



Abu Dhabi Specification

خصائص أبوظبي الفنية



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Interlocking Concrete Pavers

معايير مواد البناء البلاط المتشابك

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About the Abu Dhabi Quality and Conformity Council

The Abu Dhabi Quality and Conformity Council (QCC) was established by law No. 3 of 2009, issued by His Highness Sheikh Khalifa Bin Zayed Al Nahyan, President of the UAE.

QCC is responsible for the development of Abu Dhabi Emirate's Quality Infrastructure, which enables industry and regulators to ensure that products, systems and personnel can be tested and certified to UAE and International Standards.

Products certified by QCC receive the Abu Dhabi Trustmark. The Trustmark is designed to communicate that a product or system conforms to various safety and performance standards that are set by Abu Dhabi regulators.

1 Foreword

The QCC Working Group for Building Materials was established with a view to improve the quality of building materials used in Abu Dhabi's built environment. This would be achieved by reviewing the existing standards & draft standards relevant to various building materials, recommending the use of particular standards and, if necessary, preparing guidance documents for the special conditions and requirements found in the Emirate of Abu Dhabi.

2 Scope

This Abu Dhabi Specification recommends the use of particular standards for helping to ensure quality of interlocking pavers, a common hardscape surfaces for pedestrians and low-volume traffic in Abu Dhabi.

This document should be used on conjunction with Abu Dhabi Guideline ADG7/2015, which recommends the use of particular methods during installation and other relevant activities to help ensure quality of interlocking pavers.

3 Acknowledgements

QCC would like to thank the members of the Working Group for their contributions.

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4 General

4.1 Description

Interlocking concrete pavers shall comply with the requirements specified herein.

- A. Paver thickness shall be 60mm for pedestrian areas and 80-140 mm for vehicular areas. Dimensions are based on ASTM C936.
- B. The paving block manufacturers shall achieve the desired aesthetic appearance and finish of the paving blocks by careful combination of fine and coarse aggregates within the general grading limits specified herein to ensure an acceptable smooth surface is achieved.

5 Products

5.1 Constituent Materials Specifications

The constituent materials of the interlocking concrete pavers shall comply with the requirements of the following articles.

- A. Cement: The cement to be used in the manufacture of paving blocks shall be sulphate-resisting Portland cement Type-V, or ordinary Portland cement with partial cement replacement by supplementary cementitious materials such as fly ash and ground granulated blast-furnace slag (GGBS), and microsilica, etc., in accordance with ASTM C150.
- B. Aggregates: The aggregates to be used in the manufacture of the paving blocks shall be from crushed rocks and from approved sources, conforming to the requirements of BS EN 12620:2002+A1:2008. The sand shall be washed and free from deleterious substances. The aggregate shall not contain harmful material such as coal, mica, shale or similar laminated materials which cause strength deterioration.
 - 1. *Coarse Aggregate*: Coarse aggregate for paving blocks shall meet the following requirements:

Table 1. Coarse Aggregate for Interlocking Concrete Pavers		
Properties	Test Method⁽¹⁾	Permissible Limit
Particle Size Distribution	BS EN 933-1:2012	As per BS EN 12620:2002+A1:2008
Clay Silt & Dust	BS EN 933-1:2012	Max 1%
Organic Matter Content	BS 1377-3:1990	Nil
Water Absorption	BS EN 1097-6:2013	Max 1.5%
Relative Density	BS EN 1097-6:2013	Min 2.6
Shell Content	BS EN 933-7:1998	Nil
Flakiness Index	BS EN 933-3:2012	Max 25%
Elongation Index	BS 812-105.2:1990	Max 25%
Soundness (Mg SO ₄) 5 cycles	ASTM C88-13	Max 5%
Sulphate Content (SO ₃)	BS EN 1744-1:2009+A1:2012	Max 0.3%
Chloride Content (Cl)	BS EN 1744-1:2009+A1:2012	Max 0.20%
Aggregate Crushing Value	BS EN 1097-2:2010	Max 25%
Los Angeles Abrasion	AASHTO T 96-02	Max 25%
Note: 1) All standards refer to the latest version unless otherwise specified.		

2. *Fine Aggregate*: Fine aggregate for paving blocks shall meet the following requirements:

Table 2: Fine Aggregate for Interlocking Concrete Pavers		
Properties	Test Method	Permissible Limit
Particle Size Distribution	BS EN 933-1:2012	As per BS EN 12620:2002+A1:2008
Clay Silt & Dust	BS EN 933-1:2012	Max 3% passing 75 µm sieve
Organic Matter Content	BS 1377-3:1990	Nil
Water absorption	BS EN 1097-6:2013	Max 2%
Relative Density (Apparent)	BS EN 1097-6:2013	Min 2.6
Shell Content	BS EN 933-7:1998	Max 1%
Soundness (Mg SO ₄) 5 cycles	ASTM C88:13	Max 5%
Acid Soluble Materials	BS EN 1744-1:2009+A1:2012	Max 25%
Sulphate Content (SO ₃)	BS EN 1744-1:2009+A1:2012	Max 0.3%
Chloride Content (Cl)	BS EN 1744-1:2009+A1:2012	Max 0.1%

- C. Water: The water to be used in mixing and curing the precast concrete blocks shall be of drinking quality, clean and free from injurious substances of sewage, oil, acids, strong alkalis, vegetable matter, clay and other such substances harmful to the finished product.
- D. Pigment: Pigment shall comply to ASTM C979 to be used in manufacturing of precast concrete interlocking blocks shall be in the form of dry, soft powder of mineral oxides and shall not contain chemical compounds capable of affecting adversely the setting and development of strength of the cement and other properties of the finished products and shall be compatible with other admixtures used in the same mix. Pigments can be used throughout the concrete or for the top layer only in double mix production. Surface protection against color fading or chemical attaches are possible, but must be specifically recommended by purchaser.

5.2 Design Mix

The design mix shall comply with the requirements of the following articles.

- A. Combined Aggregate Grading: The combined grading shall satisfy the following limits.

Table 3: Combined Aggregate Grading for Interlocking Concrete Pavers	
Diameter	Limit (Percent Passing ^(1,2))
8.0 mm	100%
4.75 mm	72-82%
2.36 mm	41-61%
1.18 mm	25-46%
600 µm	16-31%
300 µm	8-17%
150 µm	3-8%
75 µm	0-3%

Notes: 1. Smooth, non-gap graded curve is expected.
2. Central tendency should be attempted.

- B. Cement Content: The cement content shall be a minimum of 430 Kg/m³.
- C. Water Cement (W/C) Ratio: The water cement ratio shall be a maximum of 0.42.
- D. Pigment Content: Only mineral oxide type from reputable source with test certificates. The pigment content shall not exceed 10% by mass of cement.

5.3 Physical & Mechanical Properties

The physical and mechanical properties of the interlocking concrete blocks shall conform to the following requirements.

- A. Bulk Density (min. 48 hrs. immersion):
1. Average > 2.375 T/m³
 2. Minimum = 2.330 T/m³

- B. Bulk/Apparent Density Ratio (min. 48 hrs. immersion)
1. Average > 0.88
 2. Minimum = 0.87
- C. Water Absorption (min. 48 hrs. immersion, tested according to ASTM C140)
1. Maximum = 3% for aggressive exposure zones¹, and 4.5% for less aggressive exposure zones²
- D. Compressive Strength (min. 48 hrs. Immersion, tested according to BS 6717:1993)
1. Average \geq 55 Mpa for aggressive exposure zones, and 49 for less aggressive exposure zones
 2. Minimum = 47 Mpa for aggressive exposure zones, and 44 for less aggressive exposure zones
- E. Abrasion Resistance (for vehicular areas only, tested as per ASTM C418)
1. Average thickness loss < 3 mm
 2. Maximum volume loss = 150 mm³ per 500 mm²
 3. Or comply with BS EN 1338 (maximum volume loss 20,000 mm³ per 5,000 mm²)
- F. Flexural Strength (tested according to ASTM C293 / C293M: 10)
1. Average Flexural Strength > 5 Mpa (Dry)
 2. Minimum Flexural Strength = 4.5 Mpa (Dry)
- G. At least 4 out of 5 of all tested specimens shall meet the specified average criteria for all physical and mechanical properties specified.
- H. The paving block manufacturers may achieve the physical properties specified herein for their products through various means such as addition of mineral and/or chemical admixtures to the concrete mix for the paving blocks.
- I. Concrete paving blocks shall be adequately cured, as specified, so that they comply with all the physical and mechanical properties upon delivery to site.

¹ Aggressive exposure zones are those areas where a shallow water table is known to be present. This underground water is generally brackish, where salt and other mineral content is capable of attacking Interlocking Concrete Pavers. This type of zone is generally found in Abu Dhabi City and other coastal areas throughout the Emirate.

² Less aggressive exposure zones have deeper water tables, comprising more fresh water. This type of zone is generally found in regions of Al Ain and Al Gharbia.

- J. Any consignments delivered to site that do not comply with the specified physical and mechanical properties shall be rejected by the Purchaser and the Manufacturer shall remove the consignment from site.
- K. Durability Criteria:
1. AS/NZS 4456.10:2003, method B
 2. Resistance to sodium sulphate and sodium chloride
 3. Conduct the test for 40 cycles and record the total loss
 4. Total loss after 40 cycles < 1% of mass of specimen

5.4 Dimensional Tolerance

- A. The length or width of each unit shall not differ by more than $\pm 1.6\text{mm}$ from the designated dimensions.
- B. The height of each unit shall not differ by more than $\pm 3\%$ from the specified standard thickness.

6 References

- 1) ASTM C88
- 2) ASTM C150
- 3) ASTM C293
- 4) ASTM C418
- 5) ASTM C936
- 6) BS 812
- 7) BS 1377
- 8) BS 6717
- 9) BS 7533
- 10) BS EN 933
- 11) BS EN 1097
- 12) BS EN 12620
- 13) BS EN 1744
- 14) AASHTO T 96-02

7 Definitions

AASHTO	American Association of State Highway and Transportation Officials
ASTM	American Society of Testing and Materials
BS	British Standard
BS EN	British Standard European Norm
Hz	Hertz
Kg	Kilogram
m	Meter
mm	Millimetre
MPa	Mega Pascal
QCC	Abu Dhabi Quality and Conformity Council
T	Tonnes
µm	Micrometre