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ICC-ES Evaluation Report

ESR-3788

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Reissued 11/2017
This report is subject to renewal 11/2018.

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

REPORT HOLDER:

3B CONSTRUCTION SOLUTIONS, INC.

**2320 JEFFERSON STREET
ANDERSON, INDIANA 46016**

EVALUATION SUBJECT:

BOLT-A-BLOK (BAB) CONCRETE MASONRY WALL SYSTEM



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

REPORT HOLDER:

3B CONSTRUCTION SOLUTIONS, INC.
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(765) 393-1376
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EVALUATION SUBJECT:

BOLT-A-BLOK (BAB) CONCRETE MASONRY WALL SYSTEM

1.0 EVALUATION SCOPE:

Compliance with the following codes:

- 2015 and 2012 *International Building Code*® (IBC)
- 2015 and 2012 *International Residential Code*® (IRC)

Property evaluated:

Structural

2.0 USES

The Bolt-A-Blok concrete masonry wall system as described in this report is used as a load-bearing masonry wall system in nonfire-resistance rated construction. When the Bolt-A-Blok concrete masonry wall system is used under the IRC, an engineered design in accordance with the IBC and this evaluation report must be submitted in accordance IRC Section R301.1.3.

3.0 DESCRIPTION:

3.1 General: The BAB wall system is a dry-stacked (mortarless and groutless) post-tensioned concrete masonry wall system which is comprised of proprietary concrete masonry blocks, proprietary steel bars, pretensioned proprietary steel bolts.

3.2 Proprietary Concrete Masonry Blocks: The concrete masonry blocks must be manufactured to comply with ASTM C90 and must comply with the dimensional requirements described in Figures 2, 3A, 3B, 3C, 3D and 3E. The minimum 28-day net compressive strength must be 4000 psi (27.6 MPa).

3.3 Proprietary Steel Bars: The steel bars are made from high-strength low-alloy weathering steel complying with ASTM A588 having a minimum yield strength of 50 ksi (345 MPa) and a minimum tensile strength of

80 ksi (552 MPa). The steel bars are 1.5 inches wide by $\frac{5}{16}$ -inch (7.9 mm) thick and come in standard lengths up to 43 inches (1092 mm). The steel bars include both $\frac{5}{16}$ -18 UNC tapped holes, which engage with the matching threads of the proprietary steel bolts, and 0.328-inch (8.3 mm) diameter drilled holes, which permit the proprietary steel bolts to pass through the steel bars. See Figure 1 for typical proprietary steel bar configurations.

3.4 Proprietary Steel Bolts: The steel bolts are hex-head, $\frac{5}{16}$ -inch diameter (7.94 mm) bolts conforming to ASTM A307 and are made from weathering steel complying with ASTM A242 having a minimum tensile strength of 70 ksi (480 MPa). The bolts are 8.75 inches long to accommodate the height of 8-inch blocks.

4.0 DESIGN AND INSTALLATION

4.1 Design: The BAB wall system must be designed in accordance with IBC considering applicable loads and load combinations. The applied loads must not exceed the corresponding allowable loads indicated in Tables 1 and 2 of this report. The connections between the BAB wall system and its supports, such as roof, floor and foundation, must be designed and constructed in accordance with the IBC. When used as a seismic force-resisting system, the BAB wall system is limited to Seismic Design Categories A and B, and is assigned with the same seismic design coefficients and factors and limitations as those for prestressed masonry shear walls prescribed in Table 12.2-1 of ASCE/SEI 7.

4.2 Installation: The BAB wall system must be installed in accordance with the report holder's published installation instructions, the approved construction documents and this report. Where differences exist between this report, the approved construction documents and the report holder's manufacturer installation instructions, the most restrictive requirement governs.

4.2.1 The BAB wall system must be constructed using proprietary concrete masonry blocks complying with Section 3.2 and 5.5, proprietary steel bars complying with Section 3.3 and proprietary bolts complying with Section 3.4. See Figures 4 and 5 for typical installation sequence and details.

4.2.2 The walls are constructed by assembling concrete masonry blocks in a running bond pattern. The walls must be fully supported by a rigid foundation. The first full course of the wall system uses the 8-inch-high (203 mm) concrete masonry blocks which are placed above the

supporting concrete foundation. The first full course may be supported by the 4-inch (102 mm) high footer blocks when determined acceptable by a registered design professional and the code official. Each steel dowel bar embedded into concrete foundation must pass through the cavities of the concrete masonry block where it connects to the steel bar with an approved steel nut as determined by the registered design professional. The steel dowel embedment and the connection between a steel dowel bar and the steel bar must be designed to equal to or exceed the allowable loads noted in Section 4.1.1. The following courses are laid on top of the lower course and a steel bar is installed along the full length of the wall at the top of each course. Two steel bolts as described in Section 3.4 are required for connecting each concrete masonry block to the lower course. The bolts are inserted through the holes in the steel bar and are fastened to the tapped holes of the steel bar located in the lower course. The bolts must be installed with a minimum installation torque of 10 ft-lb (13.6 N-m) by applying torque using a drill, wrench or socket to the bolt head that will be checked using a calibrated torque wrench.

For using as exterior walls, the BAB wall system must be protected by an approved water-resistive barrier and exterior wall covering complying with IBC Chapter 14.

4.3 SPECIAL INSPECTION

Special inspection is required in accordance with Section 1705.1.1 of the IBC. Duties of the special inspector include, but are not limited to, the following:

- Verification of components used in the BAB wall system and the installation of each component, including proprietary concrete masonry blocks, proprietary steel bars, proprietary steel bolts and when applicable other fastening components as shown in the approved construction documents.
- Verification of minimum installation torque of 10 ft-lb (13.6 N-m) during construction.
- Verification of the top and bottom connections as shown in approved construction documents.

5.0 CONDITIONS OF USE:

Bolt-A-Blok Concrete Masonry Wall System described in this report comply with, or are a suitable alternative to what is specified in those codes listed Section 1.0 of this report, subject to following conditions:

- 5.1 Construction documents, including plans and calculations for each project, specifying the masonry walls system recognized in this report, must be in accordance with the IBC and this report and prepared by a registered design professional, and be submitted to the code official for approval for each project.
- 5.2 Construction must comply with the approved construction documents, IBC, this report, and the manufacturer's instructions. In case of a conflict, the most restrict requirement governs.

- 5.3 Walls are limited to wall dimensions and support conditions described in Tables 1 and 2 of this report including footnotes to the tables.
- 5.4 Special inspection is in accordance with Section 4.3 of this report.
- 5.5 Recognition for the proprietary concrete masonry blocks, described in Section 3.2 of this report is outside the scope of this report; therefore, verification must be submitted to the code official that the masonry units comply as normal-weight units in accordance with ASTM C90 (IBC) having a minimum 28-day compressive strength of 4000 psi, and must comply with Figures 2 and 3 of this report.
- 5.6 The BAB wall system recognized under this report and used as lateral force-resisting systems must be limited to Seismic Design Categories A and B and is assigned with the same seismic design coefficients and factors and limitations as those for prestressed masonry shear walls prescribed in Table 12.2-1 of ASCE/SEI 7.
- 5.7 The BAB wall system recognized under this report is limited to nonfire-resistance rated construction.
- 5.8 This evaluation only evaluates structural performance of the BAB wall system. Other aspects of code compliance, such as fire-resistance and durability, must comply with applicable code.

6.0 EVIDENCE SUBMITTED:

- 6.1 Reports of testing on walls subjected to transverse load (flexural testing), in-plane axial compression load, combined in-plane axial compression and transverse loads, combined in-plane axial compression load and in-plane racking shear loads, in accordance with the ICC-ES Acceptance Criteria for Concrete Floor, Roof, and Wall Systems and Concrete Masonry Wall Systems (AC15), dated February 2010 (editorially revised April 2015), and test data analysis in accordance with the ICC-ES Acceptance Criteria for Fiber-reinforced Plastic (FRP) Modular Wall Systems (AC447) dated October 2012.
- 6.2 Reports of testing in accordance with ASTM C90 on concrete masonry units.
- 6.3 Reports of testing in accordance with ASTM E8 on steel bars and steel bolts.
- 6.4 Structural calculations and engineering analysis.
- 6.5 Quality documentation.

7.0 IDENTIFICATION:

The BAB proprietary steel bars and proprietary steel bolts are packaged and labeled with the report holder's name and address, product description and lot number and the ICC-ES evaluation report number ESR-3788.

TABLE 1—BOLT-A-BLOK WALL ALLOWABLE LOADS (EXCEPT IN-PLANE RACKING SHEAR)¹

TYPE OF LOADING	WALL HEIGHT (feet)	AXIAL COMPRESSIVE LOADS (plf)	UNIFORM TRANSVERSE LOAD (psf)
Axial Compression (in-plane) Loading	8	6702 ²	-
	12	4775 ²	-
Transverse (Out-of-plane) Loading	8	-	44 ³
	12	-	18 ³
Combined Axial Compression and Transverse Loads ⁴	8	2670 ²	95 ³
	12	2356 ²	41 ³

For **SI**: 1 feet=0.305m, 1 plf = 14.58 N/m, 1 psf= 47.9 Pa.

¹Bolt-a-Blok wall must be installed in accordance with Section 4. 2. The supports at top and bottom of the wall, including the connections to the top and bottom supports, must provide adequate strength and stiffness to resist the applicable loads/reactions and to prevent out-of-plane displacement.

²Allowable loads are based on the lesser of the following: (1) Ultimate test loads adjusted for loss of bolt pretension during service life and divided by a safety factor of 4.0; and (2) Loads correspond to an axial deformation of 0.125 inch of the tested walls.

³Allowable loads are based on the lesser of the following: (1) Ultimate test loads adjusted for loss of bolt pretension during service life and divided by a safety factor of 4.0; and (2) Loads correspond to a lateral (out-of-plane) deflection of L/360 or less, where L is the span of the tested walls.

⁴For walls tested with combined axial compression and transverse loads, the superimposed axial compression load helps increase the out-of-plane flexural tensile resistance of the tested walls. Thus, the transverse load resistance of walls subjected to combined axial in-plane compression and transverse loads is larger than that of the corresponding wall subjected to transverse load only.

TABLE 2—BOLT-A-BLOK WALL ALLOWABLE IN-PLANE RACKING SHEAR LOADS¹

WALL DIMENSIONS		IN-PLANE RACKING SHEAR LOAD (plf) ²	APPLIED SUPERIMPOSED AXIAL COMPRESSION LOAD (plf) ³
Height (feet)	Length (feet)		
8	8	237	1000
12	8	221	1000

For **SI**: 1 inch=25.4 mm, 1 feet=0.305 m, 1 plf= 14.58 N/m.

¹Bolt-a-Blok wall must be installed in accordance with Section 4. 2. The support at bottom of the wall, including the connections to the bottom support, must provide adequate strength and stiffness to resist the applicable loads/reactions including bending moment and in-plane shear loading, in order to represent a fixed-support condition of tested walls.

²Allowable loads are based on the lesser of the following: (1) Ultimate test loads adjusted for loss of bolt pretension during service life and divided by a safety factor of 4.0; and (2) Loads correspond to an in-plane lateral deflection (lateral drift) of L/180 or less, where L is the height of the tested walls.

³Applied superimposed axial compression loads described in this table are the actual applied axial compression loads that are not reduced by a safety factor.

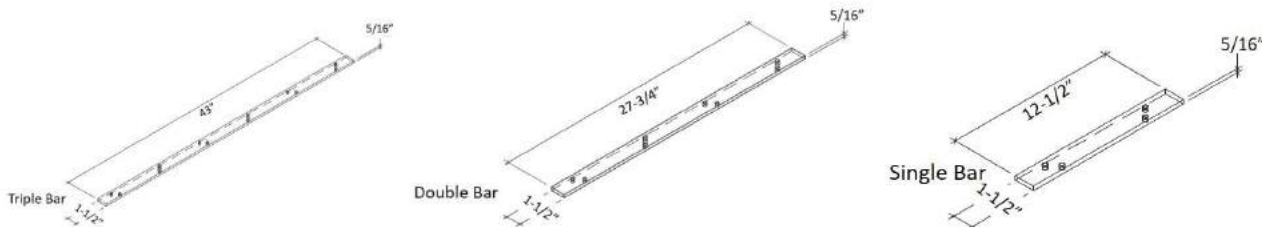


FIGURE 1—BOLT-A-BLOK PROPRIETARY STEEL BAR DETAILS

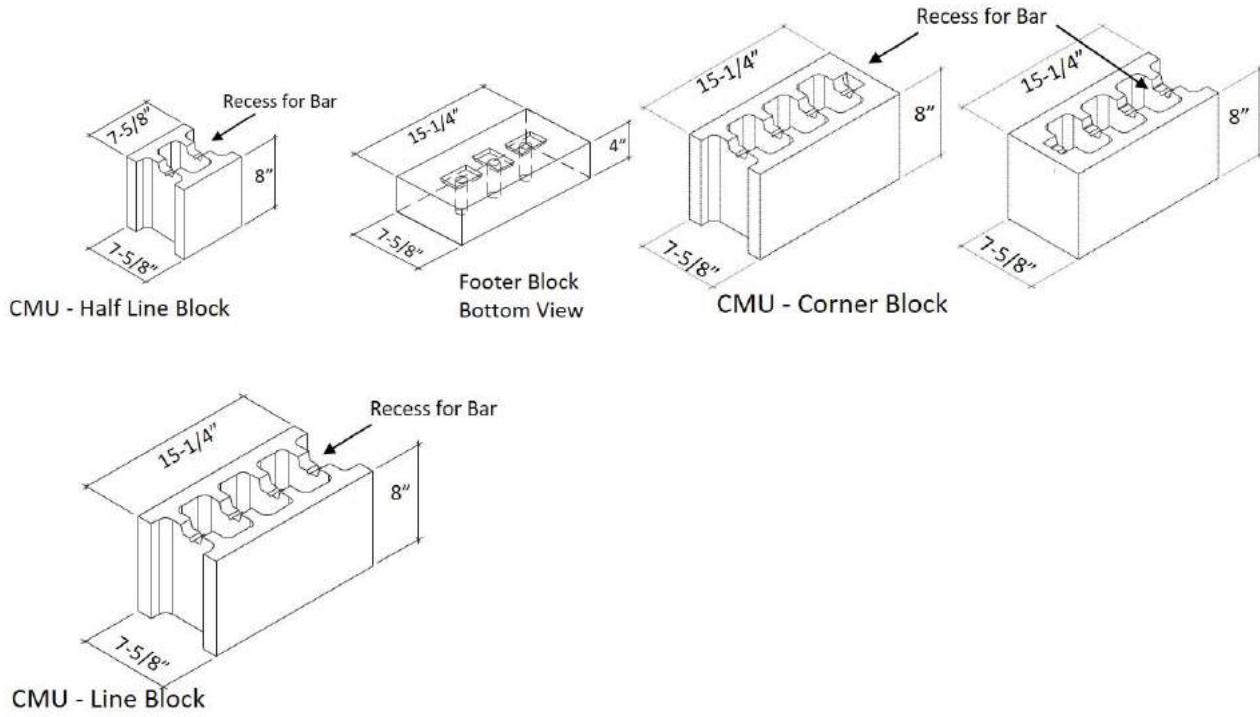


FIGURE 2—BOLT-A-BLOK PROPRIETARY CONCRETE MASONRY UNITS

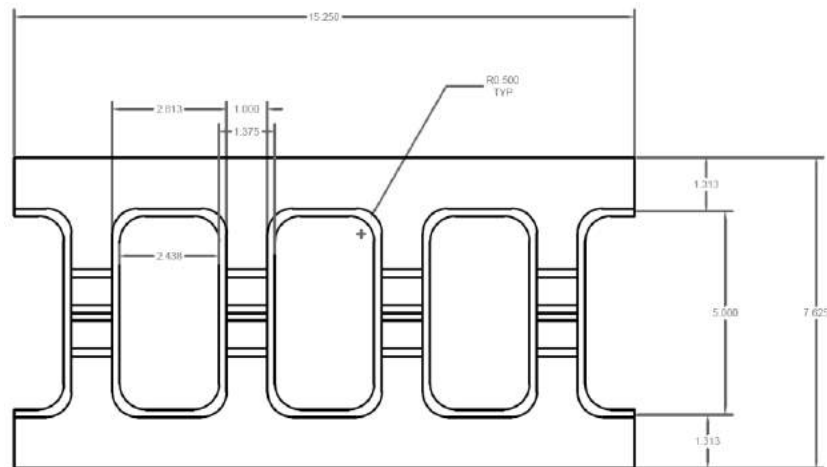


FIGURE 3A—LINE BLOCK

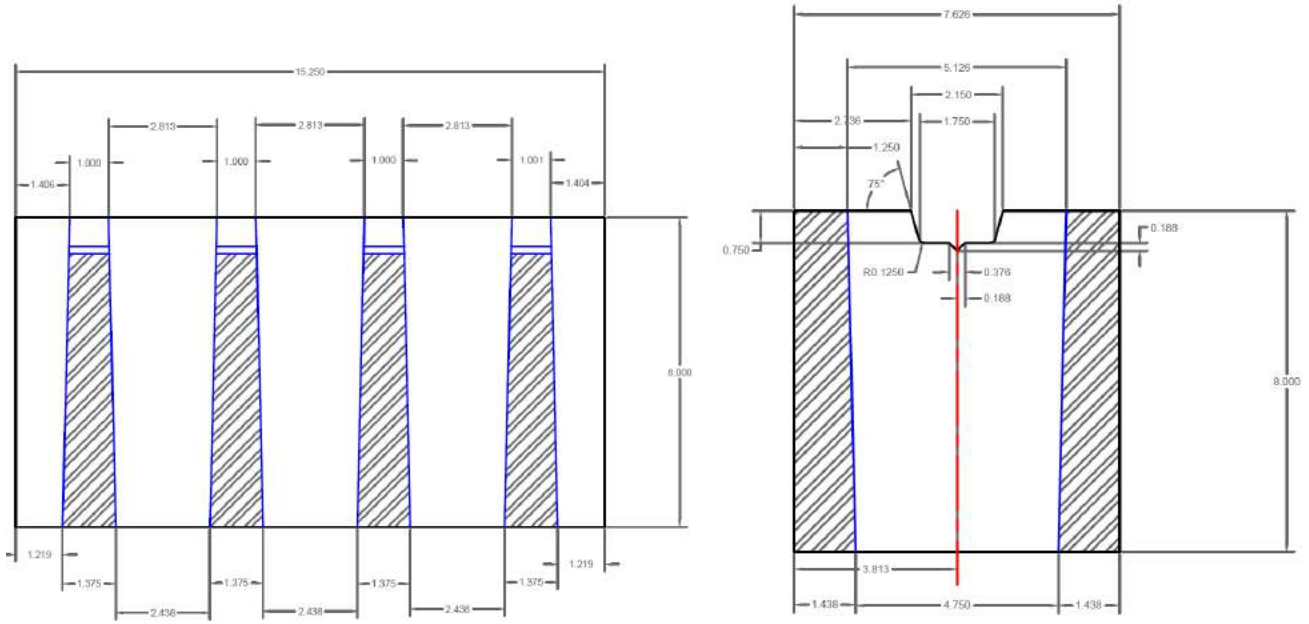


FIGURE 3A—LINE BLOCK (Continued)

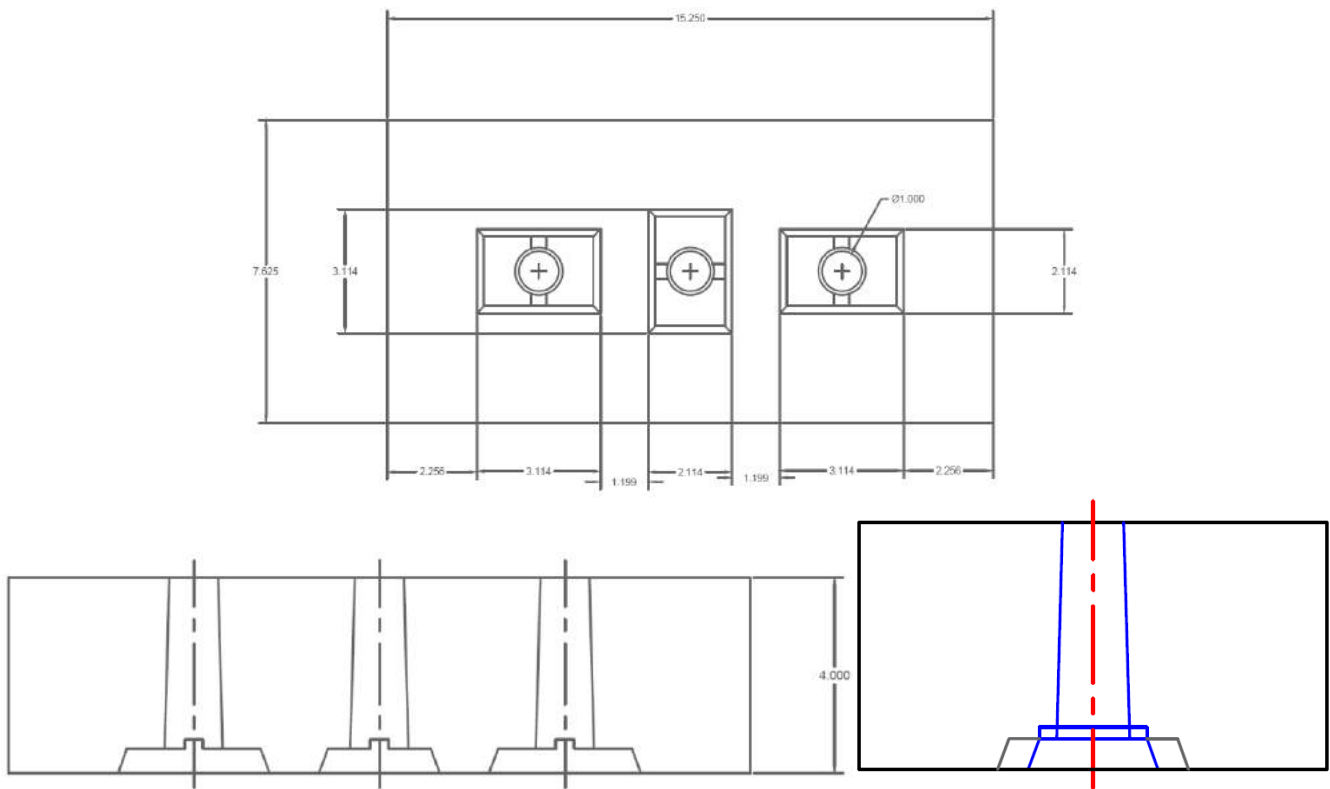


FIGURE 3B—FOOTING BLOCK

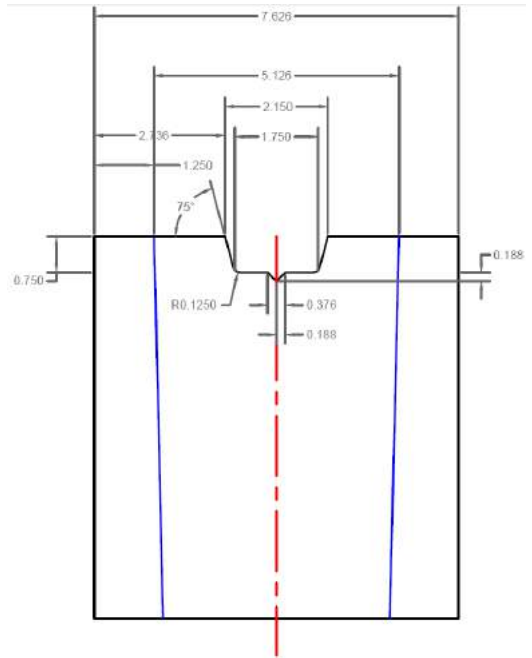
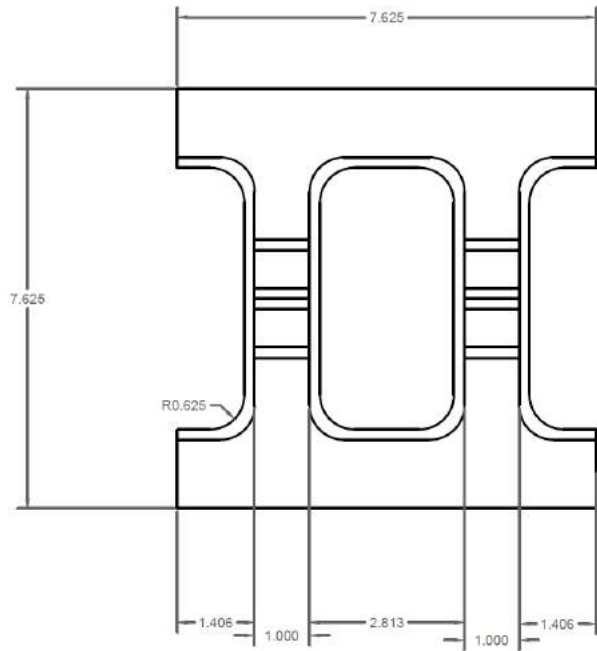


FIGURE 3C—HALF BLOCK

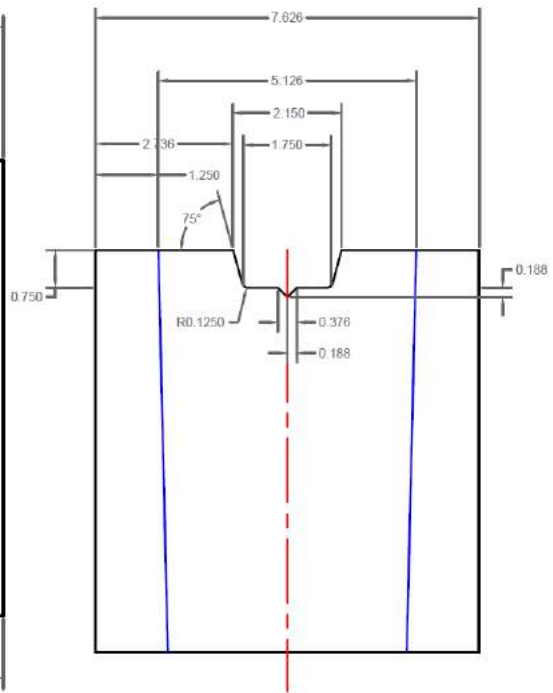
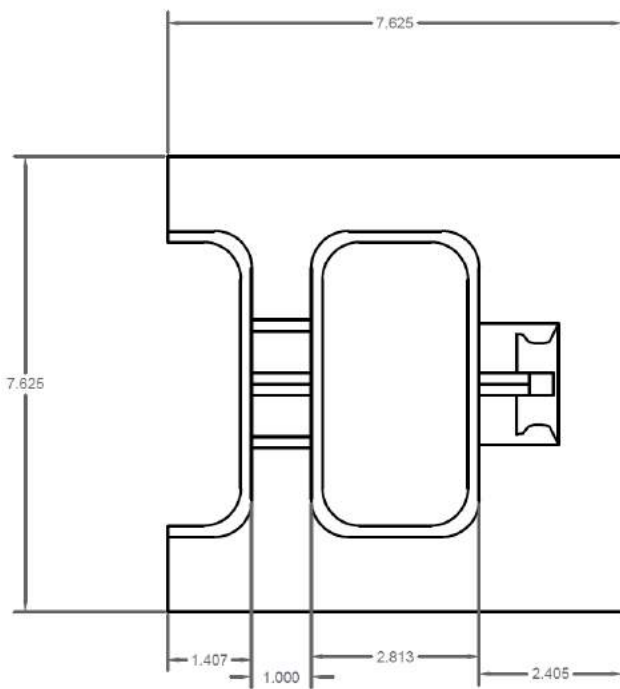


FIGURE 3D—HALF CORNER BLOCK

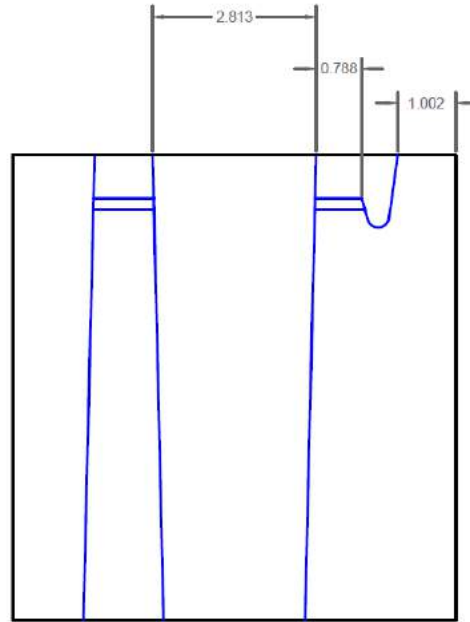


FIGURE 3D—HALF CORNER BLOCK (Continued)

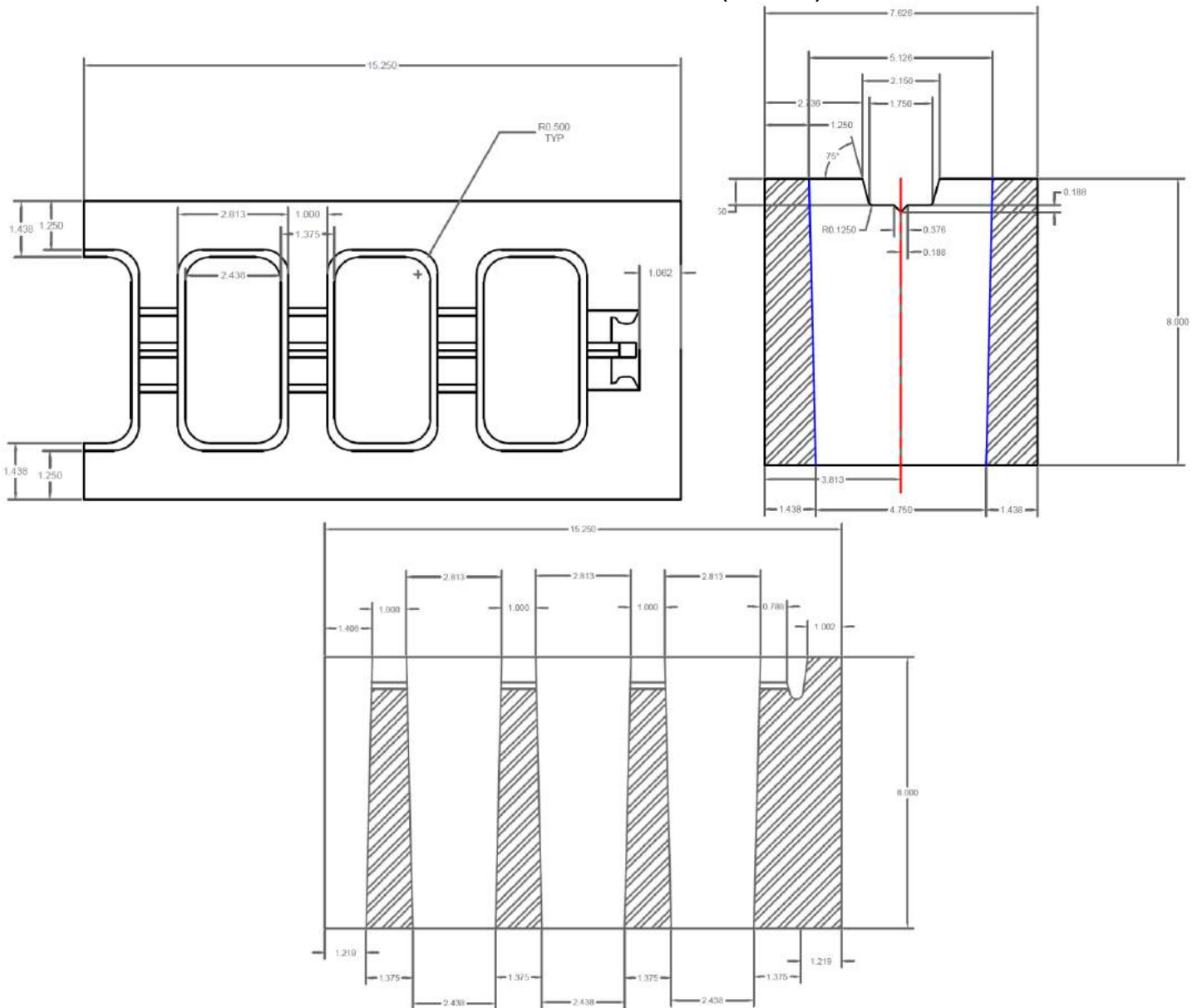


FIGURE 3E—CORNER BLOCK

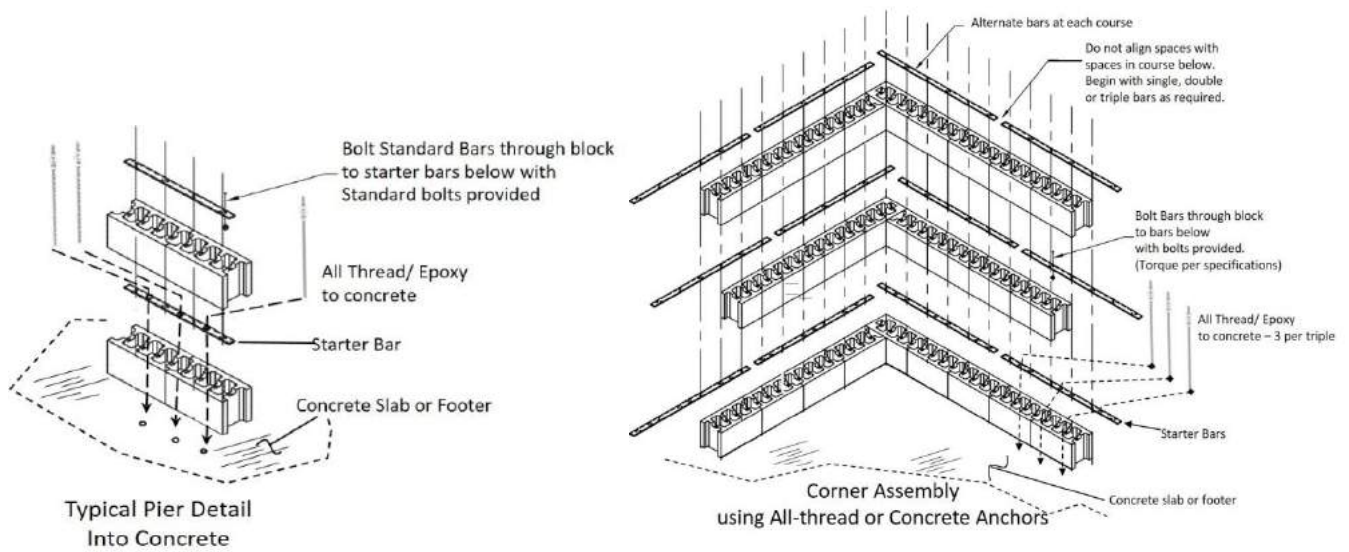


FIGURE 4—TYPICAL INSTALLATION SEQUENCE

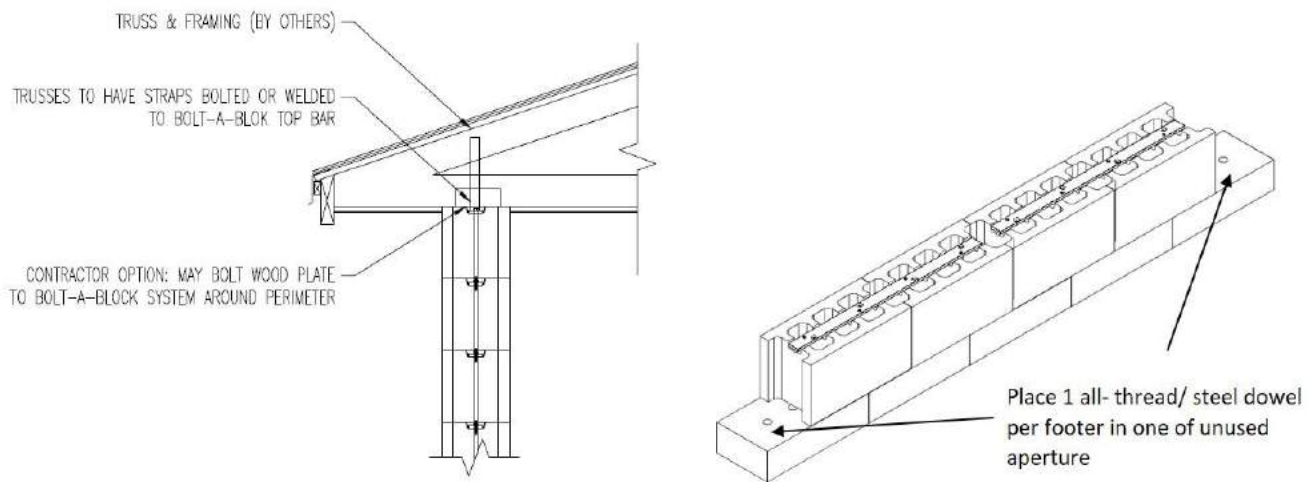


FIGURE 5—TYPICAL INSTALLATION DETAILS