# Brisbane Infrastructure Division

# Reference Specifications for Engineering Work

# S180 Unit Paving

## Amendment Register

|  |  |  |  |
| --- | --- | --- | --- |
| Ed/Rev Number | Section Number | Description | Date |
| 1.0 |  | Original issue.  Sections moved from Reference Specification for Civil Engineering Works S140 Earthworks | Apr 2014 |
| 2.0 | General | External References Updated and Corrected | May 2016 |
| 1.2 | Reference list expanded to show all referenced documents |
| 3.0 | General | Document name changed from ‘Reference Specifications for Civil Engineering Work’ to ‘Reference Specifications for Engineering Work’ | Mar 2021 |
| 3.0 | Slip resistance of pedestrian surfaces requirements updated to current Australian Standard. |
| 8.0 | Equivalent material for *Polymer modified mortar* allowed. |

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## GENERAL

### Section Content

Specified in this section: Unit paving laid on flexible or rigid base and bedded in sand or concrete.

### Standards

|  |  |  |
| --- | --- | --- |
| Australian Standard | AS 1379 | Specification and supply of concrete |
| Australian Standard | AS 2870 | Residential slabs and footings |
| Australian/New Zealand Standard | AS 3661.2 | Slip resistance of pedestrian surfaces – Guide to the reduction of slip hazards |
| Australian Standard | AS 3700 | Masonry structures |
| Australian/New Zealand Standard | AS/NZS 4455.1 | Masonry units, pavers, flags and segmental retaining wall units – Masonry units |
| Australian/New Zealand Standard | AS/NZS 4455.2 | Masonry units, pavers, flags and segmental retaining wall units – Pavers and flags |
| Australian Standard | AS 4586 | Slip resistance classification of new pedestrian surface materials |
| Australian Standard | AS 4663 | Slip resistance measurement of existing pedestrian surfaces |
| Australian Standard | Handbook HB 197 | An introductory guide to the slip resistance of pedestrian surface materials |
| Australian Standard | Handbook SA HB 198 | Guide to the specification and testing of slip resistance of pedestrian surfaces |

### References

Refer to the following other Reference Specifications for Engineering Works:

|  |  |
| --- | --- |
| S110 | General Requirements |
| S140 | Earthworks |
| S150 | Roadworks |
| S200 | Concrete Work |

### Interpretation

Definitions

Unit paving: Paving surfaces of bricks, blocks, flags and setts, including paving made with concrete segmented paving units.

## QUALITY

### Inspection

Witness points

*Refer annexure*. Give sufficient notice so that inspection may be made at completion of:

* Preparation of base.
* Sample panel for unit paving pattern.
* Paving.

### Samples

Finishes

Concrete infill: Submit a sample of concrete infill, coloured to match the paving units.

Sample panels

Prepare a sample panel, with an area not less than 20 m2. Include the finish adjacent to other features and building facades. The panel may form part of the work. Protect the panel from damage during the work.  *Refer annexure*.

### Contractor's Submissions

Execution

Unit paving pattern: If it appears that minor variations to joint widths will reduce cutting, submit proposals.

## PAVING SYSTEM

Light duty application

Masonry units and segmental pavers: To *AS/NZS 4455.1 and AS/NZS 4455.2*. Tolerances to comply with:

* Masonry units: Table 2.1 of *AS/NZS 4455.1*;
* Pavers and flags: Table 2.2 of *AS/NZS 4455.2*.

Dimensional category: DPA1 and DPB1.

Minimum compressive strength (clay units): 10 MPa.

Minimum compressive strength (concrete units): 12 MPa.

Characteristic breaking load (pedestrian): 2 kN.

Characteristic breaking load (vehicular): 5 kN.

Minimum abrasion index: 1.2.

Maximum characteristic abrasion loss (clay units): 3.5 cm3.

Minimum thickness – foot and bicycle traffic: 40 mm.

Minimum thickness – light domestic traffic occasionally up to 3 tonne gross: 50 mm.

Slip resistance of pedestrian surfaces: Generally to AS 4586 for new surface and AS 4663 for existing surface.

* New/untrafficked external surfaces (<1 in 20): Classified as Class ‘P5’ (>44 Mean BPN using a Slider 55 (TRL) rubber pad) to *AS 4586*.
* New/untrafficked external surfaces (>1in20): Mean BPN must be increased in accordance with Appendix A of HB197 – An introductory Guide to Slip Resistance of Pedestrian Surfaces.
* Existing/trafficked external surfaces: Tested to the methods in *AS 4663* and classified in accordance with HB197 – An introductory Guide to Slip Resistance of Pedestrian Surfaces.
* The pavement must demonstrate characteristics in accordance with the relevant Australian Standards of a Very Low Contribution of the surface to slips when wet. The likely contamination of the surface must be considered, and the surface must maintain its slip resistance with minimal maintenance for the estimated life of 10 years.
* Where the slope of the surface is such that the minimum slip resistance for the coloured pavement treatment cannot be achieved, then an alternative treatment is to be considered. This will be determined on a site-by-site basis.

Table 3.1 – Tolerances of paving units

|  |  |
| --- | --- |
| Dimension | Tolerance |
| Length of 20 bricks | ±60 mm |
| Width of 20 bricks | ±40 mm |
| Height of 20 bricks | ±40 mm |
| Flatness from planar | ±1 mm |

Unit paving systems

System specification: If the paver type, shape, colour, laying pattern, base type, bedding type and requirement for adhesive are not specified elsewhere, obtain direction. If pavers are not specified as a proprietary product, additional specification will be required. *Refer annexure*.

Acceptable paving systems: Unit paving systems that have been found to be tolerably reliable to date are listed in Table 3.2.

Table 3.2 – Acceptable paving systems

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Situation | Base | Bedding | Adhesive mortar | Paver type | Pattern |
| Driveways and pathways in private properties, no underground service.  Landscaping in parks.  Traffic islands. | None or flexible*(1)* | Sand | N/A | Small module | Herringbone for driveway |
| Footpaths, lightly trafficked, no new services.  Car parking areas. | Flexible*(1)* | Sand | N/A | Small module | Herringbone or header coursed |
| Footpaths at vehicle crossings, with heavy pedestrian traffic or with new services. | Concrete | Concrete | Cement | Small or large module | Any |
| Pedestrian areas with extreme pedestrian traffic. | Concrete | Concrete | Polymer modified | Large module | Header courses |
| Pedestrian areas with occasional heavy vehicles. | Concrete | Concrete | Polymer modified | Small module | Header courses |
| Heavy traffic or heavy turning movements of vehicles. | No solution known | | | | |

*(1)* Flexible base thickness as recommended by the Concrete Masonry Association of Australia for sites classified in accordance with *AS 2870*.

* Foot and bicycle traffic: None required for Class A, S, and M sites.
* Light domestic traffic occasionally up to 3 tonne gross: None required for Class A site, 75 mm for Class S and M sites.

## TOLERANCES

Surface levels

Footpaths (planar): ±25 mm from designed level, ±5 mm from a 3 m straightedge.

Roadways (planar): ±25 mm from designed level, ±10 mm from a 3 m straightedge.

Non-planar surfaces: Free draining, without visual discontinuity in grading. Do not exceed 1V:25H grade unless required by design.

Level discontinuity

Between adjacent pavers and between pavers and other surface features: Footpath areas 1.5 mm, roadway areas 2.0 mm.

Transitions

Transition abrupt grade changes to avoid excessive joint widths.

Joint lines

Deviation from line: ±15 mm over any 10 m length.

## MATERIALS

### Sand

General

Use clean coarse sand, free from deleterious material including soluble salts or other contaminants liable to cause efflorescence or reduce skid resistance. It must be a naturally occurring sand or crushed rock which may be washed or unwashed. It must contain no more than 3% by weight of clay and silt.

Bedding sand

Particle size: Maximum particle size 4.75 mm, not more than 30% by weight passing 0.3 mm sieve.

Moisture content: Uniform moisture content in the range 4 - 8%.

Stabilised sand

General: 6 parts dried bedding sand mixed with 1 part cement (by volume).

Joint filling sand

Particle size: Maximum particle size 1.18 mm with not less than 30% passing the 0.3 mm sieve.

### Mortar

Standard: To *AS 3700*.

Mix proportions: 1 part cement to 3 parts sand (by volume).

### Concrete Infill

Standard: To *AS 1379*.

Grade: N32.

Maximum aggregate size: 10 mm.

## BASE

Flexible base

Generally: To reference specification *Reference Specification* *S150 Roadworks*.

Material: Class 1 pavement material.

Concrete base

Reinforced concrete: Grade N32 concrete to *AS 1379*.

Maximum aggregate size: 20 mm.

## BEDDING

### Sand and Stabilised Sand

Preparation: Remove all loose material from the prepared base.

Spreading: Screed uncompacted sand to the required levels allowing for compaction.

Maximum thickness of layer: 50 mm.

Protection: Maintain sand in an uncompacted state until all pavers are placed on the prepared area. Protect stabilised sand from moisture until compaction. Keep traffic off paved areas until compaction.

Time limits: Place and compact stabilised sand on the day of mixing. Discard stale material. Place pavers on sand on the day of spreading. Remove and re-screed sand that has been exposed overnight.

Compaction: After pavers are placed on the prepared bedding, compact using a vibrating plate compactor. Do not compact within 1 m of the laying face. Compact using a rubber mallet only where use of a vibrating plate is impracticable.

### Concrete

Preparation: If the bedding concrete is to be bonded to hardened concrete base, remove oils, greases, retarders and loose material and leave the surface clean and dust-free. Dampen the surface.

Material: Grade N25 concrete with high workability ("Poolmix" or acceptable equivalent).

## ADHESIVE MORTAR

General

Type: Use polymer modified mortar on hardened concrete surfaces and on plastic concrete if specified.

Preparation: If the adhesive mortar is to be bonded to hardened concrete base or bedding, remove oils, greases, retarders and loose material and leave the surface clean and dust-free. Dampen the surface.

Application: Apply mortar using a 10 mm comb.

Paver preparation: Clean the edges and bedding faces of pavers of dust, loose material and any contaminant that may affect bond.

Bedding of paver: Bed paver solidly into the combed mortar using a rubber mallet.

Cement mortar

Time limit: Place pavers before the mortar has undergone initial set. Remove any stale material and discard.

Polymer modified mortar

Material: Laticrete, or equivalent.

Time limit: Place pavers before the material exhibits any surface skinning. Stale material may be reworked once only.

## PLACING PAVERS

### Cutting Units

Saw cut units to obtain consistent joint widths. Provide a 1 - 3 mm wide gap between adjoining pavers.

### Adjusting Coursing

Header courses: Lay header courses of full size units along concrete kerbs, channels, edge restraints and building facades. Mitre the ends as necessary to maintain joint widths on curved edges and at corners.

Cut courses: Do not use cut units with any plan dimension less than 50 mm. On footpaths and other linear elements, use at least two cut courses and maintain symmetry.

### Service Pits, Valves and The Like

Lids

Where service pit lids are of a type requiring infilling, use full depth pavers, matching thinner units from the same manufacturer or cut biscuits of pavers. Bed these units on epoxy mortar. Cut units to maintain the coursing. Where this would require the use of biscuits less than 12 mm thick, use concrete infill coloured to match the pavers and grooved to match the jointing pattern.

Roofs

Where service pit roofs are at a level that will not allow the normal paving system, resort (in turn) to the following:

* Replace flexible base with concrete base over the roof.
* Replace sand bedding with concrete bedding not less than 25 mm thick.
* Use concrete bedding not less than 12 mm thick bonded to the roof with wet to dry epoxy.
* Use matching thinner pavers from the same manufacturer or cut biscuits of pavers not less than 30 mm thick.
* Use cut biscuits of the pavers not less than 12 mm thick bonded to the concrete bedding by epoxy adhesive.

If this does not allow design levels to be maintained, obtain directions.

Frames

Use cut units to provide the normal joint width around lid frames. Where cut units would have any plan dimension less than 50 mm, use concrete infill to the full depth of the pavers. Colour the infill to match the jointing mortar (if any) or otherwise the pavers.

Concrete infill

Match the surface texture of the pavers. Clean paving progressively to remove mortar smears and discolouration.

### Joint Filling

Timing

Fill joints on the same day that the pavers are placed on concrete bedding or compacted sand bedding.

Sand filled joints

Fill the joints flush with sand vibrated into the joints using 2 further passes of the vibrating plate compactor. One week after commencement of traffic on the pavers, refill the joints and re-vibrate.

Mortar joints

Fill the joints flush with mortar and trowel smooth. Clean paving progressively to remove mortar smears and discolouration.

## PAVER DETAILS

### Concrete Edge Restraint

Requirement: Provide concrete edge restraint unless the edges are constrained by other pavement, kerb, channel, buildings, other structures or specifically detailed edge restraints.

Material: Concrete grade N25 to *AS 1379*.

Depth: Twice the combined depth of pavers and bedding.

Width: Minimum 100 mm.

Forming: Pour against finished paving and timber back forms. Screed level with pavers.

Control joints: Trowel cut transverse control joints to at least one-third the depth of the concrete at 3 m centres.

Finish: Wood float, non slip.

Cleanup: Clean pavers progressively to remove concrete splashes and mortar smears.

### Movement Joints

Abutting buildings

Depth: Full depth of concrete base (if any), concrete bedding (if any) and pavers.

Material: 10 mm Abelflex with removable top 10 mm, or equivalent.

Surface sealing: Thioflex 600 or equivalent.

At joints in concrete base

Depth: Full depth of base, bedding and pavers.

Material: 10 mm Abelflex with removable top 10 mm, or equivalent.

Surface sealing: Thioflex 600 or equivalent.

Change of base type

Depth: Full depth of concrete bedding (if any) and pavers.

Width: 10 mm.

Method: Form or saw cut.

Surface sealing: Thioflex 600 or equivalent.

### Paving Joins

Application: Where changes of paving occur at property alignments

Requirement: Locate the join on the line of the gate (if any) or otherwise on the property alignment.

Dividing strip: Where two types of unit paving join, provide a strip of infill concrete of minimum 100 mm wide to the full depth of pavers and bedding.

## Protection of work

Edge restraints: Keep vehicular traffic off paved areas until all edge restraints are in place and concrete has reached half its specified strength. Keep pedestrian traffic away from unrestrained edges.

Concrete base or adhesive mortar: Keep pedestrian traffic off paved areas for 48 hours after placing the last cement bound material. Keep vehicular traffic off for 7 days.

## COMPLETION

Leave paving clean on completion.