



DIVISION: 04 00 00—MASONRY
Section: 04 22 00—Concrete Unit Masonry

REPORT HOLDER:

SPHERICAL BLOCK, LLC

EVALUATION SUBJECT:

ARCH BLOCK, PENT BLOCK AND HEX BLOCK

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021 and 2018 *International Building Code*® (IBC)
- 2021 and 2018 *International Residential Code*® (IRC)

Properties evaluated:

- Material Properties

2.0 USES

The Arch Block, Pent Block and Hex Block are used to form various arch and dome structures.

3.0 DESCRIPTION

The Arch Block, Pent Block and Hex Block are normal weight concrete masonry units used in conjunction with GatorBar Fiber-Reinforced Polymer (FRP) Bars and mortar to form various arch and dome structures. The masonry units are composed of Portland cement, fly ash and a blend of aggregates as outlined in the manufacturer’s approved quality documentation.

3.1 Arch Block: The Arch Block is a solid rectangular-shaped masonry unit that varies in thickness at each corner. The variable thickness allows the blocks to be stacked to form smooth or corrugated masonry arches. See Figure 1.

The smooth arches have a flat smooth surface on the interior and exterior of the arch. The corrugated geometry provides a “herringbone” shape to the structure on the interior and exterior of the arch. See Figure 4.

3.2 Pent Block and Hex Block: The Pent Block and Hex Block are a hollow core triangular shaped masonry units. The unique shape of the Pent Block unit is designed such that when they are stacked, the units form a geodesic dome based on a pentagon. See Figure 2. The unique shape of the Hex Block units is such that when they are stacked, the units form a geodesic dome based on a hexagon. See Figure 3.

The Hex Block and Pent Block may be used individually or in conjunction with one another to create many different shapes based on polyhedral geometrical configurations to form geodesic domes. In addition to the polyhedral geometry, the order, or frequency, of the dome is selected to determine the overall size of the spherical section to be constructed.

3.3 Reinforcing Bars: GatorBar or conventional steel rebar are used to serve as a guide for placement of the Arch Block, Pent Block and Hex Block masonry units and are a non-structural component of the arch and dome systems described in this report. GatorBar is a fiber-reinforced polymer (FRP) bar that is solid and has a circular cross-section composed of glass fiber embedded in a resin matrix, as described in ESR-4526.

3.4 Mortar: Mortar used to bond Arch Block, Pent Block and Hex Block masonry units must be Type S or M mortar conforming with ASTM C270.

4.0 DESIGN AND INSTALLATION

4.1 Structural Design: Design calculations must be based on the material properties noted in Table 1. Design of arch and dome structures shall ensure that the Arch Block, Pent Block and Hex Block masonry units remains in compression under all design loads (i.e. wind, snow, live and dead) and load combinations. Contribution of the reinforcing bars to the structural capacity of the arches and domes shall not be considered in the design. Design loads and load combinations shall be in accordance with Chapter 16 of the IBC.

To accommodate lateral forces at the base of the arch and dome structures and ensure the blocks remain in compression, the use of supplementary supports may be needed. These supplementary supports could include flying buttresses; adjacent arch or dome structures; and/or pilasters.

4.2 Installation: The Arch Block, Pent Block and Hex Block are stacked using the GatorBar as a guide, and the joints between the masonry units are bonded with mortar.

4.2.1 Arch Block: The reinforcing bars are placed using a template for the profile of arch selected (corrugated or smooth). The Arch Blocks are placed in a bed of mortar with the slots placed around the reinforcing bar. The subsequent joints are bonded with mortar and the subsequent Arch Block are placed in the pre-selected pattern to form the desired arch shape. Depending on the geometry of the arch design, supplementary templates and supports may be

needed during construction, which are removed once the mortar has cured. See Figure 5.

4.2.2 Hex Block and Pent Block: The Hex Block or Pent Block are placed in a bed of mortar with the slots placed around the reinforcing bars. The subsequent joints are bonded with mortar and the subsequent Hex Block or Pent Block are placed in the pre-selected pattern to form the desired shape. Depending on the geometry of the design, templates and supports may be needed during construction, which are removed once the mortar has cured. See Figure 6.

4.3 Special Inspections: Special inspection is required in accordance with Section 1705.4 of the IBC. The special inspector must verify construction materials, details and practices including, but not limited to the following:

1. Proportions of site-prepared mortar
2. Construction of mortar joints.
3. Preparation, construction of masonry during cold weather (temperature below 44° F (4.4° C)) or hot weather (temperature above 90° F (32.2° C)).

5.0 CONDITIONS OF USE

The Arch Block, Pent Block and Hex Block described in this report complies with, or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 Structural design calculations, drawings and design details, including mortar bed thickness, for the arches and domes constructed using Arch Block, Pent Block and Hex Block, using the information noted in this report, must be included on construction plans submitted to the code official for approval. The calculations, drawings and details must be signed and sealed by a registered design professional and shall be submitted to the code official for approval.
- 5.2 Installation must comply with this report, the manufacturer's published installation instructions and the applicable code. When the manufacturer's published installation instructions differ from this report, this report governs.

5.3 The use of the Arch Block, Pent Block or Hex Block as a component of a fire-resistance rated assembly is outside of the scope of this report.

5.4 Installation and attachment of weather resistant coverings is outside of the scope of this report.

5.5 Installation and attachment of interior finishes is outside of the scope of this report.

5.6 Foundations and other supporting structures as well as anchorage of the domes and arches must be designed by a registered design professional and are outside of the scope of this report.

5.7 The Arch Block, Pent Block and Hex Block masonry units are produced in Alfred, New York, under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

6.1 Test reports for Materials Properties: Absorption, dimensions, density, and net area compressive strength of coupons in accordance with ASTM C90. Compressive strength of masonry prisms in accordance with ASTM C1314.

6.2 Quality documentation in accordance with the ICC-ES Acceptance Criteria for Quality Documentation (AC10), dated January 2019.

7.0 IDENTIFICATION

7.1 Packaging of the Arch Block, Pent Block and Hex Block carries a label indicating the manufacturer's name and address, the product name, the ICC-ES Evaluation Report Number (ESR-3992) and the ICC-ES Mark, as applicable.

7.2 The report holder's contact information is the following:

SPHERICAL BLOCK, LLC
1718 MOLAND ROAD
ALFRED STATION, NEW YORK, 14803
(585) 466-6046
www.masonryarches.com

TABLE 1 – MASONRY UNIT MATERIAL PROPERTIES

Masonry Unit	Net Compressive Strength	Unit Strength (F'm) ¹
Arch Block	2,000 psi	1,700 psi
Pent Block	2,000 psi	-
Hex Block	2,000 psi	-

1. Masonry bed joint must be constructed with Type S or M mortar conforming with ASTM C270, and the joint thickness must be no greater than 5/8 inch (16 mm).

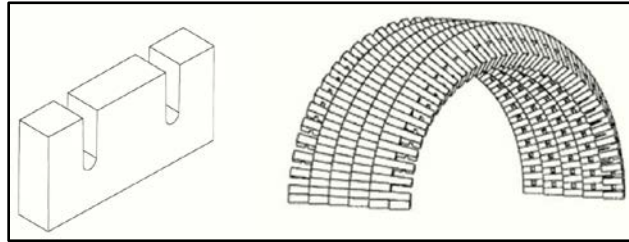


FIGURE 1 – ARCH BLOCK

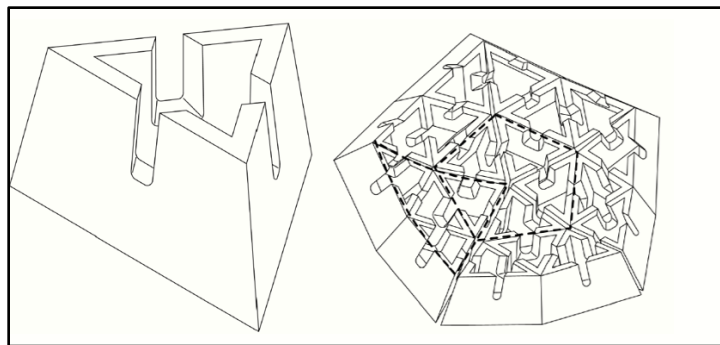


FIGURE 2 – PENT BLOCK

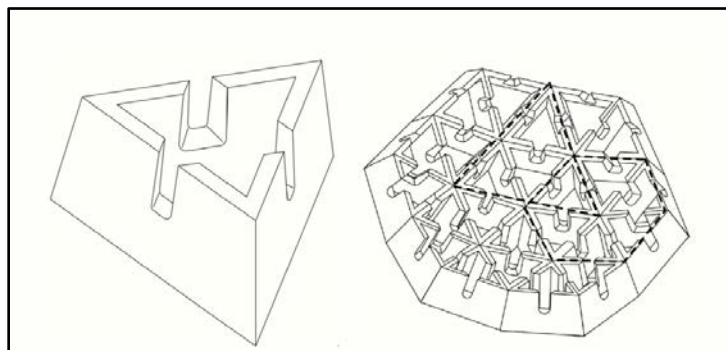


FIGURE 3 – HEX BLOCK



FIGURE 4 – SMOOTH ARCH (LEFT) ABUTTING A CORRUGATED ARCH (RIGHT)

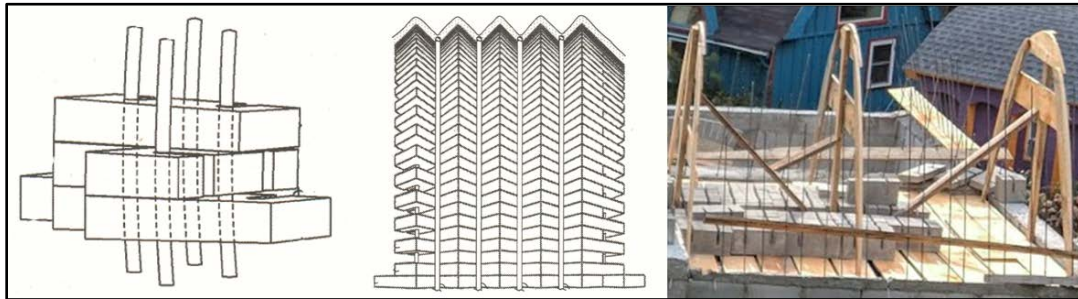


FIGURE 5 – INSTALLATION OF ARCH BLOCK



FIGURE 6 – INSTALLATION OF PENT AND HEX BLOCK