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**CCMC 12873-R**

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**CCMC**

*EVALUATION  
REPORT*

<b>DIVISION</b>	<b>04226</b>
<b>Issued</b>	<b>1998-08-10</b>
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## ***Azar Dry-Stack Block™***

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### ***1. Purpose of Evaluation***

The manufacturer sought confirmation from the Canadian Construction Materials Centre (CCMC) that “Azar Dry-Stack Block™,” a masonry unit, can be used for the construction of walls for buildings complying with the National Building Code of Canada (NBC) 1995.

### ***2. Opinion***

Test results and engineering analysis provided by the manufacturer show that “Azar Dry-Stack Block™” complies with CCMC’s Technical Guide for Dry-Stack Concrete Masonry Block, Masterformat number 04226, dated 97-10-21. If used in accordance with the limitations and conditions stated in this report, “Azar Dry-Stack Block™” provides a level of performance equivalent to that required in:

- NBC 1995, Subsections 4.3.2., 9.15.4. and Article 9.20.2.1.

Canada Mortgage and Housing Corporation permits the use of this product in construction financed or insured under the National Housing Act.

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### 3. Description

“Azar Dry-Stack Block™” is a mortarless masonry wall system that has mechanical interlocking in both the horizontal and vertical directions. The cells are filled with grout to enhance axial load capacity, provide out-of-plane resistance to transverse load and provide in-plane shear resistance.

Out-of-plane interlocking is produced by three mechanisms. The first includes a key on the top of the web that fits into a recess on the bottom of the web of the block above it. Another interlocking mechanism is created by two levels of bearing surface along each face shell at the bed joint. The overlap creates an interlock. The gap between the outer parts of the face shell simulates a mortar joint. These two interlocking features ensure vertical alignment of the blocks and resist out-of-plane displacement along a vertical line.

The third mechanism is the face shell interlocking of adjacent blocks along the head joint using the shiplap geometry.

The webs are vertically aligned, which provides vertical grout columns. The horizontal reinforcement can pass through the key way geometry along the top of the webs.

The interlocking features assist in the alignment and leveling, and limit the maximum construction tolerances.

This dry-stack form of construction allows floor and roof loads to be applied immediately upon completion of the walls and construction to continue without interruption.

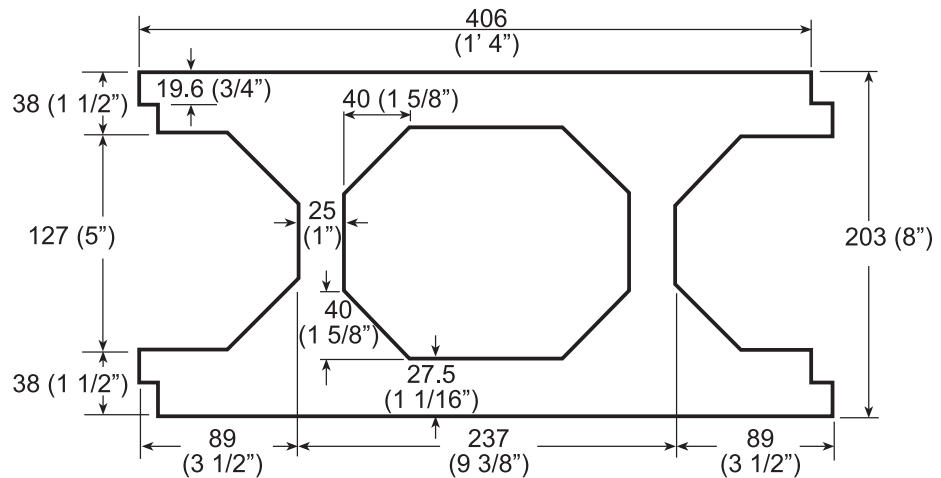
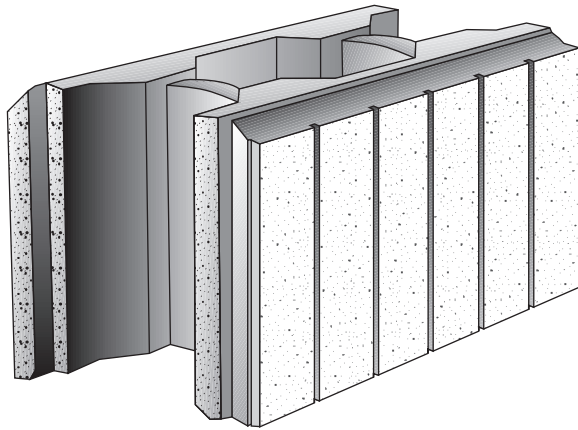


Figure 1. Azar Dry-Stack Block™, isometric and plan view

### 4. Usage and Limitations

“Azar Dry-Stack Block™” dry-stacked, interlocking concrete masonry blocks may be used for concrete

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masonry wall construction above and below grade in buildings of 3 storeys or less in building height, having a building area not exceeding 600 m<sup>2</sup> as indicated in Article 2.1.3.1. of the NBC 1995, subject to the following conditions:

- “Azar Dry-Stack Block™” concrete masonry blocks must conform to the physical properties requirements of CSA standard A165.1-94, “Concrete Masonry Units.”
- Wall construction using “Azar Dry-Stack Block™” concrete blocks shall be in accordance with the requirements of “Design and Construction Guide for Azar Dry-Stack Block™ Construction,” dated December 1998.
- Grout used with “Azar Dry-Stack Block™” must comply with CSA standard A179-94, “Mortar and Grout for Unit Masonry.”
- Care must be taken to ensure that construction is straight and plumb. Also, care must be taken to provide a level footing for the first course of blocks.
- Foundation walls must be backfilled on both sides and must not extend more than 1.2 m above grade. Otherwise the wall shall be reinforced.
- Basement walls must not exceed 2.5 m in height. For walls without reinforcement, the grade must not exceed 2.08 m above the basement floor level with well-drained soil.
- For basement walls 2.5 m in height reinforced with 15 M vertical bars not exceeding 800 mm on centre, the grade may be up to 2.49 m above the basement floor level.
- “Azar Dry-Stack Block™” used for masonry wall construction shall be fully grouted.
- For exterior above-grade walls and internal loadbearing walls, the provisions of Section 9.20. of the NBC 1995 apply. Wall height is limited to 20 times the wall thickness. Minimum reinforcement is recommended to be used in seismically active areas, for tall walls and for three-storey buildings.
- Corbelling of “Azar Dry-Stack Block™” is not permitted.
- Fully grouted walls can be used for the construction of non-loadbearing internal partitions with a maximum 5.2 m vertical or horizontal span.
- Good design practices such as reinforcing around openings, connecting intersecting walls, and proper distribution of load shared between several walls should be followed.
- Exterior walls shall be protected in accordance with Section 9.27., Section 9.28, or Article 9.20.6.4 of the NBC 1995.
- In accordance with the requirements of Section 9.25. of the NBC 1995, all walls separating heated space from unheated space shall be provided with sufficient thermal insulation to prevent moisture condensation. The wall assembly shall also contain a vapour barrier and an effective air barrier system.
- Interior finishes conforming to Section 9.29. of the NBC 1995 shall be applied when insulation is placed on the interior of the “Azar Dry-Stack Block™” wall.
- If foamed plastics are used as insulation, protection shall conform to Article 9.10.16.10. of the NBC 1995.
- Dampproofing of walls below grade shall conform to Subsection 9.13.3. of the NBC. Parging is not required below ground level when a polyethylene sheet complying to CAN/CGSB-51.34-M is used for dampproofing.
- Foundation drainage shall conform to Subsection 9.14.2. of the NBC 1995.
- Footings shall conform to Subsection 9.15.3. of the NBC 1995.

For buildings designed outside the scope of Part 9 of the NBC 1995, all drawings and related documents shall bear the authorized professional seal and signature of a professional engineer or architect skilled in masonry design and licensed to practice under the appropriate provincial or territorial legislation. Buildings shall be designed in accordance with the requirements of CSA

S304.1-94, “Masonry Design for Buildings (Limit State Design).”

Testing and assessment were conducted at laboratories recognized by the CCMC.  
The test results are summarized below.

## 5. Performance

### 1. Physical Properties (Tables 1 and 2):

**Table 1. Physical Properties of “Azar Dry-Stack Block™” Blocks**

Property	Unit	Result
Length	mm	406
Width	mm	203
Height	mm	203
Mass	kg	17.9
Block density	kg/m <sup>3</sup>	2075
Saturated moisture content	% by weight	6.85
Net area of block at mid-height	mm <sup>2</sup>	43,858
Linear shrinkage	%	0.0365
Average compressive strength for net area	Mpa	29.1 (COV 7.5%)

**Note:** The classification for “Azar Dry-Stack Block™” according to CSA A165.1-94 is H/20/A/0.

**Table 2. Physical Properties of Grout for “Azar Dry-Stack Block™”**

Properties	7 days		28 days	
	Stress MPa	COV %	Stress MPa	COV %
Compression cylinders	9.8	3.0	17.6	2.6
Compression cores	11.1	6.9	18.6	5.6
Modulus of rupture cores	1.58	6.4	2.57	11.9
Splitting tension cores	1.83	12.8	2.01	6.4

### 2. Prisms Tests (Table 3):

**Table 3. Compressive Load Test Results for Prisms**

Age (days)	Eccentricity, mm	Failure Load, kN	Average Stress, MPa
28	0	1319	18.9
28	34	983	14.1
28	68	513	7.3

### 3. Wall Tests (Tables 4, 5 and 6):

**Table 4. Bending Normal to the Bed Joint Test Results (3 specimens)**

Cracking Moment <sup>(1)</sup> , kN-m	Yield Moment <sup>(1)</sup> , kN-m	Ultimate Moment <sup>(1)</sup> , kN-m
7.6	21.2	24.1
3.8 % COV	2.7 % COV	6.3 % COV

**Table 5. Bending Parallel to the Bed Joint Test Results (3 specimens)**

Cracking Moment <sup>(1)</sup> , kN-m	Tensile Stress <sup>(1)</sup> , Mpa
9.9	2.48
1.0 % COV	1.0 % COV

<sup>(1)</sup> includes self weight and dead loads

**Table 6. Results for Eccentricity of 34 mm Top and Bottom Axial Load Tests**

Failure Load, kN	Average Stress (P/A), MPa
1384	9.91
	24.8 % COV

### 4. Design (Tables 7 and 8):

**Table 7. Maximum Soil Depth and Reinforcement Schedule for Basement Walls**

No. of Course	Wall Height, m	Maximum Soil Depth, m	As, mm <sup>2</sup> /m	Bar Size, M	Spacing, mm
10	2.03	2.03	Unreinforced		
11	2.23	2.22			
12	2.44	2.13			
13	2.64	2.07			
13	2.64	2.49	284	20	1000
14	2.84	2.69	372	20	800
15	3.05	2.9	448	20	600
16	3.25	3.1	568	25	600
17	3.45	3.3	718	25	600
18	3.65	3.5	914	25	500
19	3.86	3.66	1142	25	400

**Table 8. Minimum Wall Reinforcement for Combined Axial and Wind Loads <sup>(1)</sup>**

Wall Height, m	Factored Wind, kPa	Factored Axial Load, kN/m				
		10	20	40	60	80
4.0	2.25	(2)	(2)	(2)	(2)	(2)
	2.50	20 @ 1.2	(2)	(2)	(2)	(2)
4.4	2.00	(2)	(2)	(2)	(2)	(2)
	2.25	20 @ 1.2	20 @ 1.0	20 @ 1.2	20 @ 1.2	(2)
	2.50	20 @ 1.0	20 @ 1.0	20 @ 0.6	20 @ 0.6	20 @ 1.0
4.8	1.5	(2)	(2)	(2)	(2)	(2)
	1.75	20 @ 1.2	20 @ 1.2	(2)	(2)	(2)
	2.00	20 @ 1.0	20 @ 0.8	20 @ 0.6	20 @ 1.2	20 @ 1.2
	2.25	20 @ 0.8	20 @ 0.8	20 @ 0.6	20 @ 0.4	20 @ 0.6
	2.50	20 @ 0.8	20 @ 0.6	20 @ 0.6	20 @ 0.4	20 @ 0.4
5.2	1.25	(2)	(2)	(2)	(2)	(2)
	1.50	20 @ 1.0	20 @ 1.2	20 @ 1.2	(2)	(2)
	1.75	20 @ 0.8	20 @ 0.8	20 @ 0.6	20 @ 1.2	20 @ 1.2
	2.00	20 @ 0.8	20 @ 0.6	20 @ 0.6	20 @ 0.4	20 @ 0.4
	2.25	20 @ 0.6	20 @ 0.6	20 @ 0.4	20 @ 0.4	25 @ 0.4
	2.50	20 @ 0.6	20 @ 0.6	20 @ 0.4	20 @ 0.4	25 @ 0.4
5.6	1.00	(2)	(2)	(2)	(2)	(2)
	1.25	20 @ 1.2	20 @ 1.2	(2)	(2)	(2)
	1.50	20 @ 0.8	20 @ 0.6	20 @ 0.4	20 @ 1.2	20 @ 1.2
	1.75	20 @ 0.6	20 @ 0.6	20 @ 0.4	20 @ 0.4	25 @ 0.4
	2.00	20 @ 0.6	20 @ 0.6	20 @ 0.4	25 @ 0.6	25 @ 0.4
	2.25	20 @ 0.6	20 @ 0.4	20 @ 0.4	25 @ 0.4	25 @ 0.4
	2.50	20 @ 0.6	20 @ 0.4	20 @ 0.4	25 @ 0.4	25 @ 0.2

6.0	1.00	(2)	(2)	(2)	(2)	(2)
	1.25	20 @ 0.8	20 @ 0.6	20 @ 0.4	20 @ 1.2	20 @ 1.2
	1.50	20 @ 0.6	20 @ 0.6	20 @ 0.4	25 @ 0.4	25 @ 0.4
	1.75	20 @ 0.6	20 @ 0.4	20 @ 0.4	25 @ 0.4	25 @ 0.2
	2.00	20 @ 0.6	20 @ 0.4	25 @ 0.6	25 @ 0.4	25 @ 0.2
	2.25	20 @ 0.4	20 @ 0.4	25 @ 0.4	25 @ 0.4	25 @ 0.2
	2.50	20 @ 0.4	20 @ 0.4	25 @ 0.4	25 @ 0.2	25 @ 0.2

(Masonry  $f'_m = 16.2$  MPa, Steel  $f_y = 400$  MPa)

(1) interpolation is acceptable

(2) unreinforced is satisfactory for out-of-plane bending, however minimum reinforcement should be provided

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*Note: Readers are asked to refer to limitations imposed by NRC on the interpretation and use of this report. These limitations are included in the introduction to CCMC's Registry of Product Evaluations, of which this report is part.*

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