

**TEST REPORT**

**for**

**BOEHMERS 2 HOUR FIRE RATED CONCRETE BLOCK**

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## **INTRODUCTION**

The test data contained in this report provides an independent evaluation for Boehmers 2 Hour Fire Rated Concrete Block. The tests follow the accepted standard tests for concrete block, as defined by ASTM C140<sup>(1)</sup>. Standard 20 cm hollow concrete blocks were selected and shipped to McMaster University. A general description of the sample blocks and tests for density, absorption, compressive strength, splitting tensile strength, initial rate of absorption and drying shrinkage were conducted. The last three tests are not part of ASTM C140, but have been included as additional useful information. The shrinkage test measurements were performed in conformance with ASTM Standard C426<sup>(4)</sup>.

## **DESCRIPTION OF TESTS**

Test procedures and methods are briefly described in this section, and data specific to the supplied block is listed at the end of the report.

## **PHYSICAL CHARACTERISTICS**

The dimensions for the length, width, height, equivalent web thickness and equivalent thickness of the blocks were measured. The stretcher units had pear-shaped cells and tapered face shells which included a flared region near the top. Using measurements rounded to the nearest 0.5 mm, the average thickness, length, height, and minimum face shell thickness and web thickness were 190 mm, 390 mm, 190 mm and 43 mm and 28 mm respectively. These measurements were performed in accordance with ASTM C140<sup>(1)</sup>. The average area from tests of 5 block was found to be 47045 mm<sup>2</sup>. Equivalent thickness calculated based on average area is  $47045 \div 390 = 120.6$  mm.

Density and absorption were calculated in accordance with ASTM C140<sup>(1)</sup>. This involved determining the oven dry weight of the block, the weight of the block while submerged in water and the saturated surface dry weight. From this information, the density and the absorption of each block were calculated. Average values and the coefficients of variation are included to illustrate the statistical variability of the results.

The initial rate of absorption (IRA) for each of the blocks used for dimensions and shrinkage measurements was determined using the procedures of ASTM C67<sup>(2)</sup>. The test involved immersing the bed plane of each block in water to a depth of 3.2 mm (1/8 in.) For one minute and determining the mass of the absorbed water. Individual IRA values (called suction in this report) are included as a percentage (increase in weight as compared to the dry weight of the block) and as the increase in weight for the submerged area of the block. Average values and coefficients of variation are included. It is important to note that before the IRA test was conducted, the blocks were allowed to return to the natural state. Thus, the values obtained reflect what will occur in the field.

## **MECHANICAL PROPERTIES**

**Compressive Strength:** Five randomly selected blocks, not used in any other tests were tested under axial compression in accordance with ASTM C140<sup>(1)</sup>. Each block was capped top and bottom using hydrostone to ensure uniform bearing on 76.2 mm (3 in.) Thick solid steel plates. The blocks were tested in a Riehle Universal Test machine with a 2500 kN capacity. The blocks were centered carefully and exhibited a typical conical mode of failure. Individual failure loads, the average of the five values and the coefficient of variation are listed in Table 3 of this report.

**Splitting Tensile Strength:** Although tensile testing of a block is not required, splitting tensile tests were performed to provide a broad base of data for research on the behaviour of masonry walls. The test was done following the procedure outlined in ASTM standard C1006<sup>(3)</sup>. In this test, line loads were applied to the face shells (on opposite bed planes) using 15 mm diameter bars. The bars were placed at the centre of one cell for each concrete block. Strips of masonite were placed between the loading bar and the block to reduce stress concentration along the loading lines. The loads required to produce splitting failure, the calculated tensile strengths, average values and coefficients of variation are summarized in Table 4. Measurements to determine the area of the splitting plane were taken after completion of the test, in accordance with ASTM Standard C1006<sup>(3)</sup>. The average face shell thickness at mid-height was 45.5 mm.

**Drying Shrinkage:** The final information included in this report is the drying shrinkage of the blocks from a saturated surface dry condition to an oven dry condition according to the requirements of ASTM C426<sup>(4)</sup>. In this procedure, five blocks were soaked in water for 48 hours, after which weights and initial length readings (one reading over a 200 mm gauge length along the centreline) were taken and recorded for both sides of each block. The blocks were air dried until drying shrinkage reached an equilibrium, and then they were placed in a 50°C (122°) oven for final drying. Weight and shrinkage readings were taken regularly until a state of equilibrium was reached. The average shrinkage for each block has been included in Table 5 of this report, along with the average overall value and the coefficient of variation.

**REFERENCES:**

1. A.S.T.M., "C140: Standard Methods of Sampling and Testing Concrete Masonry Units", Annual Book of A.S.T.M. Standards, Philadelphia, PA.
2. A.S.T.M., "C67: Standard Methods of Sampling and Testing Brick and Structural Clay Tile", Annual Book of A.S.T.M. Standards, Philadelphia, PA.
3. A.S.T.M., "C1006: Standard Test Method for Splitting Tensile Strength of Masonry Units", Annual Book of A.S.T.M. Standards, Philadelphia, PA.
4. A.S.T.M., "C426: Standard Test Method for Drying Shrinkage of Concrete Block", Annual Book of A.S.T.M. Standards, Philadelphia, PA.

## Test Data for Boehmers 2 Hour Fire Rated Concrete Block

Table 1: Raw Data for Absorption, Suction and Density

Specimen Number	Oven Dry Mass (grams)	I.R.A. Mass (grams)	Water Mass (grams)	S.S.D. Mass (grams)
S1	18,983	19,024	11,143	20,047
S2	18,982	19,047	11,125	20,088
S3	18,986	19,029	11,150	20,225
S4	18,681	18,729	10,978	19,746
S5	18,970	19,017	11,165	20,033

Table 2: Area, Absorption, Suction and Density

Specimen Number	Area mm <sup>2</sup>	Absorption (%)	Absorption (kg/m <sup>3</sup> )	Suction (%)	Suction (kg/m <sup>2</sup> /min)	Density (kg/m <sup>3</sup> )
S1	46,964	5.61	119.5	0.216	0.873	2,132
S2	47,335	5.83	123.4	0.342	1.373	2,118
S3	47,871	6.53	136.5	0.226	0.898	2,092
S4	46,266	5.70	121.5	0.257	1.037	2,131
S5	46,789	5.60	119.9	0.248	1.005	2,139
Average	47,045	5.85	124.2	0.258	1.037	2,122
C.O.V. %	1.47	6.3	5.7	19.3	19.3	0.8

Table 3: Compressive Strength

Specimen Number	Failure Load (kN)	Compressive Strength (MPa)
C1	1,569	33.4
C2	1,619	34.2
C3	1,582	33.0
C4	1,596	34.5
C5	1,649	35.2
Average	1,603	34.1
C.O.V. %	2.0	2.6

Table 4: Splitting Tensile Strength

Specimen Number	Failure Load (kN)	Tensile Strength (MPa)
C1	65.7	2.42
C2	66.4	2.45
C3	64.0	2.36
C4	59.8	2.20
C5	61.3	2.26
Average	63.4	2.33
C.O.V. %	4.5	4.5

Table 5: Drying Shrinkage

Specimen Number	Drying Shrinkage (%)
C1	0.017
C2	0.021
C3	0.018
C4	0.018
C5	0.021
Average	0.019
C.O.V. %	9.85