ASTM Specifications for Pavers

2017-2 Webinar

The National Brick Research Center
Clemson University

Paver History – The Beginning

- Clay pavers have been utilized in the United States since the late 1800's. The first street paved in brick was in Charleston, West Virginia in 1870.
- Some of the early quality requirements for a high grade paving unit were:
  - 1. Toughness, hardness, and strength
  - 2. Uniformity of quality throughout a given lot of brick
  - 3. Homogeneity of structure and freedom of laminations
  - 4. Weather-resisting quality
  - 5. Regularity in form and size

Paver History – Part 2

- In 1895, the National Brick Manufacturers Association appointed a commission to investigate the subject of paving brick tests and to develop a set of standards.
- Some of the tests developed were:
  - 1. The Rattler Test (Impact and Abrasion Test)
  - 2. Absorption
  - 3. Crushing Test
  - 4. Cross-breaking Test (MOR)
  - 5. Specific Gravity
- The work done in the early 1900's led to the development of the ASTM C-7 Street Paving Specification in 1942.

Paver History – Later Development

- Since pavers are used on horizontal surfaces that are in contact with the ground, they are exposed to potentially extreme weathering conditions. They are subject to being saturated with water and going through numerous freezing and thawing cycles in the winter season in many areas of the country.
- Extensive research work done in the brick industry on the durability of paving units led to the development of a new set of specification requirements. The ASTM C-902 Specification for Pedestrian and Light Traffic Paving Brick was adopted in 1979.
- C-902 was not intended for heavy vehicular traffic. A new specification, ASTM C-1272, has been written to cover that application.

C902 – Light Traffic Paving Brick

- Class: SX, MX, NX (weather)
  - Class SX – brick intended for use where the brick may be frozen while saturated with water
  - Class MX – exterior use where resistance to freezing is not a factor
  - Class NX – Not for exterior use
- Type: I, II, III (traffic)
  - Based off of Abrasion Index
    - AI = 100 x Cold Water Absorption/Compressive Strength
  - Type I – subjected to extensive abrasion
  - Type II – subjected to intermediate abrasion
  - Type III – subject to low abrasion
- Applications: PX, PS (dimensions)

Designations in C902

TABLE 1 Freeze Thaw Resistance Property Requirements

Designation	Compressive Strength, flatwise, gross area, min, psi (MPa)		Cold Water Absorption, max, %		Saturation Coefficient, max[A]	
	Average of 5 Brick	Individual	Average of 5 Brick	Individual	Average of 5 Brick	Individual
Class SX	8000 (55.2)	7000 (48.3)	8.0	11.0	0.78	0.80
Class MX	3000 (20.7)	2500 (17.2)	14.0	17.0	no limit	no limit
Class NX	3000 (20.7)	2500 (17.2)	no limit	no limit	no limit	no limit

[A] The saturation coefficient is the ratio of absorption by 24-h submersion in room temperature water to that after 5-h submersion in boiling water.

C1272 Heavy Vehicular Paving Brick

- Types: F, R
  - Depends on installation
  - R is for mortar/asphalt bed
  - F for sand bed
  - F is the stricter type
- Applications: PX, PS, PA (dimensions, warpage)

Designations in C1272

TABLE 1 Physical Requirements

Type	Minimum Compressive Strength, Gross Area, psi (MPa)		Minimum Breaking Load, lb/in. (kN/mm)		Maximum Cold Water Absorption, %	
	Avg. of 5 Brick	Individual	Avg. of 5 Brick	Individual	Avg. of 5 Brick	Individual
R	8000 (55.2)	7000 (48.3)	. . .	. . .	6.0	7.0
F	10 000 (69.0)	8800 (60.7)	475 (83)	333 (58)	6.0	7.0

C902 and C1272 Key Differences

C902

- Light Traffic
- Uses Abrasion Index for Type
- Takes C/B into account

C1272

- Heavy Vehicular Traffic
- Requires Breaking Load Test for Type F
- Does not use C/B
- Minimum Thickness
  - Type R – 2 ¼ in.
  - Type F – 2 5/8 in.

Abrasion Resistance of Paving Brick

- The abrasion resistance of paving brick are listed in ASTM C 902 and ASTM C 1272.
- In both standards, the abrasion resistance can be either calculated and reported as an Abrasion Index or determined by a loss in volume test and reported as a Volume Abrasion Loss.
- The abrasion index is calculated form the **cold absorption** in percent and the **compressive strength** in pounds per square inch. The formula is as follows:
  - *abrasion index = 100 x absorption/compressive strength*

Calculated Abrasion Resistance

- The abrasion index is calculated from the **cold absorption** in percent and the **compressive strength** in pounds per square inch. The formula is as follows:
  - *abrasion index = 100 x absorption/compressive strength*

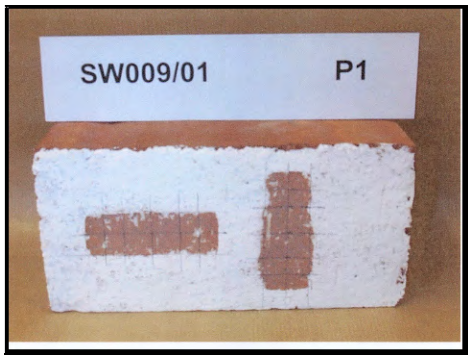
ASTM C 902

	Abrasion Index, max	Volume Abrasion Loss Max, cm^3/cm^2
Type I	0.11	1.7
Type II	0.25	2.7
Type III	0.50	4.0

ASTM C 1272

	Abrasion Index, max	Volume Abrasion Loss Max, cm^3/cm^2
R and F	0.11	1.7

Abrasion Testing of Pavers



The abrasion test described in the *British Brick Standards* was used for these tests.

Abrasion Resistance - Actual Versus Calculated

Sample	Actual Ranking	Calculated Ranking	Error From Actual
P1	15	12	+3
P2	5	3	+2
P3	12	7	+5
P4	12	5	+7
P5	7	8	-1
P6	1	1	0
P7	14	13	+1
P8	9	4	+5
P9	7	10	-3
P10	16	9	+7
P11	17	17	0
P12	4	14	-10
P13	9	15	-6
P14	5	11	-6
P15	11	6	+5
P16	2	2	0
P17	2	N/A	N/A

EN 1344 – Pendulum Test Methods

- Brick are saturated for at least 2 hrs.
- The brick are then tested with a water spray on the surface of the brick.
- Saturation prevents the brick from wicking the water away during testing.
- The height of the pendulum is adjusted to maintain contact over the range of the sweep.
- The surface of the brick is saturated with a water spray.
- Five swings are performed on the brick and then the brick is rotated 180° and repeated.
- The surface is rewet after each swing.

EN 1344 – Pendulum Test Methods

The National Brick Research Center
Clemson University

Recommended Pendulum Values

Potential for Slip	Pendulum Value
High	19 and below
Moderate	20 to 39
Low	40 to 74
Extremely Low	75 and above

Questions?

For more information on any of these standards or specifications, please visit ASTM.org

The National Brick Research Center
Clemson University