates: To *0152 Schedule of rates – supply projects*, this worksection, the drawings and **PAY ITEMS** 1145.1 to 1145.2 inclusive.

Lump Sum prices: Not acceptable.

Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology

The following methodology will be applied for measurement and payment:

- Excavation and preparation of subgrade: To *1112 Earthworks (Roadways)*.
- Subbase and Base: To *1113 Stabilisation* and *1141 Flexible pavements base and subbase* or *1132 Lean mix concrete subbase*, as appropriate.

Kerb and/or gutter: To *1121 Open drains, including kerb and channel (gutter)*.

- Edge strips: In conformance with this worksection and not *0319 Minor concrete works*.
- Miscellaneous minor concrete work not included in the pay items in this worksection: To *0319 Minor concrete works*.

5.2 PAY ITEMS

Pay items

Pay items	Unit of measurement	Schedule rate scope
1145.1 Edge strips	Linear metre Measured along the length of the edge strip	All costs associated with the following: Excavation, forming, concreting, contraction joints, backfilling and compaction adjacent to the completed edge strip.
1145.2 Segmental paving— Road pavements	m ² The surface area of segmental paving for road and driveway pavements calculated from the width and length as shown on the drawings or as directed by the Superintendent.	All costs associated with the following: Supply, laying and compaction of segmental paving units, bedding sand and joint filling sand. Cutting of units. Joints overlying concrete pavement joints. Concrete surrounds or aprons around surface penetrations.