

INTERLOCKING CONCRETE PAVEMENT CONSTRUCTION FOR AIRFIELD PAVEMENT

Note: This is a guide specification for installation of interlocking concrete pavers with mechanical equipment. It is intended for airport pavements involving engineers, project inspectors, general contractors, paver installation contractors, and paver manufacturers. Like every large paving project, mechanical installation of interlocking concrete pavements requires forethought and planning among all these parties from its inception. This specification should be used as a tool to facilitate that planning process, as well as quality control and quality assurance processes during the project. This guide specification should be edited for specific project conditions by a qualified design professional with input from all involved. Notes are provided for consideration in the editing process. Selected paragraphs and phrases are [bracketed] to draw specific attention to them during project planning and drafting this specification. ICPI Tech Spec technical bulletins and the ICPI manual, Airfield Pavement Design with Concrete Pavers – Canadian Edition should be read for additional information on design and construction.

The term Contractor designates the general contractor, installer designates the concrete paver installation subcontractor, and manufacturer designates the concrete paver producer or supplier. The set of contractual relationships among the owner, engineer/designer, contractors and suppliers will vary with each project. This document assumes that the designer/engineer works for the owner who hires a general contractor to build the project. The General Contractor subcontracts the pavement portion of the work to a company that specializes in interlocking concrete paving. The subcontractor purchase pavers from a paver manufacturer(s). The designer/engineer or employees working for the owner inspect and accept the paving. In such cases, it is critical to establish the bases of acceptance with these specifications and with a mock-up area before paving begins.

1.0 DESCRIPTION

This item shall consist of a surface course composed of interlocking concrete pavers set in bedding sand on an approved base course constructed in accordance with the Plans and Specifications. All paver pavers shall be manufactured for the construction of paved surfaces to be trafficked by jet or propeller driven aircraft. This item shall include paver pavers, bedding sand, joint sand, edge restraints, and sealer manufactured and installed in accordance with these Specifications. This item shall be required for construction of concrete paver pavements in the manner and at the locations shown on the Plans, or as directed by the Engineer.

A woven geotextile fabric is required when a cement treated base is used to prevent loss of bedding sand through shrinkage cracks in the cement treated base. A woven geotextile fabric is also recommended when pavers are used as an overlay or inlay over cracked hot mix asphalt surfaces. The use of concrete pavers is not recommended for areas subjected to full power or reverse thrust (e.g. runways, taxiways, or apron areas subject to aircraft "power-back" operations).

2.0 MATERIALS

2.1 CONCRETE PAVERS

2.1.1 GENERAL

Concrete pavers shall be manufactured in accordance with CSA-A231.2-95, except as modified by Sections 4.1 and 4.2 of this Specification. Hard face, face mix or pavers with special finishes shall not be used. Pavers shall be chamfered with a beveled edge around the top of the paver unit and shall be constructed with spacer bars, i.e. small protrusions on each side of the paver to keep the pavers uniformly spaced so that sand can fill the joints. Chamfers shall have a nominal size of 3 to 6 mm and the spacers shall have a nominal size of 2 mm in thickness.

2.1.2 DIMENSIONS

Concrete pavers shall consist of rectangular chamfered units, 100 mm by 200 mm by 80 mm thick, nominal dimensions, or other shapes and sizes as shown on the Plans. All pavers shall have round spacer bars, not exceeding 2 mm in thickness. The minimum thickness of concrete pavers for airport application is 80 mm.

2.1.3 COLOUR

Colour shall be natural grey, except where indicated on the Plans. Coloured pavers shall use natural or synthetic mineral oxides with proven colourfastness.

Note: ACI Report No. 212-1R provides guidance on the use of pigments.

2.1.4 FREEZE-THAW DURABILITY

The Contractor shall submit test results and certification that the concrete pavers meet the durability requirements of Section 6.2 of CSA Standard A231.2-95, "Precast Concrete Pavers".

2.1.5 EFFLORESCENCE

Concrete pavers shall be manufactured with additives to reduce efflorescence.

Note: CSA Standard A231.2-95 provides guidance on the reduction of efflorescence.

2.1.6 ABRASION RESISTANCE

Abrasion resistance of concrete pavers shall conform to the weight loss requirements of ASTM C 936 when tested in accordance with ASTM C 418.

2.1.7 ACCEPTANCE

Concrete pavers shall be accepted by the Engineer at the source of manufacture in accordance with the acceptance requirements contained in Sections 4.1 and 4.2 of this Specification.

2.2 BEDDING SAND

Bedding sand shall be clean, non-plastic and free from deleterious or foreign matter. Bedding sand shall be fine, naturally occurring or manufactured hard sand. Limestone screenings or stone dust shall not be used. The sands shall be as hard as practically available when concrete pavers are subject to aircraft traffic. Grading shall not vary from the high limit on one sieve to the low limit on the next larger sieve. Bedding sand shall conform to the requirements of CSA-A23.2-2A, except for gradation requirements that are contained in Table 1 of this Specification. Locally available manufactured sand is acceptable, provided the sand is manufactured from rock having a Los Angeles Abrasion loss of 20 or less, when tested in

accordance with CSA-A23.2-16A, and the sand is washed to meet the grading requirements of Table 1. The sand shall contain no more than ten percent of acid soluble material. Limestone screenings or stone dust shall not be used.

TABLE 1
GRADING REQUIREMENTS FOR BEDDING SAND
(CSA-A23. 1-FA1)

SIEVE SIZE	PERCENT PASSING
10 mm	100
5 mm	95 - 100
2.5 mm	80 - 100
1.25 mm	50 - 90
630 µm	25 - 65
315 µm	10 - 35
160 µm	2 - 10

2.3 JOINT SAND

All sand for joints shall conform to the grading requirements of CSA-A179 as shown in Table 2. Sand blasting sand may be used. Masonry and beach sands shall not be used. Where locally available, bagged silica sand should be specified for joint sand.

TABLE 2
GRADING FOR JOINT SAND
(CSA-A179)

SIEVE SIZE	PERCENT PASSING
5 mm	100
2.5 mm	90 - 100
1.25 mm	85 - 100
630 µm	65 - 95
310 µm	15 - 80
160 µm	0-35

2.4 SEALER

Sealer for stabilizing joint sand shall be a urethane, or approved equal, capable of 100 percent elongation in accordance with ASTM D 2370. The sealer shall have demonstrated acceptable performance in similar application for a minimum of one (1) year. The sealer shall be applied in strict accordance with manufacturer's recommendations and shall carry a five (5) year minimum manufacturer's warranty. The sealer shall stabilize the joint sand to resist repeated blasts from jet engines and propeller wash and shall prevent the ingress of water through the joint sand. The sealer shall also be resistant to jet fuels, aviation gasoline, hydraulic fluids, and de-icing chemicals.

2.5 JOINT SEALING FILLER

When shown on the Plans, joint sealing filler shall be applied at edge restraint interfaces. This item is considered incidental to installation of edge restraints.

3.0 INITIAL ACCEPTANCE REQUIREMENTS

3.1 SUBMITTAL

The Contractor shall submit the following for the approval of the Engineer at least 30 days prior to the start of concrete paver installation.

3.1.1 CERTIFICATION

The Contractor shall provide certifications that all materials to be incorporated into the work can meet the requirements of Sections 4.1 and 4.2 of this Specification. Certifications shall be substantiated by data from tests performed within 90 days of the planned start date for installation.

3.1.2 SAMPLES

The Contractor shall submit the following samples for preliminary testing and evaluation by the Engineer. Sampling and testing shall be carried out by a concrete testing laboratory, certified in accordance with CSA Standard A283, by a certification organization accredited by the Standards Council of Canada in the subject area of Building Products and Structures.

1) Pavers

Twenty (20) full sized concrete pavers, cured for 28 days, shall be submitted to the Engineer for testing and evaluation in accordance with Sections 4.1 and 4.2 of this Specification. Ten (10) pavers shall be measured in accordance with Section 7.4 of CSA A231.2-95. Test sampling and frequency shall be in accordance with Section 5 in CSA-A231.2-95 except for modifications outlined in this Specification.

2) Bedding and Joint Sand

Sieve analyses and samples of bedding and joint sand shall be submitted to the Engineer for evaluation and testing in accordance with Sections 4.1 and 4.2 of this Specification.

3) Sealer

Manufacturer's catalogue cuts shall be submitted for the proposed sealer.

4) Edge Restraints

Mill reports and steel detailing showing hole sizes and layout shall be submitted to the Engineer for approval, when steel angle edge restraints are shown on the Plans. When concrete edge restraints are shown on the Plans, the concrete shall conform to Specifications.

3.1.3 STATEMENT OF CONTRACTOR QUALIFICATIONS

The paver Contractor shall have installed at least 30,000 m² in commercial, municipal, port or airport projects over the past twelve (12) months. If mechanical installation is to be used, at least 10,000 m² of which shall have been mechanically installed. Submit a list to the Engineer of projects completed by the Installer. Include a list of completed projects with project names, addresses, telephone numbers, names of Engineers/Architects and Owners, and dates of construction.

3.2 MOCK UP

Prior to installation of unit pavers, construct a mock up at least 10 m by 10 m for each form and pattern of unit paver required. Build mock-up(s) using materials, base construction, joints and special features for continuous work, as indicated for final unit of work. The mock up shall also be used to establish "roll down" and sand surcharge requirements for grade control.

- 1) Locate mock-ups on project site in the location as directed by Engineer.
- 2) Notify Engineer in advance of dates when mock-up(s) will be erected.
- 3) Demonstrate quality of workmanship that will be produced in final unit of work.
- 4) Obtain Engineer's acceptance of mock-up(s) before start of final unit of work.
- 5) Retain and maintain mock-up(s) during construction in undisturbed condition as a standard for judging work.
- 6) Accepted mock-up(s) in undisturbed condition at time of substantial completion may become part of completed unit of work.

3.3 CONCRETE MIX DESIGN

Proportioning requirements for concrete paver manufacture shall be designed for a compressive strength consistent with the acceptance criteria contained in Sections 4.1 and 4.2 of this Specification. Prior to the start of paver production and after approval of all material to be used in the concrete, the Contractor shall submit a mix design verification showing the proportions and actual compressive strengths at 28 days of the unit pavers, tested in accordance with Section 4.1 of this Specification. The mix design shall include a complete list of materials including type, brand, source and amount of cement, fly ash or other pozzolans, ground slag, and admixtures, and copies of test reports and certifications. Production shall not begin until the mix design and accompanying test data are reviewed and approved by the Engineer. The mix design shall be submitted at least 15 days prior to the start of paver production.

4.0 MATERIAL ACCEPTANCE

4.1 ACCEPTANCE SAMPLING AND TESTING

All testing for acceptance of concrete pavers, and bedding and joint sand, will be performed by the Engineer without cost to the Contractor. Concrete paver will be sampled at the location of manufacture and tested by the Engineer for acceptance before shipment to the job site. Bedding and joint sand will be sampled from stockpiles maintained by the Contractor at the job site for testing by the Engineer.

4.1.1 CONCRETE PAVERS

Concrete pavers shall be sampled, tested and accepted by the Engineer on a lot basis. A lot shall consist of one tenth of the total area to be paved or 50,000 units, whichever is smaller except for the last lot which shall consist of the number of units required for completion of paving. Each lot shall be divided into five (5) equal sublots. Three (3) full size units shall be randomly located by the Engineer within each subplot in accordance with ASTM D 3665. Each specimen selected shall be suitably marked so that it can be identified according to lot, subplot, and sample number at any time. The tests indicated below are required.

4.1.1a COMPRESSIVE STRENGTH

Compressive strength testing in accordance with CSA CAN3-A23.2-M90 shall be performed on samples at 28 days. Five representative cubes cut from five pavers shall be tested.

4.1.1b ABRASION RESISTANCE

Three units shall be sampled out of every 500,000 units produced and abrasion resistance shall be measured in accordance with ASTM C 418.

4.1.1c FREEZE-THAW DURABILITY

Three units shall be tested for freeze-thaw durability in accordance with CSA-231.2-95. Weight loss shall be reported at twenty-five (25), and, if necessary, at fifty (50) cycles.

4.1.2 BEDDING SAND

Bedding sand shall be sampled, tested and accepted by the Engineer on a lot basis. A lot shall consist of the lesser of 2,000 m² or ten percent of the total paved area. The minimum lot size shall be 1,000 m², except for the last lot, which shall consist of the number of square metres required for completion of paving. Each lot shall be subjected to the following tests for acceptance.

4.1.2a GRADATION

Each lot will be divided into two equal sublots. One (1) sample shall be randomly located by the Engineer within the subplot in accordance with CSA-A23.2-7B. The Engineer shall test each sample for grading in accordance with CSA-A23.2-2A (dry sieve).

4.1.2b BEDDING SAND DEGRADATION

One 1.5 kg sample shall be randomly located within each lot in accordance with ASTM D 3665. The sample shall be dried for 24 hours at 115° C to 121° C. Obtain three (3) sub-samples each weighing 0.2 kg by passing the main sample several times through a riffle box. Carry out a sieve analysis test on each sub-sample according to CSA-A23.2-2A. Remix each sub-sample and place in a nominal quart/liter capacity porcelain jar with two (2) 25 mm diameter steel ball bearings weighing 75 ±5 grams each. Rotate each jar at 50 rpm for six (6) hours. Repeat the sieve analysis. Record the individual and average sieve analysis.

4.1.3 JOINT SAND

Joint sand shall be sampled, tested and accepted by the Engineer on a lot basis. A lot shall consist of the lesser of 2,000 m² or ten percent of the total paved area. The minimum lot size shall be 1 000 m², except for the last lot, which shall consist of the number of square metres required for completion of paving. One (1) sample will be randomly selected for each lot. The Engineer shall test the sample for gradation in accordance with CSA-A23.2-2A (dry sieve). The joint sand shall satisfy the physical requirements for concrete fine aggregate.

4.2 ACCEPTANCE CRITERIA

4.2.1 CONCRETE PAVERS

Concrete pavers shall be evaluated on a lot basis by the Engineer. All acceptance requirements must be fully met as described below for a lot of concrete pavers to be considered acceptable for

incorporation into the work. Failure to meet any one or more of the acceptance requirements detailed below will result in rejection of the entire lot of concrete pavers.

4.2.1a COMPRESSIVE STRENGTH

For acceptance, the average compressive strength of the five (5) pavers tested in accordance with Paragraph 4.1.1a shall be 50 MPa or greater with no individual test less than 45 MPa.

4.2.1b DIMENSIONAL TOLERANCES

The dimensional tolerances of ten (10) pavers sampled for each lot in accordance with Section 6.3 of CSA CAN3-A23.2-M77 shall not vary by more than the following amounts:

Length -1.0 to mm +2.0 mm

Width -1.0 mm to +2.0 mm

Thickness ± 3.0 mm

Each side of each paver within the sample shall be normal to the wearing surface and the opposite face. The sides shall be considered normal if the sides do not deviate by more than 1.6 mm.

4.2.1d ABRASION RESISTANCE

Samples tested in accordance with paragraph 4.1.1d shall not have a volume loss greater than 15 cm³ per 50 cm². The average thickness loss shall not exceed 3 mm.

4.2.1e VISUAL REQUIREMENTS

All pavers shall be sound and free from defects that would interfere with the proper placing of the pavers or impair the strength or performance of the construction. Defects that impair the structural or functional performance of the wearing surface of the paver shall be sufficient reason for rejection. The Engineer, at his/her sole discretion, may allow pavers with minor chipping to remain as part of the completed pavement.

4.2.1f FREEZE THAW DURABILITY

The average weight loss of samples tested in accordance with Paragraph 4.1.1d shall not exceed 1 percent after fifty (50) cycles.

4.2.2 BEDDING SAND

Bedding sand shall be evaluated by the Engineer on a lot basis for compliance with the following characteristics:

4.2.2a GRADATION

The two (2) samples of bedding sand tested in accordance with 4.1.2a shall be averaged for comparison to the grading requirements of Table 1. The Contractor shall take appropriate corrective action when the acceptance tests indicate that the grading requirements are not being met.

4.2.2b BEDDING SAND DEGRADATION

For each sample tested in accordance with Section 4.1.2b, the maximum increase in the percentages passing each sieve and the maximum individual percent passing shall be:

Sieve Size	Maximum Increase	Maximum Passing
75 µm	2%	2%
150 µm	5%	15%
300 µm	5%	35%

4.2.3 JOINT SAND

Joint sand sampled and tested in accordance with Paragraph 4.1.3 shall be evaluated for compliance to the requirements of Table 2.

4.2.4 SEALER

The sealer shall meet the requirements outlined in Section 2.4 of this Specification.

4.2.5 COMPLIANCE

Where any of the individual acceptance tests for concrete pavers and/or sand fail to meet the requirements specified above, the lot shall be rejected because of non-compliance subject to the following:

4.2.5a REMOVAL OF DEFECTIVE MATERIALS

The Contractor may elect to inspect the lot, remove any items he/she considers to be defective and submit the remainder for re-sampling and re-testing by the Engineer in accordance with Section 4.1 and 4.2 of this Specification. The costs for re-sampling and retesting shall be borne by the Contractor. Should these further test results fail to meet the requirements, the entire lot shall be rejected. Where defective materials have been discarded from the lot, the lot shall be considered a new lot and the initial test results shall not be used in the Engineer's evaluation for compliance.

5.0 DELIVERY, STORAGE AND HANDLING

5.1 CONCRETE PAVERS

Concrete pavers shall be delivered to the project site in steel-banded, plastic-banded, or plastic wrapped cubes capable of transfer by fork lift or clamp lift. The pavers shall be unloaded without damage to pavers or existing construction. The individual unit pavers shall be protected from damage during delivery, storage and construction.

5.2 SAND

Sand shall be covered with waterproof covering to prevent exposure to rainfall or removal by wind. Covering shall be secured in place.

5.3 ACCESS

Access to buildings will be provided at all times. The paving schedule is to be coordinated to minimize interference with the normal use of the premises.

6.0 INSTALLATION

Pavers shall not be installed during heavy rain or snowfall or over frozen base materials. Sand shall not be installed if frozen, or over frozen base materials. After final compaction, all excess sand and debris shall be removed. 95 % of the joints shall be between 2 mm and 3 mm in width.

The sealer shall be applied as soon as practical after final compaction, in accordance with the sealer manufacturer's requirements regarding application methods, equipment, and rate. The joints at the interface between pavers and adjacent pavement and edge restraints shall be sealed with joint sealing filler material as directed by the Engineer. Bedding sand, pavers, and joint sand shall not be installed during periods of heavy rain or when temperatures are below 0°C.

6.1.1 EXAMINATION

- 1) Verify that the [aggregate] [asphalt] [cement-stabilized] [concrete] base upon which the bedding sand and pavers are to be installed is placed and compacted as specified to required grades.
- 2) Verify that the surface of the base is free of debris, standing water or obstructions, prior to installation of the bedding sand and concrete pavers. Provide drainage during installation of the wearing course and joint fill sand by means of weep holes, temporary drains into slot drains, dikes, ditches, etc. to prevent standing water on the base and in the bedding sand.
- 3) Verify that edge restraints are constructed as shown on the Plans.

Note: Edge restraints should be in place in places where pavers are installed. Some projects can have completed edge restraints with paving activity near it while the construction schedule dictates that the opposite side of the area may see initial construction of edge restraints. In such cases, the Contractor may propose an edge restraint installation schedule in writing for approval by the Engineer.

- 4) Inspect all locations of paver contact with other elements of the work, including but not limited to, weep holes, slot drains, edge restraints, utility boxes, manholes, and foundations. Insure that the underlying [aggregate] [cement-treated] [asphalt-treated] [concrete] base has been installed such that adequate clearance remains to install the wearing course and that all contact surfaces are vertical. Areas where clearance is not in compliance or the design or contact faces at adjacent pavements, edges, or structures are not vertical shall be brought to the attention of the Engineer in writing including location information. Remediation method(s) shall be proposed by the Contractor for approval by the Engineer. All such areas shall be repaired prior to commencing paver installation. Alternately, the Contractor may propose a repair schedule in writing for approval by the Engineer.

6.2 EXECUTION

6.2.1 BEDDING SAND COURSE

- 1) Screed a uniform layer to a maximum 25 mm thickness. Maintain a thickness within a tolerance of ± 5 mm. Allow for surcharge due to compaction of the pavers. Set intermediate screed rails to line and level where distances between rails exceed 4 m.
- 2) Do not expose the screeded bedding course to foot traffic or from mechanical equipment.
- 3) Fill voids with sand from removal of screed rails as the bedding proceeds.
- 4) Maintain a sufficient area of screeded sand ready to receive pavers for at least a day's work.

6.2.2 CONCRETE PAVERS

- 1) Locate and secure string lines in the direction of paving at approximately ft 6 m intervals to establish and maintain joint lines at maximum allowable width of clusters.

- 2) Lay paver clusters in pattern(s) as shown on the Plans.

Note: Herringbone patterns are recommended for airport pavements. The orientation of the herringbone pattern (45° or 90°) is typically governed by the site layout and the need to minimize cutting at the pavement perimeter.

- 3) Lay pavers from the existing laying face or edge restraint in such a manner as to ensure squareness of pattern.
- 4) Place machine laid pavers against the existing laying face.
- 5) Lay full pavers first, including a single-string course of pavers along all edge restraints and around fixed points such as the edges of catch basins/drains, utility boxes, foundations, and slabs.
- 6) If the cluster pattern is shipped to the site with half-sized paver units, [adjust locations] [remove and fill openings with full-sized pavers] so that each cluster is stitched and interlocked with adjacent clusters into the designated laying pattern. The resulting final pattern shall be part of the method statement.
- 7) Cut all pavers with a table-mounted masonry saw. Do not cut the top (wearing) or bottom surfaces.
- 8) Do not allow concrete waste and dust from cutting operations to collect or drain on the bedding sand, joint sand, or in unfinished joints. Such contact will be considered contamination of the work and will require removal and replacement of the affected materials.
- 9) No cut paver shall be smaller than one-third of a full paver.
- 10) Compact the pavers after placement on the bedding sand course, after all cut pavers have been inserted to provide a full and complete surface, after pattern lines have been straightened, and after joints brought into conformance with this specification.
- 11) Compact the pavers using a vibrating plate compactor with a plate area not less than 0.2 m² that transmits a force of not less than 0.1 MPa at 70 to 100 Hz.

Note: This compaction equipment typically exerts a minimum centrifugal force of 22 kN. Higher force equipment may be required on pavers over 80 mm thickness.

- 12) Continue compaction until the finished surface levels are within the tolerances.
- 13) Initial compaction of the all placed pavers shall be within [50] feet [15 m] of all unrestrained edges. If rain is forecast or imminent, then compact the pavers within 3 ft (1 m) of the laying face.

Note: It is ideal that initial compaction occur within 3 ft (1 m) of all unrestrained edges at the end of each day. However, large areas of paving are placed each day and often require inspection by the Engineer or other owner's representative prior to initial and final compaction. In these cases, the total allowable uncompacted area should be decided by the Engineer based on the daily production of the installer, inspection schedules, and weather.

- 14) After initial compaction, remove cracked or damaged pavers and replace with whole pavers.

6.2.3 JOINT FILLING SAND

1) After initial compaction of the pavers into the bedding sand, brush joint filling sand into the joints. Vibrate the sand into the joints using the same type of compaction equipment to initially set the pavers into the bedding sand until all joints are filled to the top with sand.

Note: Joint is spread on the surface of the pavers and typically allowed to dry so it can enter the joints readily. Bag joint sand is dry and will enter joints readily.

2) Complete vibration and filling joints with sand to within three feet of any unconfined edge at the end of the day if rain is forecast after vacating the job site. If no rain is forecast, fill joints with sand and compact [every [] days] [as approved by the Engineer] within 1 m of the laying face.

6.2.4 PROOF ROLLING

- 1) After compaction, remove loose sand and debris from the surface.
- 2) Proof roll areas designated by the Engineer with a minimum 10-ton (9 T) pneumatic-tired roller with offset wheels having a tire pressure of at least 90 psi.
- 3) Add joint filling sand as required where sand levels fall. Sweep these areas clean and proof roll until full and no change in joint sand levels.
- 4) Clean the surface on completion of proof rolling so it is free from excess sand, oil, laitance, dust, and any loose debris.

6.2.5 JOINT SAND STABILIZATION

Install joint sand stabilizer within [one week] after completion of a proof rolled area. Clean or re-clean the surface prior to the installation of the stabilizer. Install the stabilizer in accordance with the manufacturer's recommendations.

6.2.6 TOLERANCES ON COMPLETION:

Joint widths: 2 mm to 6 mm.

Smoothness: $\pm 3/8$ in. (± 10 mm) over a 10 ft (3 m) straightedge.

6.2.7 PROTECTION AND CLEAN UP

- 1) The Contractor shall insure that no vehicle traffic is permitted on any pavers until completion of all work in that portion of project. Maintain close coordination with other contractors working in the area.
- 2) Protect work from damage or theft until Final Acceptance. Repair or replace damaged work to original condition, or as directed by the Engineer.
- 3) Remove all debris and other materials from the pavement.

7.0 CONTRACTOR QUALITY CONTROL

7.1 GENERAL

The Contractor shall provide and maintain a quality control system that will provide methods and procedures to assure that all materials and completed construction submitted for acceptance conform to contract requirements whether manufactured or processed by the Contractor, or procured from Subcontractors or vendors. Quality control testing and inspection shall be

completed in accordance with the Public Works Canada publication, "Pavement Construction Methods and Inspection", AK-68-22-000 with the addition of the following sections.

7.2 EXAMINATION AND VERIFICATION PRIOR TO CONCRETE PAVER PLACEMENT

The Field Control Technician, who can be the Installer's on-site superintendent, shall also be responsible for the following:

- 1) Examination of surfaces designated to receive unit pavers for compliance with required installation tolerances. Verification that all surfaces to receive pavers are in proper condition, and that no conditions exist which may adversely affect progress or quality of work.
- 2) Verification that the base is dry and ready to support bedding material, pavers, and imposed loads.
- 3) Verification of base gradients and elevations.
- 4) Verification of location, type, installation, and elevations of adjacent edge restraints, drainage inlets, grounding lugs, and other appurtenances in the pavement.
- 5) Provision of adequate drainage during the entire construction phase by means of temporary drains, ditches, or other means to prevent the build-up of standing water.

7.3 QUALITY CONTROL TESTING

The Contractor shall perform any quality control tests necessary to control the production and construction processes applicable to these Specifications and as set forth in the approved Quality Control Plan.

7.3.1 PAVER PRODUCTION

The testing program for paver manufacture shall include, but not necessarily be limited to tests for control of:

- a) Batch proportioning
- b) Aggregate gradation (evidence from quarry tickets will be acceptable).
- c) Aggregate moisture content
- d) Water-cement ratio
- e) Density measurements

A minimum of two (2) tests for each property shall be made for each production day. For automated plants with recordation, the Contractor may submit printed tickets, in lieu of daily testing, provided evidence of recent plant calibration is submitted to the Engineer for approval prior to the start of production.

7.3.2 BEDDING AND JOINT SAND

The Contractor shall control the gradation and moisture content of the bedding and joint sand used for installation.

8.0 METHOD OF MEASUREMENT

The quantity of each element of work installed and accepted, comprising this item, shall be in accordance with the following measurements:

8.1 CONCRETE PAVERS AND JOINT SAND

Per square metre (m²), measured in-place, completed and accepted.

8.2 BEDDING SAND

Per tonne, measured on approved truck scales, completed and accepted.

8.3 EDGE RESTRAINT

Per linear metre, measured in-place, completed and accepted.

8.4 SEALER

Per square metre (m²) completed and accepted.

9.0 MATERIALS AND TESTING REQUIREMENTS

CSA-A23.1M90	Concrete Materials and Methods of Concrete Construction
CSA-CAN3-A23.2-M77	Methods of Test for Concrete
CSA-A23.2-1A	Sampling Aggregates for Use in Concrete
CSA-A23.2-2A	Sieve Analysis for Fine and Coarse Aggregate
CSA-A23.2-7B	Random Sampling of Construction Materials
CSA-A23.2-16A	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
CSA-A82.56M	Aggregate for Masonry Mortar
CSA-231.2-95	Precast Concrete Pavers
ACI 212-IR-81	Admixtures for Concrete
ASTM C 418	Test Method for Abrasion Resistance of Concrete by Sandblasting
ASTM C 979	Pigments for Integrally Coloured Concrete
ASTM D 2370	Standard Test Method for Tensile Properties of Organic Coatings
ASTM D 3665	Random Sampling of Paving Materials