GUIDE SPECIFICATIONS FOR CONSTRUCTION OF THE
AQUAPAVE® PERMEABLE ON-SITE STORMWATER SOURCE
CONTROL SYSTEM

SECTION 32 14 13.19
AQUAPAVE® PERMEABLE INTERLOCKING CONCRETE PAVEMENT

Note: This guide specification is for the construction of an AquaPave® permeable interlocking concrete paver system which is designed to allow for the infiltration, detention and release of stormwater from a permeable, open-graded base. Components covered under this specification include AP SC1000 Woven Geotextile, SC Membrane®, SC Integrid®, permeable clear crushed open-graded sub-base, Inbitex® Geotextile, Bedding Layer, AquaPave® Pavers and AquaPave® Engineered Joint Stabilizer, which are generic to all AquaPave® Systems. Additional specifications are required where drain pipes, geogrid and/or an impermeable liner are used. The text below must be edited to suit specific project requirements. It will require review by a qualified civil or geotechnical engineer, or landscape architect familiar with the site conditions and local materials. Edit this specification as necessary to identify the design professional in the General Conditions of the Contract. This guide specification is intended for use in the U.S. or Canada and should be edited to fit terms and standards appropriate to each region.

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes
   1. AquaPave® Permeable Concrete Pavers.
   3. Clear crushed open-graded aggregate Bedding Course.
   4. Inbitex® Geotextile.
   5. Clear crush open-graded sub-base materials.
   6. [SC Integrid® - Base reinforcement grid].
   7. AP SC1000 Woven Geotextile.
   8. [SC Membrane® - Impermeable liner].

Note: Curbs will typically be precast or cast-in-place concrete. Plastic edging with steel spikes can be used if the spikes are driven into substantial soils and are not driven into any of the open-graded drain rock or pierce any portion of the water containment system. Plastic edging should not be used where wheel loads are within 2.5 feet of the restrained edge. In areas of severe freeze-thaw cycles plastic edge restraints are not recommended.

1.02 RELATED SECTIONS

A. Section [ - ]: Curbs.
B. Section [ - ]: Stabilized aggregate base.
C. Section [ - ]: [PVC] Drainage pipes.
D. Section [ - ]: Impermeable liner.
E. Section [ - ]: Edge restraints.
F. Section [ - ]: Drainage pipes and appurtenances.
G. Section [ - ]: Earthworks/excavation/soil compaction.
1.03 REFERENCES

A. American Society of Testing Materials (ASTM)
   5. D 448, Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
   6. D 698, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5-lb (2.49 kg) Rammer and 12 in. (305 mm) drop.
   7. D 1557, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (4.54 kg) Rammer and 18 in. (457 mm) drop.
   10. D 2922, Standard Test Methods for Density of Soil and Soil Aggregate In-Place by Nuclear Methods (Shallow Depth).

B. Canadian Standards Association (CSA)
   1. A231.2-14, Precast Concrete Pavers.
   2. A231.1-14, Precast Concrete Paving Slabs.

1.04 SUBMITTALS

A. In accordance with Conditions of the Contract and Submittal Procedures Section.
B. Site Plan - indicate the following: area of AquaPave® Paver installation; perimeter conditions; stormwater run-on area; and, layout, patterns and color arrangements.
C. Installation details – provide details for each of the following: junction with other materials; expansion and control joints; layout pattern, and relationship of paving joints to fixtures; geotextile panel installation drawing; and project formed details.
D. AquaPave® Engineered Joint Stabilizer, Bedding Course and Sub-base (upper and lower):
   1. Sieve analysis of aggregates per [ASTM C 136] [CSA A23.2A].
   2. Durability of aggregates using Micro-Deval Degradation per [ASTM D 6928] [CSA A23.2A].
   3. Percentage of angular and sub-angular particles per [ASTM D 2488].
   4. Minimum 3 lb (2kg) samples of sub-base, base and bedding aggregate materials.
E. Site soils report including: in-situ density test reports; soil classification(s); infiltration rate(s) measured on-site under compacted conditions; and recommendations on suitability of native soils for the intended project.
F. Erosion and sediment control plan.
G. Stormwater management (quality and quantity) calculations.
H. Permeable concrete pavers:
   1. Manufacturer’s product catalog sheets with specifications.

2. [Four] representative full-size samples of each paver [slab] type, thickness, color, and finish. Submit samples indicating the extremes of color expected in the finished installation. Note that accepted samples become the standard of acceptance for the work of this Section.
3. Laboratory test reports certifying compliance of the concrete pavers [slabs] with [ASTM C936M-15] [CSA A231.1-14] [CSA A231.2-14].
4. Copy of ICPI Certified Manufacturer Certificate.
5. Manufacturer's material safety data sheets for the safe handling of the specified materials and products.

I. Geotextiles:
1. Manufacturer’s product catalog sheet with specifications.
2. One 0.5 x 0.5 m (18 x 18 in.) panel of each: Inbitex®, AP SC1000 geotextile, SC Intergrid® geogrid and/or SC Membrane® for inspection and testing. The sample panels shall be uniformly rolled and shall be wrapped in plastic to protect the material from moisture and damage during shipment. Samples shall be externally tagged for easy identification. External identification shall include: name of manufacturer; product type; product grade; lot number; and physical dimensions.

J. Paver Installation Subcontractor:
1. Statement of Installer Qualifications: Submit list of comparable projects completed by installer. Include list of completed projects with project names, addresses, names of Architect/Engineer and Owners with contact information, and dates of construction.
2. Copy of current ‘ICPI Concrete Paver Installer Certification Program’ Level I Certificate, or Level II Certificate if project is to be mechanically installed, for site supervising personnel.
3. A letter of assurance or copy of Certificate from the manufacturer stating that the site supervising personnel is an AquaPave® Approved Installer.
4. Written Method Statement and Quality Control Plan that describes material staging and flow, paving direction and installation procedures, including representative reporting forms that ensure conformance to the project specifications.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced, certified installer who has successfully completed permeable pavement installations similar in design, material, and extent indicated for this project.
B. Review paver installation subcontractor’s Method Statement and Quality Control Plan with a pre-construction meeting of representatives from the manufacturer, paver installation subcontractor, general contractor, engineer and/or owner’s representative.
C. Field-constructed Mock-up:
1. Install 3 x 3 m (10 x 10 ft) area with Geotextiles, Sub-base, Bedding Course, AquaPave® Engineered Joint Stabilizer and AquaPave®.
2. Use area to determine surcharge of the bedding layer, joint sizes, lines, laying pattern(s), color(s), and texture of the job.
3. Use the area as the standard to judge the remaining work.
4. Subject to acceptance by the owner, mock-up may be retained as part of the finished work.
5. If mock-up is not retained, remove and dispose of mock-up.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Concrete Pavers:
1. Comply with manufacturer’s ordering instructions and lead-time requirements to avoid construction delays.
2. Coordinate delivery of paving stones to minimize interference with onsite works, and normal use of buildings, roads and structures adjacent to works.
3. Deliver concrete pavers to the site palletized for transfer by forklift or clamp lift. Maintain manufacturer’s original, unopened, undamaged packaging with identification labels intact.
4. Unload pavers at job site in the location designated by the Installation Contractor and in such a manner that no damage occurs to the product or existing construction.
B. Imported Soils:
   1. Handle and transport material to avoid segregation, contamination and degradation.
   2. Keep different materials sufficiently separated as to prevent mixing. Do not dump or store one material on top of another unless it is part of the installation process.
   3. Cover material with waterproof covering if needed to prevent exposure to rainfall or removal by wind. Secure the covering in place.

C. Geotextiles:
   1. Geotextiles shall be delivered, stored and handled in accordance with [ASTM D-4873].
   2. Maintain manufacturer’s original, unopened, undamaged packaging with identification labels intact.
   3. The geotextiles shall be kept dry and wrapped in waterproof wrapping such that it is protected from UV light and the elements during delivery and storage.

D. The Installer shall check all materials delivered to the site to ensure that the correct materials have been received and are in good condition prior to signing off on the manufacturer’s packing slip.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not install in heavy rain, or snow.
B. Do not install frozen Bedding Course, AquaPave® Engineered Joint Stabilizer or Sub-base materials.
C. Do not install on frozen soil subgrade.

1.08 MAINTENANCE

A. Extra materials: Provide [Specify area] [Specify percentage] additional material for use by owner for maintenance and repair.

PART 2 PRODUCTS

2.01 PAVING UNITS

A. Manufactured by Abbotsford Concrete Products
   Phone: 1-800-663-4091   Fax: 1-604-852-4819
   AquaPave® Standard: [Color]
      225 mm x 112.5 mm x 80 mm thick
   AquaPave® Old Country Stone Type 1: [Color]
      225 mm x 181 mm x 60 mm thick
   AquaSlab® HydraPressed Slab: [Color]
      457 mm x 457 mm x 50 mm thick
   AquaPave® Venetian Cobble Series: all sizes are combined on one pallet. [Color]
      Type 1 – 228 mm x 304 mm x 90 mm thick
      Type 2 – 152 mm x 304 mm x 90 mm thick
      Type 3 – 228 mm x 228 mm x 90 mm thick
      Type 4 – 152 mm x 228 mm x 90 mm thick
      Type 5 – 152 mm x 152 mm x 90 mm thick

Note: ASTM C936/C936M-15 or CSA A231.2-14 applies to AquaPave® pavers. ASTM C1782/C1782M-16 or CSA A231.1-14 applies to AquaSlab® HydraPressed slabs.
B. Meet [ASTM C936/C936M-15] [CSA A231.2-14] [CSA A231.1-14]. Freeze-thaw requirements may be waived in applications with no freeze-thaw conditions.

1. When testing 3-1/8 in. (80 mm) thick units for conformance to [C 936/C936M-15], compressive strength tests shall be corrected by multiplying the results by 1.18 to equate the results to that from 2-3/8 in. (60 mm) thick pavers.

C. Color(s): [Specify from selection in Abbotsford Concrete Products literature].

2.02 CLEAR CRUSHED OPEN-GRADED BEDDING COURSE AND SUB-BASE MATERIALS

Note: The bedding and sub-base materials are an integral part of the AquaPave® system design. When designing an AquaPave® system, compliance with the following points must be strictly observed.

A. Aggregates to be clean, non-plastic, and free from deleterious or foreign matter.
B. Micro-Deval Degradation of less than 8%. Soft Aggregates such as Limestone cannot be used as they will lead to total system failure.
C. Percentage of angular and sub-angular particles greater than 90%. Do not use rounded river gravel. Base and bedding materials must be clear crushed open-graded aggregates.
D. Gradation criteria.

Note: Dx is the particle diameter size at which x percent of the particles are finer. For example, D15 is the particle size of the aggregate for which 15% of the particles are smaller and 85% are larger.

1. D15 upper and lower sub-base stone /D50 bedding stone < 5.
2. D50 upper and lower sub-base stone/D50 bedding stone > 2.

E. Crushed stone with 90% fractured faces, LA Abrasion <40 per ASTM C 131, minimum CBR of 80% per ASTM D 1883.

Note: The following gradations in Tables 1, 2 and 3 can be used for the clear crushed open-graded bedding course and sub-bases. Check gradations against the above criteria.

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
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<tbody>
<tr>
<td><strong>Grading Requirements for Clear Crushed Bedding Course (ASTM D 448 No. 8)</strong></td>
</tr>
<tr>
<td>Sieve Size</td>
</tr>
<tr>
<td>12.5 mm (1/2 in.)</td>
</tr>
<tr>
<td>9.5 mm (3/8 in.)</td>
</tr>
<tr>
<td>4.75 mm (No. 4)</td>
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<tr>
<td>2.36 mm (No. 8)</td>
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<tr>
<td>1.16 mm (No. 16)</td>
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<table>
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<tr>
<th>Table 2</th>
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<tbody>
<tr>
<td><strong>Grading Requirements for Clear Crushed Upper Sub-Base (ASTM D 448 No. .56)</strong></td>
</tr>
<tr>
<td>Sieve Size</td>
</tr>
<tr>
<td>37.5 mm (1-1/2 in.)</td>
</tr>
<tr>
<td>25 mm (1 in.)</td>
</tr>
<tr>
<td>19 mm (3/4)</td>
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<tr>
<td>12.5 mm (1/2 in.)</td>
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<tr>
<td>9.5mm (3/8 in.)</td>
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<tr>
<td>4.75mm (No. 4)</td>
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<tr>
<td>Sieve Size</td>
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<tr>
<td>------------------</td>
</tr>
<tr>
<td>75 mm (3 in.)</td>
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<tr>
<td>63 mm (2-1/2 in.)</td>
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<tr>
<td>50 mm (2 in.)</td>
</tr>
<tr>
<td>37.5 mm (1-1/2 in)</td>
</tr>
<tr>
<td>19 mm (3/4 in.)</td>
</tr>
</tbody>
</table>

### 2.03 GEOTEXTILES AND GEOGRIDS

A. AP SC1000 and Inbitex® geotextiles and SC Intergrid® as supplied by: Abbotsford Concrete Products PH: 1-800-663-4091

### 2.04 AquaPave® ENGINEERED JOINT STABILIZER

A. Pre-bagged AquaPave® Engineered Joint Stabilizer as supplied by: Abbotsford Concrete Products PH: 1-800-663-4091

### PART 3 EXECUTION

#### 3.01 ACCEPTABLE INSTALLERS

A. [Specify acceptable paver installation subcontractors.]

#### 3.02 EXAMINATION

**Note:** The elevations and surface tolerance of the soil subgrade determine the final surface elevations of concrete pavers. The paver installation contractor cannot correct deficiencies in excavation or grading of the soil subgrade with the addition of bedding materials. Therefore, the surface elevations of the soil subgrade should be checked and accepted by the General Contractor or designated party, with written certification presented to the paver installation subcontractor prior to starting work.

A. Acceptance of Site Verification of Conditions:

1. **General Contractor shall inspect, accept and certify in writing to the paver installation subcontractor that site conditions meet specifications for the following items prior to installation of interlocking concrete pavers.**

**Note:** Compaction of the soil subgrade may be necessary to achieve stability under vehicle loads. Compaction, however, will reduce the permeability of soils. In such cases, laboratory and on-site testing for density and soil permeability should be conducted. These can help establish a relationship between compacted density and anticipated design permeability after compaction. An experienced civil or geotechnical engineer familiar with local soil conditions should be consulted for determining project standards for the percentage of soil Proctor density and test methods for permeability. When soil compaction is required, standard Proctor density per ASTM D 698 for pedestrian and driveway areas is recommended. Modified Proctor density per ASTM D 1557 is recommended for vehicular areas. Density and moisture should be checked in the field with a nuclear density gauge or other test methods for compliance to specifications. Stabilization of the soil and/or base material may be necessary with weak or continually saturated soils, or when subject to high wheel loads. These conditions may require the use of drain pipes within open-graded bases. Compaction on the “open aggregate base” for pedestrian and residential driveway areas, a minimum 97% standard Proctor density per ASTM D 698 is recommended. For vehicle and high traffic areas, a minimum 97% modified Proctor density per ASTM D 1557 is recommended.
a. Verify that subgrade preparation, compacted density and elevations conform to specified requirements, particularly where backup drains are to be located.
b. Provide written density test results for soil subgrade to the Owner, General Contractor and paver installation subcontractor.
c. Verify location, type, and elevations of edge restraints, [concrete collars around] utility structures, and drainage pipes and inlets.

2. Do not proceed with installation of bedding and interlocking concrete pavers until subgrade soil conditions are corrected by the General Contractor or designated subcontractor.

3.03 PREPARATION

<table>
<thead>
<tr>
<th>Note: The minimum slope of the soil subgrade is typically 0.5%. Actual slope of soil subgrade will depend on the drainage design and exfiltration type.</th>
</tr>
</thead>
</table>

A. Verify that subgrade surface, base and sub-base materials are free from standing water, uniform, even, free of any organic material or sediment, debris, are ready for installation, prior to installation of AP SC1000 geotextile.

B. Edge Restraints:
   1. Verify location, type, installation and elevations of edge restraints around the perimeter to be paved. Ensure the side of the edge restraint adjacent to the paver is perpendicular to the bedding course. This will ensure proper interlock eliminating possibility of creep, or a potential trip hazard.

C. Beginning of installation means acceptance of subgrade and edge restraints.

3.04 INSTALLATION

<table>
<thead>
<tr>
<th>Note: Geotextile is placed on the compacted soil subgrade under the clear crushed open-graded lower sub-base. The geotextile is applied to the bottom and sides of the excavation with overlapped joints a minimum of 30 cm (12 in.) Overlap is a function of CBR, 30 to 45 cm (12 to 18 in.) for CBR 3.0 and above, 60 to 90 cm (24 to 36 in.) for CBR 1.0 to 3.0, for CBR values below 1.0 they should be sewn. Please consult manufacturers’ specifications and your Geotechnical Engineer. Overlaps should follow down slope with drainage. All drainpipes, observation wells, overflow pipes, and SC Membrane® impermeable liner (if applicable) should be in place per the drawings either prior to or during placement of the base, depending on their location. The open-graded base is typically compacted in 10 to 15 cm (4 to 6 in.) thick lifts with a minimum 10 T (10 ton) static roller. Care must be taken not to damage drainpipes during compaction and paving. There should be at least 4 passes with no visible movement in the base material when compaction is complete. Absolutely no mud or sediment can be left on the base or bedding aggregates. If they are contaminated, they must be removed and replaced with clean materials.</th>
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</thead>
</table>

A. Keep area where pavement is to be constructed free from sediment during entire job. Geotextiles, sub-bases and bedding materials contaminated with sediment shall be removed and replaced with clean materials.

B. Place geotextile on the bottom and sides of the excavated area with a minimum down slope overlap of 30cm (12 in.). Allow for enough geotextile to exceed the final elevation of the AquaPave® surface. After final compaction the excess geotextiles should be cut flush with the finished surface.

C. Place and spread the clear crushed open-graded lower sub-base without wrinkling or folding the geotextile. To prevent damage to the geotextile, track vehicles must not be used to spread the initial base course.

D. Do not damage drainpipes, overflow pipes, observation wells, or any inlets and other drainage appurtenances during installation.

E. Spread, moisten and compact clear crushed open-graded lower and upper sub-bases in 10 to 15 cm (4 to 6 in.) lifts with a minimum 10 T (10 ton) vibratory roller.

F. For each lift, make at least two passes in the vibratory mode then at least two in the static mode until there is no visible movement of the material. Do not crush aggregate with the roller.
G. The elevation of the final surface of the clear crushed lower sub-base should not deviate more than ±65 mm (± 2 ½ in.) over a 3 m (10 ft.) straightedge. The upper sub-base should not deviate more than ±25 mm (± 1 in.) over a 3 m (10 ft.) straightedge.

H. Place the Inbitex® geotextile over the clear crushed open-graded upper sub-base following the panel installation drawings. Ensure a minimum down slope overlap of 30cm (12 in.), allowing for enough Inbitex® to exceed the final elevation of the AquaPave® surface.

I. Spread, moisten and lightly compact the bedding material course. Use a Plate Compactor on this course. No visible movement should occur in base material when compaction is complete.

J. Loose screed the Bedding Course. The elevation of the bedding layer shall not deviate more than ±10 mm (±3/8 in.) over a 3 m (10 ft) long straightedge.

K. Lay the AquaPave® in the pattern(s) shown on the drawings. Maintain straight pattern lines.

L. Fill gaps at the edges of the paved area with cut units, ensuring no cut unit is less than one third its original size.

M. The use of Guillotine or Paver Splitters is not acceptable. Cut pavers with a masonry saw only. Do not allow slurry from the cuts to adhere to the surface of the pavers.

N. Compact and seat the pavers into the bedding material using a low amplitude, 75-90 Hz plate compactor capable of at least 5,200 lbs. (23 kN) centrifugal compaction force. After the first pass with the vibrating plate compactor, remove and replace any damaged pavers.

O. Apply a dressing of AquaPave® Engineered Joint Stabilizer to the surface and sweep into the joints. Approximately 3kg/m² (6.6lbs/10 ft²) will be required. Fill joints and sweep off excess material before continuing compaction. Two or three more passes with the compactor will be required.

P. Do not compact within 1 m (3 ft) of the unrestrained edges of paving units.

Q. Remove excess aggregate by sweeping pavers clean.

R. All pavers outside of the 1 m (3 ft) laying face must be left fully compacted at the completion of each day.

S. The final surface elevations shall not deviate more than ±10 mm (±3/8 in.) under a 3 m (10 ft) long straightedge.

T. The surface elevation of pavers shall be 13 mm (1/2 in.) above adjacent drainage inlets, concrete collars, or channels to allow for future settlement.

3.05 FIELD QUALITY CONTROL

A. After sweeping the surface clean, check final elevations for conformance to the drawings.

B. The top surface of the pavers shall extend 13 mm (1/2 in.) above the final elevations after compaction to compensate for possible minor settling. (see 3.04 T)

C. Lippage: No greater than 3 mm (1/8 in.) difference in height between adjacent pavers.

D. Remove excess Inbitex® and AP SC1000 geotextile from the top edge of AquaPave® Permeable concrete pavers.

3.06 PROTECTION

A. After work in this Section is complete, the General Contractor shall be responsible for protecting the work from damage and sediment due to subsequent construction activity on the site.

B. Design consideration must be taken to ensure that soft landscaping is retained to prevent migration of softscape materials on to the AquaPave® surface. This will significantly help to maintain the integrity of the system.

End of section