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EVALUATION
REPORT

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Re-Evaluation
in process

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:

- National Building Code of Canada 1995, Subsections 4.3.2., 9.15.4. and 9.20.2.

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

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 interlock 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 with 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 allows construction to continue without interruption.

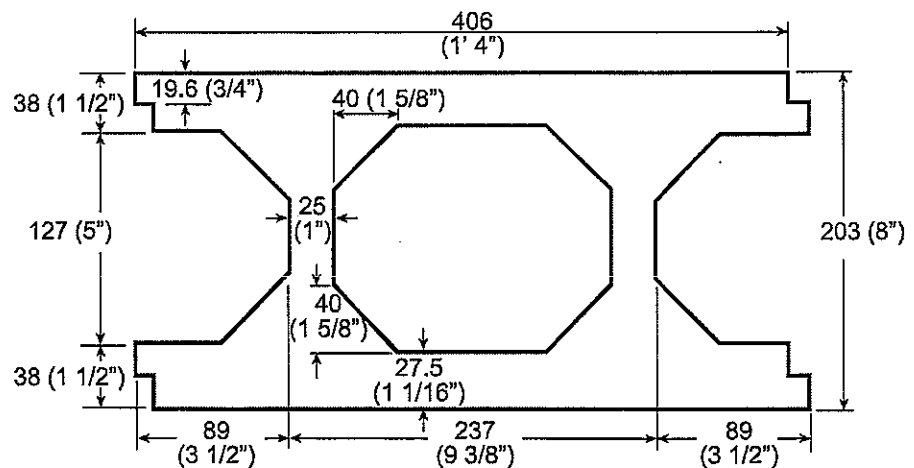
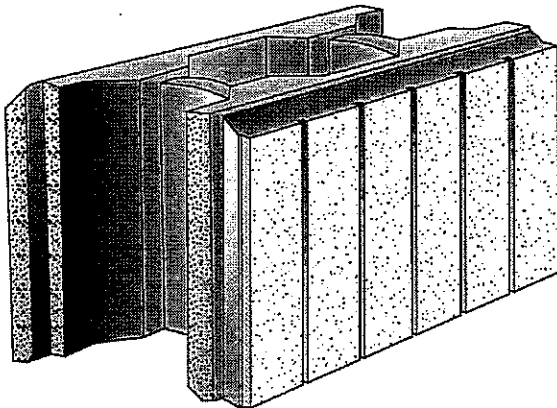


Figure 1. Azar Dry-Stack Block™, isometric and plan view

4. Usage and Limitations

"Azar Dry-Stack Block™" dry-stacked interlocking concrete masonry blocks may be used for concrete masonry wall construction above and below grade in buildings of 3 storeys or less in building height that have a building area not exceeding 600 m² as indicated in Article 2.1.3.1. of the NBC 1995, subject to the following conditions:

- "Azar Dry-Stack Block™" concrete masonry blocks conform to the physical properties requirements of CSA 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 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 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.
- 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 NBC 1995 Section 9.27., Section 9.28 or Article 9.20.6.4.
 - 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.
 - 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.
 - Footings shall conform to Subsection 9.15.3. of the NBC 1995.
- For buildings designed outside the scope of Part 9 of the NBC, 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)."

5. Performance

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

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 ³	2075
Saturated Moisture Content	% by weight	6.85
Net Area of Block at Mid-height	mm ²	43,858
Linear Shrinkage	%	0.0365
Average Compressive Strength for Net Area	MPa	33.4 (COV 5.32%)

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

Table 2. Physical Properties Grout for "Azar Dry-Stack Block™"

Properties	28 days		
	Compressive Strength MPa	Tensile Strength MPa	COV %
Cylinders	19.4		2.5
Prism	30.6		3.5
Modulus of Rupture	2.57	4.44	12.7
Splitting Tension	2.01	4.46	18.8

2. Prisms Tests (Table 3):

Table 3. Compressive Load Test Results for Prisms/Diagonal Shear Test Results.

Age (days)	Grouted (G) or Surface Bonded (SB)	Failure Load kN	Strength MPa
28	Compression G	1098	13.45
28	Compression SB	543	20.15
28	Diagonal Shear G	105	1.29
28	Diagonal Shear SB	527	1.53

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

Table 4. Flexural Test for Surface Bonded Block Walls

Direction of Bending	Clear Span, mm	Total Moment, kN-m
Parallel to Bed Joints	1473	8.34
Perpendicular to Bed Joints	1473	7.95

Table 5. Compression Test Results for Walls Loaded at 34 mm Eccentricity

Height	Failure Load, kN
2.55	212.5
5.05	179

Table 6. Shear Slip Test Results

Failure Load, kN	Shear Slip Strength, Mpa
15.44	0.576

4. Design (Tables 7 and 8):

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

No. of Courses	Wall Height, m	Maximum Soil Depth, m	As, mm ² /m	Bar Size, M	Spacing, mm
10	2.03	2.03			
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

Note to Table 7:

(1) Unreinforced is satisfactory for out-of-plane bending, however, minimum reinforcement should be provided.

Table 8. Minimum Wall Reinforcement for Combined Axial and Wind Loads (1)

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

Notes to Table 8:

(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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