## SPECIFICATION 1145 – SEGMENTAL PAVING

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1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide segmental paving of the type and to the extent as documented.

Performance
Quality: Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies: To 0161 Quality (Construction).

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).

1.2 REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

Standards
AS 1141 Methods for sampling and testing aggregates
AS 1141.11.1.1-2009 Particle size distribution — Sieving method
AS/NZS 4455:2010 Masonry units, pavers, flags and segmental retaining wall units — 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 4586:2004 Slip resistance classification of new pedestrian surface materials
AS/NZS 4663:2004 Slip resistance measurement of existing pedestrian surface materials

Other publications
AUSTROADS
AP-C87-2010 Austroads Glossary of terms
AGPT03 – 2009 Guide to pavement technology part 3: Pavement surfacings
Concrete Masonry Association of Australia (CMAA) Specifications
MA56-2010 Guide to permeable interlocking concrete pavements
MA57-2010 Guide to concrete segmental and flag pavements - guide to specifying
T45-1997 Concrete segmental pavements—Design guide for residential access ways and roads
T46-1997 Concrete segmental pavements—Detailing guide

Clay Brick and Paver Institute Specifications
Manual 1: 2003 Clay paving design and construction

1.3 INTERPRETATIONS

Abbreviations
General: For the purposes of this worksection the abbreviations given below apply:
- CBPI: Clay Brick and Paver Institute, also known as Think Brick Australia.

Definitions
General: For the purposes of this worksection the definitions given below 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 as shown in Annexure A. Lay any of these at either 90° or 45° to the line of edge restraints.

### 1.4 SUBMISSIONS

**Acceptance criteria**

*General: All submissions will be subject to the approval of the Superintendent.*

**Documents**

Submit the following for approval:

- Manuals:
- Technical data: NATA Certification for bedding sand.
- Type tests results:
  - Slip resistance to AS/NZS 4586 for the wet pendulum test.
  - Slip resistance: Verification of completed pavement to AS/NZS 4663.
- Samples:
- Warranties:

### 1.5 INSPECTION

**Notice**

*General: Give notice so that the inspection may be made of the following:*

**Summary of HOLD POINTS**

<table>
<thead>
<tr>
<th>Clause title/Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Segmental paving</td>
<td>Submit pavers type, quality and supplier</td>
<td>2 weeks before ordering</td>
<td>Superintendent</td>
</tr>
<tr>
<td>materials – NOMINATED materials</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>EXECUTION</strong></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgrade preparation – Dimensions and specification</td>
<td>Present the finished subgrade</td>
<td>1 working day before proceeding</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Subbase – Dimensions and specification</td>
<td>Present finished subbase for approval</td>
<td>1 working day before proceeding</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Base – Dimensions and specification</td>
<td>Present the finished base for approval</td>
<td>2 working days before proceeding</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

**Summary of WITNESS POINTS**

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedding sand – Additional requirements</td>
<td>Provide NATA Certification</td>
<td>1 week before delivery</td>
</tr>
<tr>
<td>Sand bedding course - Screeding</td>
<td>Re-inspect screed left more than 1 day</td>
<td>Progressive</td>
</tr>
<tr>
<td>Compaction - Inspection</td>
<td>Regularly inspect joints after</td>
<td>Progressive</td>
</tr>
</tbody>
</table>

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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, WITNESS POINTS.

3 MATERIALS

3.1 SEGMENTAL PAVING MATERIALS

Nominated materials
Approval: Submit details of all proposed segmental paving materials, including bedding sand and joint filling sand, supported with test results from a nominated NATA registered laboratory, confirming that the constituents comply with the requirements of this worksection. Do not deliver materials until the Superintendent has approved the type and quality of the pavers and noted the source of supply as compliant to the requirements of this worksection. This is a HOLD POINT.
Responsibility: Such approval does not relieve the Contractor of any responsibility for supplying materials that comply with this worksection.

3.2 CONCRETE SEGMENTAL PAVERS

Properties
Classification: To CMAA MA57, CMAA T45 and CMAA T46.
Permeable interlocking concrete pavers: To CMAA MA56.
Material requirements: To AS/NZS 4455.2 Tables 2.2(A) and Table 2.2(b) when tested as follows:
- 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.
Proprietary product: Conform to the Paver Schedule.

3.3 CLAY SEGMENTAL PAVERS

Properties
Specification: To the AS/NZS 4455.2 or CMAA MA57.
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.
Application and Category to AS/NZS 4455.2 Table 2.8: [complete/delete]
Proprietary product: Conform to the SELECTIONS schedule.

3.4 BEDDING SAND

Grading
Quality: Well-graded, clean, hard, uncoated grains of uniform quality, generally passing a 4.75 mm sieve.
Grading: Obtain material from a single source or blend to achieve, when tested to conform with AS 1141.11.1, the following grading:

<table>
<thead>
<tr>
<th>AS Sieve</th>
<th>% Passing</th>
</tr>
</thead>
</table>

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### 3.5 JOINT FILLING SAND

#### Grading

Quality: Sand used for bedding is not suitable for joint filling.

Grading: Well graded, passing a 2.36 mm sieve and having when tested to conform with AS 1141.11.1, the following grading:

<table>
<thead>
<tr>
<th>AS Sieve</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.36 mm</td>
<td>100</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>90–100</td>
</tr>
<tr>
<td>600 µm</td>
<td>60–90</td>
</tr>
<tr>
<td>300 µm</td>
<td>30–60</td>
</tr>
<tr>
<td>150 µm</td>
<td>15–30</td>
</tr>
<tr>
<td>75 µm</td>
<td>5–10</td>
</tr>
</tbody>
</table>

#### Additional requirements

Protection when stored on site: Cover to protect from rain penetration.

Moisture content: Dry when spread.

Cleanliness: Free of deleterious soluble salts or other contaminants.

### 3.6 CONCRETE FOR EDGE RESTRAINTS

#### Properties

Specification: To conform with 0319 Minor concrete works.

Strength: Unless otherwise indicated on the drawings, or where the edge restraint is provided by kerb and/or gutter (channel), provide edge restraints for pavers in concrete with the following minimum 28-day characteristic compressive strength:

- Edge restraints for pavers on road pavements: 32 MPa.
- Edge restraints for pavers on footpaths, cycleways, medians and driveways: 25 MPa.
3.7 SELECTIONS

Pavers
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 Drawings and in Paver Schedule for each area of application.

Paver schedule

<table>
<thead>
<tr>
<th>Property</th>
<th>Application location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Paver material</td>
<td></td>
</tr>
<tr>
<td>Shape type / shape name.</td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td></td>
</tr>
<tr>
<td>Laying pattern</td>
<td></td>
</tr>
<tr>
<td>Product</td>
<td></td>
</tr>
</tbody>
</table>

Slip resistance
Pedestrian traffic and vehicular traffic: Wet pendulum test classification ‘W’ to AS/NZS 4586.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Control of traffic: Conform to the following:
- Conform with worksection 1101 Control of traffic.
- Conform with Traffic Guidance Scheme 1101 Control of traffic.

4.2 SUBGRADE PREPARATION

Dimensions and specification
Formation: Form the subgrade to the depth below finished surface level as shown on the drawings, or as directed, to conform with 1112 Earthworks (Roadways). This is a HOLD POINT.

4.3 SUBBASE

Dimensions and specification
Construction: If shown on the drawings, construct a subbase or working platform, to conform with 1113 Stabilisation, 1132 Mass concrete subbase and 1141 Flexible pavements and as appropriate, with thicknesses noted on the drawings. This is a HOLD POINT.

4.4 BASE

Dimensions and specification
Construction: 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 drawings or as directed by the Superintendent in conformance with 1141 Flexible pavements. Extend the base course in width to at least the rear face of all new edge restraints. This is a HOLD POINT.

Tolerances
Design levels: Despite the finished level tolerances contained within 1141 Flexible pavement, if road pavements are to be overlain with segmental paving, trim the base course to within +10 mm or −0 mm of design levels
Finished base surface: Maximum 10 mm deviation from a 3 m long straightedge placed anywhere in any direction.
Remedial work: Do not use sand bedding material as a levelling material to compensate for base finishing outside the above tolerances.
Base surface drainage: Freely without ponding.
4.5 EDGE RESTRAINTS

Requirements
Extent: Provide edge restraints along the perimeter of all segmental paving as shown on the drawings or as directed.
Design: Construct concrete kerb and/or gutter (channel) and edge strips to conform with 1121 Open drains, including kerb and channel gutter and 0319 Minor concrete works. Faces of edge restraints abutting pavers to be vertical.
Edge restraint support: On compacted base and/or subbase.
Thickness: Compacted base and/or subbase as follows unless noted otherwise on drawings:
- 100 mm adjacent to road pavements and medians.
- 50 mm adjacent to footpaths, cycleways and driveways.
Joints
Contraction joints: 20 mm deep every 5 m of edge restraint length, unless otherwise shown on the drawings.
Backfilling
Timing: 3 days after placing concrete unless otherwise directed by the Superintendent.
Compaction: Backfill the spaces at the back of the edge restraint with earth, compacted in layers not greater than 150 mm thick, then topsoiled to meet surrounding design levels.

4.6 SAND BEDDING COURSE

Requirements
Allowance levels: Spread the sand bedding course in a single uniform layer and screed in a loose condition to the nominated design profile and levels plus that necessary to achieve a uniformly thick nominal 20 – 25 mm layer following final compaction of the segmental paving.
Depressions: Before laying paving units, loosen, rake and re-screed any depressions in the screeding sand exceeding 5 mm.,
Compaction
Manual placing of paving units: Maintain the bedding sand at a uniform loose density.
Mechanised laying: Provide firm, uniform but not full compaction.
Screeding
Progressive screeding: Do not screed more than 2 m in advance of the laying face at the completion of work on any day.
Remediation: Check screeded sand left overnight and subject to rain for level and rescreed where necessary before pavers are placed. This is a WITNESS POINT.

4.7 LAYING PAVERS

Manual laying
Placement and jointing: Uniformly place pavers on the screeded sand bedding to the nominated laying pattern.
Joints: Lay pavers without direct contact with each other and with uniform 3 mm nominal joint widths so that all joints are within the 2–4 mm range on completion of subsequent bedding compaction and joint filling operations.
Variation: Mix the pavers between various pallets to evenly distribute any colour variation between pallets of pavers over the entire paved area.
Sequence: Locate the first row next to an edge restraint or an established straight line and lay at a suitable angle to achieve the required orientation of pavers in the completed pavement.
Odd shapes: In each row, first lay the full units. Next, neatly cut edge or closer units using a paver scour, or mechanical or hydraulic guillotine, and fit. Do not use cut pieces of pavers which are smaller in size than one quarter of a full block.
Penetrations
Restraint: Finish access chambers, drainage gullies and similar penetrations in the pavement against the paving with a concrete surround or apron designed to suit and fit the laying pattern, otherwise conform to the requirements for edge restraints.
Movement joints
Location: If pavers are placed over an isolation, contraction or expansion joint in an underlying concrete pavement, provide a joint in the pavers.
Joint: 10 mm thick preformed jointing material of bituminous fibreboard or approved equivalent.

Protection
Foot or barrow traffic: Provide boards overlaying paving to prevent disturbance of units prior to compaction.
Construction traffic: Do not allow construction traffic on the pavement prior to compaction and provision of joint filling sand.

4.8 BEDDING COMPACATION

Method
Compactor: Fully compact the sand bedding after laying the pavers and bring the surface 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. Continue the compaction until all pavers form a smooth surface with adjacent paver edges matching.
Lippage: Maximum 2 mm level difference between the adjoining edges of any two pavers, to avoid trip hazards, unless approved otherwise for rough textured pavers.
Damage: Remove and replace any units which are structurally damaged during bedding compaction and then recompact the pavement for at least 1 m surrounding each replacement unit.
Progressive compaction: Arrange the paving operations to enable the following:
- Use of the plate compactor proceeds progressively behind the laying face without undue delay
- Compaction is completed prior to stopping work on any day.
- No compaction within 1 m of the laying face except on completion of the pavement against an edge restraint.

Finished levels
Tolerance: Maximum deviation of finished surface level from the design level at any point laid in any direction:
- ± 6 mm for all roads or areas with 80 mm thick concrete segmental pavements.
- ± 8 mm for all other areas.
Finished base surface: Maximum deviation from a 3 m long straightedge placed anywhere in any direction except at grade changes:
- 6 mm for road pavements.
- 8 mm for all other areas

Drainage inlets
Levels: Finish channels formed between abutting chamfered units with their inverts not less than 5 mm nor more than 10 mm above adjacent drainage inlets.

4.9 FILLING JOINTS

Timing
Compaction: Complete all compaction and bring the pavement to design profiles before spreading or placing sand filling in the joints. Spread and fill as soon as practicable after bedding compaction and, in any case, prior to stopping work on any day.
Process
Spreading: Spread the joint filling sand over the pavement and fill the joints by brooming.
Sand moisture content: To complete filling of the joints, make sure filling sand and pavers are as dry as practicable as when sand is spread and broomed into the joints.
Compaction: After spreading make one or more passes of a plate compactor and refill the joints. Repeat the process sufficiently to ensure that the joints are completely filled.
Joint between pavers and buildings, or other structures shall be a maximum width of 40mm. This shall be filled with a concrete render mix with a permanent coloured tint to match the colour of the pavers after the render has completely dried.
4.10 COMPLETION

Protection of work
Restrictions: Do not 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 prior to opening to traffic.
Traverse greatest area: As soon as practicable after the filling of joints, construction vehicles may use the pavement, and are encouraged to traverse the greatest possible area of pavement to assist in the development of ‘lock-up’.

Inspection
Joint filling: Inspect the pavement at regular intervals up until the expiration of the Defects Liability Period to ensure that all joints remain completely filled. This is a WITNESS POINT.

4.11 LIMITS AND TOLERANCES

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

Summary limits and tolerances

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/tolerances</th>
<th>Worksection clause reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finished surface level of base for road pavement:</td>
<td>Within +10 mm or –0 mm of design levels.</td>
<td>Base</td>
</tr>
<tr>
<td>Maximum deviation of base other than road pavements</td>
<td>Within ±10 mm of design levels</td>
<td>Base</td>
</tr>
<tr>
<td>Maximum deviation from a 3 mm straightedge.</td>
<td>10 mm.</td>
<td>Base</td>
</tr>
<tr>
<td>Laying paving units</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joint widths</td>
<td>Within the range 2–4 mm</td>
<td>Laying pavers</td>
</tr>
<tr>
<td>Completed segmental paving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum deviation of surface level from design level for roads.</td>
<td>±6 mm for road pavements and bedding compaction</td>
<td></td>
</tr>
<tr>
<td>Maximum deviation of surface level from design level for other than roads.</td>
<td>±8 mm for other than road pavements</td>
<td></td>
</tr>
<tr>
<td>Maximum Deviation from 3 m straightedge for roads</td>
<td>6 mm for road pavements</td>
<td>Bedding compaction</td>
</tr>
<tr>
<td>Maximum deviation from 3 m straightedge for roads</td>
<td>8 mm for other than road pavements</td>
<td></td>
</tr>
<tr>
<td>Level adjacent to drainage inlets</td>
<td>Invert level of channels between abutting chamfered units not to be less than 5 mm and not more than 10 mm above the level of adjacent drainage inlets.</td>
<td>Bedding compaction</td>
</tr>
<tr>
<td>Lippage - Difference in level of adjacent pavers</td>
<td>≤ 2 mm</td>
<td>Bedding compaction</td>
</tr>
</tbody>
</table>
5 MEASUREMENT AND PAYMENT

5.1 GENERAL

Payment shall be made for all the activities associated with completing the work detailed in this worksection and shown on the drawings, in accordance with provisions made in contract document.
6 ANNEXURE

6.1 PAVER PATTERNS

- Herringbone
- Basketweave
- Stretcher
- Zig Zag Running Bond