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# ICC-ES Report

## ESR-2866

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Reissued 03/2015  
This report is subject to renewal 03/2016

**DIVISION: 04 00 00—MASONRY**  
**SECTION: 04 22 00—CONCRETE UNIT MASONRY**

**REPORT HOLDER:**

**NAVAJO FLEXCRETE BUILDING SYSTEMS, INC.**

**1950 INDUSTRIAL DRIVE  
PAGE, ARIZONA 86040**

**EVALUATION SUBJECT:**

**NAVAJO FLEXCRETE FIBER REINFORCED AERATED CONCRETE MASONRY BLOCKS**



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

## REPORT HOLDER:

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## EVALUATION SUBJECT:

NAVAJO FLEXCRETE FIBER REINFORCED AERATED  
CONCRETE MASONRY BLOCKS

## 1.0 EVALUATION SCOPE

## Compliance with the following codes:

- 2009 *International Building Code*® (2009 IBC)
- 2006 *International Building Code*® (2006 IBC)
- 2013 *Abu Dhabi International Building Code* (ADIBC)<sup>†</sup>

<sup>†</sup>The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

## Properties evaluated:

- Structural
- Thermal resistance
- Fire resistance

## 2.0 USES

Navajo FlexCrete Fiber Reinforced Aerated Concrete (FRAC) masonry blocks are used to construct interior and exterior reinforced or unreinforced masonry walls, columns, and beams in Type V-B (IBC) construction and dwellings constructed in accordance with the IRC, or as a fire-resistive-rated wall construction in accordance with Section 4.4 of this report. Uses include load-bearing, nonload-bearing, and shear wall applications.

## 3.0 DESCRIPTION

## 3.1 General:

The Navajo FlexCrete FRAC masonry blocks are manufactured of fiber-reinforced, aerated concrete.

## 3.2 Material:

**3.2.1 Navajo FlexCrete FRAC Masonry Blocks:** The FlexCrete FRAC masonry blocks are produced from a mixture of sand, pozzolanic material, cement, chemical admixtures, polypropylene fibers and an aerating agent. FlexCrete FRAC masonry blocks are produced with compressive strengths and densities as summarized in Table 1. The FlexCrete masonry blocks are available in three different configurations: Solid Blocks, U-Blocks and

O-Blocks. The dimensions of the three configurations are as shown in Tables 3, 4, and 5, respectively.

**3.2.2 FlexCrete Thin-Bed Mortar:** FlexCrete Thin-Bed Mortar is a proprietary mixture of portland cement, adhesive and additives. The mortar complies with Section 2103.11 of the 2009 IBC (Section 2103.11.1 of the 2006 IBC). The FlexCrete Thin-Bed Mortar is prebagged in dry form at the factory. Mixing instructions are printed on the bag for the addition of water and the appropriate mixing sequence. FlexCrete Thin-Bed Mortar is used with FlexCrete FRAC Masonry Blocks. The working life of the Thin-Bed Mortar mixture is one hour. The Thin-Bed Mortar has a one-year shelf life from the date of manufacture when stored in unopened bags and protected from moisture.

**3.2.3 Fasteners:** Mechanical connections, except for code-complying anchors installed in grouted U-blocks in accordance with Section A.1.7 of TMS 402 (ACI 530), must be approved by the code official for each project.

## 4.0 DESIGN AND INSTALLATION

## 4.1 Design:

Building structures constructed of Navajo FlexCrete FRAC Masonry Block units must be designed in accordance with IBC Section 2101.2.2, and Chapter 1 and Appendix A of the TMS 402-08/ACI 530-08/ASCE 5-08 Building Code Requirements for Masonry Structures (TMS 402) [ACI 530-05/ASCE 5-05/TMS 402-05 for the 2006 IBC (ACI 530)], for strength design of autoclaved aerated concrete (AAC) masonry.

**4.1.1 Required Strength:** Required strength must be determined in accordance with the strength design load combinations noted in Section 1605.2 of the IBC.

**4.1.2 Design Strength:** FlexCrete FRAC masonry members must be proportioned such that the design strength exceeds the required strength. Design strength must be determined in accordance with Appendix A of TMS 402 (ACI 530 for the 2006 IBC) for AAC.

**4.1.3 Seismic Design Provisions:** Navajo FlexCrete FRAC masonry must comply with the provisions of Section 2106 of the IBC, and Chapter 1 and Appendix A of TMS 402 (ACI 530) for AAC. For ordinary reinforced masonry shear walls of Navajo FlexCrete FRAC used in the seismic-force-resisting system of structures, the response modification factor,  $R$ , shall be permitted to be taken as 2, the deflection amplification factor,  $C_d$  shall be permitted to be taken as 2, and the system overstrength factor,  $\Omega_o$ , shall be permitted to be taken as  $2^{1/2}$ . Navajo FlexCrete FRAC masonry, ordinary reinforced shear walls acting as components of the seismic force-resisting system of structures, are not limited in height when assigned to Seismic Design Category A or B; are limited in height to 35 feet (10 668 mm) for structures assigned to Seismic

Design Category C; and are not permitted for buildings assigned to Seismic Design Categories D, E, and F.

#### 4.2 Installation:

The Navajo FlexCrete published installation instructions and this report must be strictly adhered to, and a copy of the instructions must be available at all times on the jobsite during installation. Additionally, construction documents must supplement the published instructions, and feature detailed information concerning how the FlexCrete FRAC block units described in this report are to be integrated into the building structures under construction.

Exterior walls exposed to weather must have a code-complying water-resistive barrier.

With the exception of the first course, which is placed on an ASTM C 270 Type M or S leveling mortar bed in accordance with 2009 IBC Section 2103.11 (2006 IBC Section 2103.11.2), FlexCrete FRAC masonry block units used in wall construction are laid with FlexCrete Thin-Bed Mortar with horizontal and vertical joint mortaring. The Thin-Bed Mortar must be mixed and applied according to Navajo FlexCrete's published installation instructions such that the joints are  $\frac{1}{16}$  inch (1.5 mm) to  $\frac{1}{8}$  inch (3 mm) in thickness. The block unit walls must be built in running bond, i.e., the vertical joints must be staggered a minimum of one-quarter the length of the unit but not less than 4 inches (102 mm).

Cored blocks must be placed within 24 inches (610 mm) of corners, each side of openings, and each side of control joints, to accommodate vertical reinforcement. Cores on the blocks must either be factory-installed or drilled on-site. Field-installed cores for blocks 8 inches (203) thick or thicker must be a minimum of 4 inches (102 mm) in diameter. Vertical reinforcement size and spacing must be specified by the structural design professional. Vertical reinforcement must be spliced in accordance with Section A.3.3.4 of TMS 402 (ACI 530) to reinforcement dowels from the foundation and continuing up the walls through the vertical cores with a 90-degree standard hook in bond beam. The cores must then be filled with fine grout complying with ASTM C 476.

A bond beam consisting of a row of U-blocks must be installed at the top of each floor level of the FRAC wall. Two deformed, minimum No. 4 reinforcing bars must be installed in the U-shaped cavity that runs horizontally through the wall. The vertical reinforcement in the vertical core must terminate with a 90-degree standard hook in the bond beam. A truss anchor plate, wood sill plate or ledger must be anchored to the bond beam. Bent pieces of deformed reinforcement must be used to tie the cores and corner together. The details of reinforcement, including splice length, must comply with A.3 of TMS 402 (ACI 530). See Figure 1 for typical reinforcing details.

The Thin-Bed Mortar must be applied to a clean masonry unit surface, using a  $\frac{1}{8}$ -inch-by- $\frac{1}{8}$ -inch (3 mm by 3 mm) notched trowel. The minimum ambient temperature during installation must be 40°F (4°C). FlexCrete FRAC block units must be cut to exact shapes and sizes with a hand saw or an electric saw. Ordinary wood-working tools may be used, but special saws and scraping tools are also available.

#### 4.3 Thermal Properties:

Thermal conductivity and resistance properties for FRAC block units are indicated in Table 2.

#### 4.4 Fire-resistive-rated Wall Construction:

Walls constructed from minimum  $7\frac{13}{16}$ -inch-thick units in accordance with Section 4.2, to a maximum height of 10 feet (3050 mm), with a maximum allowable axial

compressive load of 4,500 lbf/ft (66 kN.m), have a four-hour fire-resistance rating.

#### 4.5 Special Inspection:

Special inspection of structural masonry must conform to IBC Section 1704.5. The special inspector's duties include verifying masonry unit and mortar identification; unit placement; placement of field reinforcement; mortar preparation; and application.

#### 5.0 CONDITIONS OF USE

The Navajo FlexCrete FRAC Masonry Blocks described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 The Navajo FlexCrete FRAC masonry block structures must be installed in accordance with the applicable code, the FlexCrete Installation Manual and this report. In the event of a conflict between the Installation Manual and this report, this report governs.
- 5.2 Plans, specifications, engineering calculations and other construction documents specifying the use of these aerated concrete masonry blocks, must be submitted to the code official for approval. The calculations and documents must be prepared by a registered design professional when required by the statutes of the jurisdiction where the project is to be constructed.
- 5.3 Surfaces of basement walls in contact with the ground must be waterproofed in accordance with the code. Exterior walls and other building elements exposed to weather and/or outside moisture must have code-complying weather-resistance coverings.
- 5.4 Inspection of construction using Navajo FlexCrete FRAC masonry blocks must comply with the requirements set forth in the applicable code for structural masonry.
- 5.5 Special inspection must be provided and must comply with Section 4.5 of this report.
- 5.6 The Navajo FlexCrete FRAC masonry block units are manufactured in Page, Arizona, by Navajo FlexCrete under a quality control program with inspections by ICC-ES.

#### 6.0 EVIDENCE SUBMITTED

- 6.1 Reports of dry bulk density, compressive strength and drying shrinkage tests in accordance with ASTM C 1386.
- 6.2 Reports of tests for static modulus of elasticity in accordance with ASTM C 469.
- 6.3 Reports of flexural strength tests in accordance with ASTM C 1609 and C 293.
- 6.4 Reports of splitting tensile strengths in accordance with ASTM C 1006 and C 496.
- 6.5 Reports of coefficient of friction tests in accordance with ASTM G 115.
- 6.6 Reports of thermal transmission tests in accordance with ASTM C 177.
- 6.7 Reports of flexural bond strength tests in accordance with ASTM E 518.
- 6.8 Reports of splitting tensile strength tests in accordance with ASTM C 1006.
- 6.9 Reports of wall shear resistance tests in accordance with ASTM E 564, modified.
- 6.10 Reports of compressive strength of mortar tests in accordance with ASTM C 109.

6.11 Report of fire test in accordance with ASTM E 119.

6.12 A quality control manual.

7.0 IDENTIFICATION

All Navajo FlexCrete FRAC product labels include the evaluation report number (ESR-2866), the name of the inspection agency [ICC\_ES] and the following information:

7.1 Navajo FlexCrete FRAC Masonry Block Units:

All pallets of Navajo FlexCrete FRAC masonry block units recognized in this report bear the manufacturer's name

(Navajo FlexCrete) along with a code that indicates the production plant and production date, the product type and the strength class and density.

7.2 Navajo FlexCrete FRAC Thin-Bed Mortar:

Packages of Navajo FlexCrete FRAC Thin-Bed Mortar carry the manufacturer's name (Navajo FlexCrete), the weight, mixing instructions and application instructions.

TABLE 1—PHYSICAL CHARACTERISTICS OF NAVAJO FLEXCRETE FRAC BLOCK

STRENGTH CATEGORY	MINIMUM COMPRESSIVE STRENGTH, $f_{frac}$ (psi)	DENSITY (pcf)
FRAC2	290	22 to 28
FRAC3	435	28 to 34

For SI: 1 psi = 0.0069 MPa, 1 pcf = 16.02 kg/m<sup>3</sup>.

TABLE 2—THERMAL PROPERTIES OF FLEXCRETE AC BLOCK PER INCH OF THICKNESS

CLASS	DRY DENSITY, lb/ft <sup>3</sup> (kg/m <sup>3</sup> )	THERMAL CONDUCTIVITY, K (Btu·in/hr·ft <sup>2</sup> ·°F)	THERMAL RESISTANCE, R (hr·ft <sup>2</sup> ·°F/Btu), PER INCH OF THICKNESS
FRAC2	25 (400) ± 1.6	1.04	1.22
FRAC3	31 (500) ± 1.6	1.04	1.22

For SI:  $\frac{1\text{Btu}}{\text{hr} \cdot \text{ft}^2 \cdot \text{F}} = 1.73 \frac{\text{M}}{\text{m} \cdot \text{k}}, \frac{1\text{hr} \cdot \text{ft}^2 \cdot \text{F}}{\text{Btu}} = \frac{0.1761\text{K} \cdot \text{m}^2}{\text{W}}$

TABLE 3—DIMENSIONS OF NAVAJO FLEXCRETE SOLID BLOCK UNITS

THICKNESS (inches)	HEIGHT (inches)	NOMINAL LENGTH (inches)
7 <sup>13</sup> / <sub>16</sub> , 9 <sup>13</sup> / <sub>16</sub> , 11 <sup>13</sup> / <sub>16</sub>	8	24

For SI: 1 inch = 25.4 mm.

TABLE 4—DIMENSIONS OF FLEXCRETE U-BLOCK UNITS

THICKNESS (inches)	HEIGHT (inches)	NOMINAL LENGTH (inches)	a (inches)	b (inches)	c (inches)	d (inches)
7 <sup>13</sup> / <sub>16</sub>	8	24	1 <sup>1</sup> / <sub>2</sub>	5	1 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>2</sub>
9 <sup>13</sup> / <sub>16</sub>	8	24	2 <sup>1</sup> / <sub>2</sub>	5	2 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>2</sub>
11 <sup>13</sup> / <sub>16</sub>	8	24	3 <sup>1</sup> / <sub>2</sub>	5	3 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>2</sub>

For SI: 1 inch = 25.4 mm.

TABLE 5—DIMENSIONS OF FLEXCRETE O-BLOCK UNITS

THICKNESS (inches)	CORE DIAMETER (inches)	d1 (inches)	d2 (inches)	d3 (inches)
7 <sup>13</sup> / <sub>16</sub>	4	4	2	18
9 <sup>13</sup> / <sub>16</sub>	4	5	3	17
11 <sup>13</sup> / <sub>16</sub>	4	6	4	16

For SI: 1 inch = 25.4 mm.

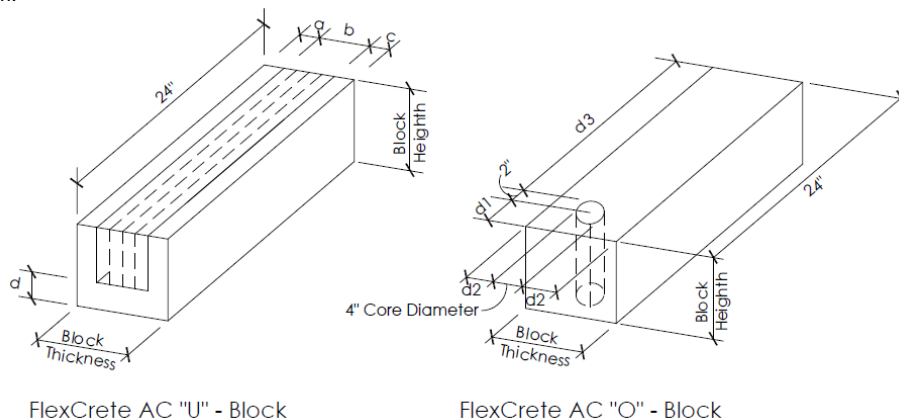


FIGURE 1—FLEXCRETE AC U-BLOCK AND FLEXCRETE AC O-BLOCK