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**Test Results of Material Characterization Testing of Carboclave (CO₂ cured) Concrete
Masonry Blocks produced by Boehmers**

Attn: Mr. Paul Hargest, President, Boehmers
Plant Address: 1038 Rife Road
Cambridge, ON, N1R 5S3
Mailing Address: P.O. Box 25059
Kitchener, ON, N2A 4A5

April 26, 2016

Dear Mr. Hargest,

In response to your request to conduct material characterization testing of the Carboclave concrete masonry blocks supplied by Boehmers, please note that the following tests were conducted:

Physical Characteristics: Evaluation of the dimensions for the length, width, height, equivalent web thickness and the minimum face shell thickness of blocks in accordance with ASTM C140. The density and absorption involved determining the oven dry weight of the block, the weight of the block while submerged in water and the saturated surface dry weight. The initial rate of absorption (IRA) for the blocks was determined using the procedures of ASTM C67.

Drying Shrinkage: Determination of drying shrinkage of the blocks, from a saturated surface dry condition to an oven dry condition, according to the requirements of ASTM C426.

Compressive Strength: Blocks were tested under axial compression in accordance with ASTM C 140 in a Riehle Universal Test machine with a 2,500 kN capacity.

Splitting Tensile Strength: For the splitting tensile strength testing, additional blocks were tested following the procedure outlined in ASTM standard C1006.

Please see the test results for each blocks series in the following two pages. I am also attaching the test results of the normal weight and light weight autoclaved Boehmers blocks that we tested in September 2015. As you can observe, the Carboclave blocks appear to have approximately 50% higher strength than the autoclaved units.

Sincerely,

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Test Data for Boehmers CO2 Cured Blocks

April, 2016

Table 1: Raw Data for Absorption, Suction and Density

Specimen	Received Wt (kg)	Oven Dry Mass (kg)	Water absorbed during IRA Test (kg)	Mass of Block in Water (kg)	S.S.D. Mass (kg)	Average Height (mm)
S1	17.194	16.940	0.029	10.121	17.805	189.51
S2	17.250	16.921	0.034	10.125	17.815	189.29
S3	17.301	17.070	0.024	10.202	17.797	188.40
S4	17.268	16.961	0.029	10.149	17.835	189.10
S5	17.221	16.934	0.032	10.122	17.806	189.87

Table 2: Area, Absorption, Suction and Density

Specimen	Area (mm ²)	Absorption (%)	Absorption (kg/m ³)	Suction (%)	Suction (kg/m ² /min)	Density (kg/m ³)
S1	40547	5.106	112.6	0.171	0.715	2205
S2	40625	5.283	116.3	0.201	0.837	2200
S3	40314	4.259	95.7	0.140	0.595	2248
S4	40646	5.153	113.7	0.171	0.713	2207
S5	40471	5.149	113.5	0.189	0.791	2204
Average	40521	4.990	110.3	0.174	0.730	2213
C.O.V. (%)	0.3	8.3	7.5	13.1	12.6	0.9

Table 3: Compressive Strength

Specimen	Failure Load (KN)	Compressive Strength (MPa)
C1	1540.37	38.0
C2	1350.01	33.3
C3	1418.71	35.0
C4	1573.68	38.8
C5	1322.45	32.6
Average	1441.0	35.6
C.O.V. (%)	7.8	7.8

Table 4: Splitting Tensile Strength

Specimen	Failure Load (kN)	Tensile Strength (MPa)
T1	42.7	2.07
T2	37.6	1.82
T3	41.9	2.06
T4	41.4	2.07
T5	43.5	2.18
Average	41.4	2.04
C.O.V(%)	5.5	6.4

Table 5: Drying Shrinkage

Specimen	Drying Shrinkage (%)
LS1	0.0204
LS2	0.0184
LS3	0.0188
LS4	0.0216
LS5	0.0192
Average	0.0196
C.O.V(%)	6.7

Table 6 : Measurements

Specimen	Width (mm)	Length (mm)	Height (mm)	Face Shell Thickness (mm)	Web Thickness (mm)
S1	190.1	390.0	189.5	32.89	27.08
S2	190.0	390.0	189.3	32.89	27.20
S3	190.5	389.8	188.4	33.16	27.58
S4	190.5	390.0	189.1	33.05	27.48
S5	190.2	389.8	189.9	33.05	27.10
Average	190.3	389.9	189.2	33.0	27.3
C.O.V.(%)	0.1	0.0	0.3	0.3	0.8



**Test Results of Material Characterization Testing of Normal Weight and Light
Weight Concrete Masonry Blocks produced by Boehmers**

Attn: Mr. Paul Hargest, President, Boehmers
Plant Address: 1038 Rife Road
Cambridge, ON, N1R 5S3
Mailing Address: P.O. Box 25059
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September 10, 2015

Dear Mr. Hargest,

In response to your request to conduct material characterization testing of normal weight and light weight concrete masonry blocks, please note that the following tests were conducted on both series of blocks.

Physical Characteristics: The dimensions for the length, width, height, equivalent web thickness and the minimum face shell thickness of blocks were evaluated in accordance with ASTM C140. The density and absorption involved determining the oven dry weight of the block, the weight of the block while submerged in water and the saturated surface dry weight. The initial rate of absorption (IRA) for the blocks was determined using the procedures of ASTM C67.

Drying Shrinkage: The drying shrinkage of the blocks, from a saturated surface dry condition to an oven dry condition, according to the requirements of ASTM C426, was evaluated.

Compressive Strength: Blocks were tested under axial compression in accordance with ASTM C 140 in a Riehle Universal Test machine with a 2,500 kN capacity.

Splitting Tensile Strength: For the splitting tensile strength testing, additional blocks were tested following the procedure outlined in ASTM standard C1006.

Please see the test results for each blocks series in the two following pages.

Sincerely,

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Test Results for Boehmers Normal Concrete Block

Table 1: Raw Data for Absorption, Suction and Density

Specimen	Oven Dry Mass (kg)	I.R.A Mass (kg)	Water Mass (kg)	S.S.D. Mass (kg)	Average Height (mm)
D1N	16.457	16.531	9.647	17.388	188.59
D2N	16.571	16.678	9.785	17.551	190.52
D3N	16.611	16.741	9.853	17.606	189.18
D4N	16.448	16.602	9.700	17.488	189.82
D5N	16.468	16.556	9.681	17.413	189.70

Table 2: Area, Absorption, Suction and Density

Specimen	Area (mm ²)	Absorption (%)	Absorption (kg/m ³)	Suction (%)	Suction (kg/m ² /min)	Density (kg/m ³)
D1N	41048	5.657	120.3	0.450	1.803	2126
D2N	40763	5.914	126.2	0.646	2.625	2134
D3N	40982	5.990	128.3	0.783	3.172	2143
D4N	41029	6.323	133.5	0.936	3.753	2112
D5N	40760	5.738	122.2	0.534	2.159	2130
Average	40917	5.924	126.1	0.670	2.702	2129
C.O.V. (%)	0.350	4.379	4.147	29.023	28.876	0.528

Table 3: Compressive Strength

Specimen	Failure Load (KN)	Compressive Strength (MPa)
C1N	959.9	23.5
C2N	903.2	22.1
C3N	983.6	24.0
C4N	932.5	22.8
C5N	856.4	20.9
Average	927.1	22.7
C.O.V. (%)	5.4	5.4

Table 4: Splitting Tensile Strength

Specimen	Failure Load (kN)	Tensile Strength (MPa)
T1N	33.5	1.63
T2N	37.6	1.81
T3N	40.9	1.98
T4N	38.8	1.88
T5N	38.0	1.84
Average	37.7	1.83
C.O.V.(%)	7.2	7.1

Table 5: Drying Shrinkage

Specimen	Drying Shrinkage (%)
D1N	0.0136
D2N	0.0136
D3N	0.0128
D4N	0.0128
D5N	0.0118
Average	0.0129
C.O.V.(%)	5.8

Table 6 : Measurements

Specimen	Average Thickness (mm)	Length (mm)	Height (mm)	Min. Face Shell Thickness (mm)	Web Thickness (mm)
D1N	189.7	391.5	189.7	33.68	27.64
D2N	190.0	391.8	189.8	33.48	27.58
D3N	190.4	391.5	189.2	33.58	27.58
D4N	189.8	391.8	190.5	33.43	27.53
D5N	190.4	391.5	188.6	33.62	27.60
Average	190.1	391.6	189.6	33.6	27.6
C.O.V.(%)	0.2	0.0	0.4	0.3	0.1

Test Results for Boehmers Light Weight Concrete Block

Table 1: Raw Data for Absorption, Suction and Density

Specimen	Oven Dry Mass (kg)	I.R.A Mass (kg)	Water Mass (kg)	S.S.D. Mass (kg)	Average Height (mm)
D1L	13.826	13.892	7.150	14.947	190.97
D2L	13.563	13.693	7.092	14.878	189.83
D3L	13.556	13.643	6.900	14.742	191.06
D4L	13.555	13.627	6.880	14.693	189.55
D5L	13.68	13.822	7.136	15.011	189.97

Table 2: Area, Absorption, Suction and Density

Specimen	Area (mm ²)	Absorption (%)	Absorption (kg/m ³)	Suction (%)	Suction (kg/m ² /min)	Density (kg/m ³)
D1L	40829	8.108	143.8	0.477	1.616	1773
D2L	41017	9.695	168.9	0.958	3.169	1742
D3L	41046	8.749	151.2	0.642	2.120	1729
D4L	41220	8.395	145.7	0.531	1.747	1735
D5L	41454	9.730	169.0	1.038	3.425	1737
Average	41113	8.935	155.7	0.729	2.416	1743
C.O.V. (%)	0.573	8.336	7.959	34.835	34.399	1.002

Table 3: Compressive Strength

Specimen	Failure Load (KN)	Compressive Strength (MPa)
C1L	921.8	22.4
C2L	952.6	23.2
C3L	942.3	22.9
C4L	1033	25.1
C5L	991.6	24.1
Average	968.3	23.6
C.O.V. (%)	4.6	4.6

Table 4: Splitting Tensile Strength

Specimen	Failure Load (kN)	Tensile Strength (MPa)
T1L	38.3	1.82
T2L	36.3	1.72
T3L	41.0	1.95
T4L	37.1	1.77
T5L	37.2	1.78
Average	38.0	1.81
C.O.V.(%)	4.8	4.9

Table 5: Drying Shrinkage

Specimen	Drying Shrinkage (%)
D1L	0.0192
D2L	0.0176
D3L	0.0184
D4L	0.0184
D5L	0.0190
Average	0.0185
C.O.V.(%)	3.4

Table 6 : Measurements

Specimen	Average Thickness (mm)	Length (mm)	Height (mm)	Min. Face Shell Thickness (mm)	Web Thickness (mm)
D1L	190.4	391.8	190.0	34.61	27.76
D2L	190.8	391.8	189.5	34.85	27.69
D3L	190.6	393.0	191.1	34.33	28.13
D4L	190.7	392.8	189.8	34.26	27.75
D5L	190.5	392.5	191.0	34.21	27.77
Average	190.6	392.4	190.3	34.5	27.8
C.O.V.(%)	0.1	0.1	0.4	0.8	0.6