

# ICC-ES Evaluation Report

**ESR-1525**

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**DIVISION: 03 00 00—CONCRETE**
**Section: 03 11 19—Insulating Concrete Forming**
**REPORT HOLDER:**

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**EVALUATION SUBJECT:**
**CELBLOX® INSULATING CONCRETE FORMS (ICFs)**
**1.0 EVALUATION SCOPE**
**Compliance with the following codes:**

- 2006 *International Building Code*® (IBC)
- 2006 *International Residential Code*® (IRC)

**Properties evaluated:**

- Structural
- Surface burning characteristics
- Crawl space fire evaluation
- Fire-resistance-rated construction
- Noncombustible construction

**2.0 USES**

Celblox® insulating concrete forms (ICFs) are used as permanent formwork for structural concrete, load-bearing and nonload-bearing, below-grade and above-grade walls. The forms are used in construction of plain and reinforced concrete exterior and interior walls, foundation walls and retaining walls. The forms remain in place after placement and curing of concrete and must be protected with approved interior and exterior wall finish material. Forms may be used in Type V construction; and may be used in buildings of Types I, II, III and IV (noncombustible) construction when installation is in accordance with Section 4.4. Use in fire-resistance-rated construction is as described in Section 4.3.

**3.0 DESCRIPTION**
**3.1 General:**

Celblox® ICFs are classified as flat ICF wall systems in accordance with IRC Section R611.3. Celblox® ICFs consist of two expanded polystyrene (EPS) foam plastic face panels connected with plastic cross-ties. The cross-

ties are attached to plastic flanges molded into the EPS panels. The flanges are used to attach interior and exterior wall finishes. The interior ICF wall surface must be covered with an approved thermal barrier as described in Section 4.2.2.1, and the exterior ICF wall surface must be covered with an approved wall covering in accordance with IBC Section 1405.2 and IRC Section R703 and as described in Section 4.2.3 of this report.

The forms are available in a standard length of 48 inches (1219 mm), a height of 16 inches (406 mm), and a panel face thickness of 2.5 inches (64 mm), with standard cavity widths of 4, 6, 8, 10 and 12 inches (102, 152, 203, 254 and 305 mm). There are also 90-degree corner forms, 45-degree corner forms, taper top forms and brick ledge forms. See Figure 1.

Vertical and horizontal reinforcing steel bars must be placed inside the forms and is supported by the cross-ties. The top and bottom edges of the forms have a 1/2-inch-thick (13 mm) tooth and keyhole design for interlocking of the forms. The forms must be filled with concrete to produce a solid, monolithic, flat concrete wall.

**3.2 Materials:**

**3.2.1 Foam Plastic:** The EPS panels are expanded polystyrene foam plastic having a nominal density of 1.5 pcf (24 kg/m<sup>3</sup>), and comply with ASTM C 578 as Type II. The EPS has a flame-spread index of 25 or less and a smoke-developed index of 450 or less when tested in accordance with ASTM E 84.

**3.2.2 Cross-ties:** The plastic cross-ties consist of flanges that are 1 1/2 inches (38 mm) wide, molded into each panel at 8 inches (203 mm) on center and connected with plastic hinges. See Figure 2. The location of flanges is indicated on the exterior surface of the ICF by a 1/4-inch-wide (6.4 mm) vertical line molded into the ICF.

**3.2.3 Concrete:** Concrete must be normal-weight concrete complying with the applicable code. The maximum aggregate for 4-inch (102 mm) walls is 3/8-inch-diameter (9.5 mm) gravel; for 6-inch (152 mm) walls is 1/2-inch-diameter (13 mm) gravel; and for 8-inch (203 mm) through 12-inch (305 mm) walls is no more than 3/4-inch-diameter (19 mm) stone. The concrete slump must be between 4 and 6 inches (102 to 152 mm) when tested in accordance with ASTM C 143, unless specified otherwise by the registered design professional. Under the IRC, concrete must comply with IRC Sections R404 and R611.6.1. The minimum compressive strength must be 3,000 psi (20.7 MPa) at 28 days, except as noted in Section 4.3.2 of this report for fire-resistance-rated construction.

**3.2.4 Reinforcement:** Walls must be reinforced with deformed steel bars having a minimum yield strength of either 40 ksi (275 MPa) or 60 ksi (413 MPa), depending on the structural design. The deformed steel bars must comply with Section 3.5.3.1 of ACI 318-05 (IBC); under the IRC, reinforcement must comply with IRC Sections R404.4.6 and R611.6.2.

**3.2.5 Other Components:** Wood members in contact with concrete for plates or windows and door framing must be preservative-treated with an approved wood preservative in accordance with the applicable code, and attached with fasteners complying with IBC Section 2304.9.5 or IRC Section R319.3, as applicable.

## 4.0 DESIGN AND INSTALLATION

### 4.1 Design:

**4.1.1 IBC Method:** Concrete walls formed by the Celblox<sup>®</sup> ICFs must be designed and constructed in accordance with IBC Chapters 16 and 19, as applicable. Footings and foundations must be designed and constructed in accordance with IBC Chapter 18.

**4.1.2 IRC Method:** Insulated concrete walls formed by the Celblox<sup>®</sup> ICFs comply with IRC Figure R611.3 as flat insulating concrete wall forms. Wall design, construction and materials must comply with IRC Sections R404.4 and R611, for flat ICF wall systems. The 4-inch (102 mm) walls is limited to above-grade construction in accordance with Section R611 of the IRC.

Design of foundation wall reinforcements must be in accordance with IRC Sections R404.1 and R404.1.2, and IRC Table R404.1.1.

**4.1.3 Alternative IRC Design Method:** When the Celblox<sup>®</sup> ICFs are used to construct buildings that do not conform to the applicability limits of IRC Sections R404.4.1 and R611.2, the structural analysis and design of the concrete must be in accordance with ACI 318 and IBC Chapter 19, as permitted by IRC Sections R104.11 and R301.1.1. Use of the empirical design approach specified in Section 14.5 of ACI 318 (IBC) is permitted for the design of concrete walls formed by the Celblox<sup>®</sup> ICFs.

### 4.2 Installation:

**4.2.1 General:** The Celblox<sup>®</sup> ICFs must be installed in accordance with the Cellox LLC published installation instructions, this report and the applicable code. The published installation instructions and this report must be strictly adhered to, and a copy of these instructions must be available at all times on the jobsite during installation.

Celblox<sup>®</sup> ICFs and resulting concrete walls must be supported on concrete footings complying with IBC Chapters 18 and 19, or IRC Chapter 4, as applicable. Vertical rebars embedded in the footing must extend into the base of the wall system the minimum development length necessary for compliance with Chapter 12 of ACI 318 (IBC and IRC). Additional reinforcement around doors and windows must be described in the approved plans. Concrete quality, mixing and placement must comply with IBC Section 1905 or IRC Section R611.6.1, as applicable. Window and door openings must be built into the forms, with wood or polyvinyl chloride plastic frames of the same dimensions as the "rough stud opening" specified by the window or door manufacturer, prior to the placement of the concrete. Wood ledgers must be attached to the concrete wall by removing the face shell of the forms, with the height of the removed portion being equal to the depth of the wood ledger. Wood plates must be anchored to the top of the wall. Anchor bolts used to connect the wood ledgers or

plates to the concrete must be cast-in-place, with the bolts sized and spaced as required by design and the applicable code. Details must be prepared to accommodate the specific job situation, in accordance with the applicable code and the requirements of this report, subject to the approval of the code official.

### 4.2.2 Interior Finish:

**4.2.2.1 General:** The installation details in this section (Section 4.2.2) address compliance with the thermal barrier and interior finish requirements of the codes. The interior side of the forms must be covered with a thermal barrier consisting of minimum 1/2-inch-thick (12.7 mm) regular gypsum wallboard complying with ASTM C 36 or ASTM C 1396, placed either vertically or horizontally. The wallboard must be attached to the flanges of the cross-ties with minimum 0.136-inch-diameter-by-1<sup>5</sup>/<sub>8</sub>-inch-long (3.5 mm by 41.3 mm), Type W, coarse-thread gypsum wallboard screws spaced 12 inches (305 mm) on center vertically and a maximum of 16 inches (406 mm) on center horizontally in the field. The screws must penetrate through the cross-tie flange a minimum of 1/4 inch (6.4 mm), minimum. Gypsum wallboard joints and screw heads must be taped and filled with joint compound in accordance with GA-216 or ASTM C 840. See Section 4.2.2.2 for installation details when Celblox<sup>®</sup> ICFs are used as walls of crawl spaces without a covering on the interior face.

**4.2.2.2 Crawl Space Installation:** When the Celblox<sup>®</sup> ICFs are used as walls of crawl spaces and no ignition barrier is applied to the crawl space side of the foam plastic, all the following conditions must be met:

1. Entry to the crawl space is only to service utilities, and no storage is permitted.
2. There are no interconnected crawl space areas.
3. Air in the crawl space is not circulated to other parts of the building.
4. Under-floor (crawl space) ventilation is provided when required by IBC Section 1203.3 or IRC Section R408.1, as applicable.
5. Combustion air is provided in accordance with Sections 701 and 703 of the 2006 *International Mechanical Code*<sup>®</sup>.
6. ICF forms produced from BASF Neopor beads are not recognized for crawl space applications without a code-prescribed ignition barrier. See Sections 5.10 and 7.0 for labeling requirements.

### 4.2.3 Exterior Finish:

**4.2.3.1 Above Grade:** The Celblox<sup>®</sup> ICFs must be covered on the exterior with an approved wall covering in accordance with the applicable code or a current evaluation report. Under the IRC, the wall openings must be flashed in accordance with IRC Section R703.8. The approved exterior wall covering must be attached to the flanges of the cross-ties with No. 6 Type W coarse thread gypsum wallboard screws. The screws must be corrosion-resistant and have sufficient length to penetrate through the cross-tie flange at least 1/4 inch (6.4 mm). The screws have allowable withdrawal and lateral capacities as shown in Table 1. The fastener spacing must be designed to support the gravity loads of the wall covering and to resist the negative wind pressures. The negative wind pressure capacity of the exterior finish material must be the same as that recognized in the applicable code for generic materials, or that recognized in a current ICC-ES evaluation report for proprietary materials.

**4.2.3.2 Below Grade:** Materials used to dampproof basement walls must be specified by Cellox LLC and must comply with the applicable code or a current ICC-ES evaluation report, and must be compatible with the foam plastic ICFs. Applicable dampproofing and waterproofing requirements are in IBC Section 1807 and IRC Section R406. Compliance is required with drainage requirements in IBC Section 1807.4 or IRC Section R405.1, as applicable. No backfill is applied against the wall until the complete floor system is in place, unless the wall is designed as a freestanding wall that does not rely on the floor system for structural support.

**4.2.4 Foundation Walls:** Celblox® ICFs used as a foundation stem wall when supporting wood-framed or concrete construction must be supported on concrete footings complying with the applicable code. Design and installation of the Celblox® ICFs as foundation stem walls must comply with IBC Section 1805.5 or IRC Section R404.4, as applicable.

**4.2.5 Retaining Walls:** Celblox® ICFs used to form concrete retaining walls are to be reinforced with reinforcement designed in accordance with accepted engineering principles and Section 4.1 of this report.

**4.2.6 Protection Against Termites:** Where the probability of termite infestation is defined as “very heavy” by the code official, the foam plastic must be installed in accordance with IBC Section 2603.8 or IRC Section R320.5, as applicable. Areas of very heavy termite infestation must be determined in accordance with IBC Figure 2603.8 or IRC Figure R301.2(6), as applicable.

**4.3 Fire-resistance-rated Wall Construction:**

**4.3.1 General:** Celblox® ICFs can be used to construct fire-resistance rated wall assemblies of 2 to 4 hours for limited load-bearing and nonload-bearing walls, as follows:

CONCRETE THICKNESS (inches)	FIRE-RESISTANCE RATING (hours)
4	2
6	2
8	4
10	4
12	4

For SI: 1 inch = 25.4 mm.

**4.3.2 Two-hour Limited Load-bearing Fire-resistance-rated Walls:** The 4- and 6-inch-thick (102 and 152 mm) concrete walls constructed with Celblox® ICFs have a two-hour fire-resistance rating and are rated for exposure to fire from both sides. The Celblox® ICFs must be filled with minimum 3,500 psi (24.2 MPa) normal-weight concrete and reinforced with minimum No. 4 deformed steel reinforcement bars, spaced 16 inches (406 mm) on center vertically and horizontally, unless other code provisions require more restrictive reinforcement. The interior of the wall must be covered with a minimum 5/8-inch-thick (15.9 mm) Type X gypsum wallboard complying with ASTM C 36 or ASTM C 1396, attached to the flanges of the cross-ties in accordance with Section 4.2.2.1. Gypsum wallboard joints must be taped and filled with joint compound in accordance with GA-216 or ASTM C 840. The Celblox® ICFs must be covered on the exterior with an approved wall covering in accordance with Section 4.2.3.1 and the IBC or a current evaluation report. The allowable axial stress for the wall, calculated in accordance with Chapter 14 of ACI-318, is limited to 7,000 pounds per lineal foot (102 157 N/m), per 9-foot wall (2.7 m) height.

**4.3.3 Four-hour Limited Load-bearing Fire-resistance-rated Walls:** The 8-, 10- and 12-inch-thick (203, 254 and 305 mm) concrete walls constructed with Celblox® ICFs have a four-hour fire-resistance rating and are rated for exposure to fire from both sides. The normal-weight concrete must have a minimum 28-day compressive strength of 3,000 psi (20.7 MPa). The walls are reinforced with No. 4 steel reinforcements at 16 inches (406 mm) on center vertically and horizontally, unless other code provisions require more restrictive reinforcement. The interior wall finish is 5/8-inch-thick (15.9 mm) gypsum wallboard, complying with ASTM C 36 or ASTM C 1396, and is fastened in accordance with Section 4.2.2.1. Gypsum wallboard joints must be taped and filled with joint compound in accordance with GA-216 or ASTM C 840. The Celblox® ICFs must be covered on the exterior with an approved wall covering in accordance with Section 4.2.3.1 and the IBC or a current evaluation report. The allowable axial stress for the wall, calculated in accordance with Chapter 14 of ACI-318, is limited to 3,500 pounds per lineal foot (51,065 N/m), per 10-foot (3 m) wall height.

**4.4 Types I, II, III and IV (Noncombustible) Construction (IBC):**

**4.4.1 General:** The assemblies described in this section (Section 4.4) comply with IBC Section 1406.2.1.1.

**4.4.2 Interior Finish:** The interior side of the forms must be covered with a thermal barrier consisting of minimum 1/2-inch-thick (12.7 mm) regular gypsum wallboard as described in Section 4.2.2.1.

**4.4.3 Exterior Finish:** The exterior finish must be either an EIFS lamina, exterior plaster or brick veneer, as follows:

**4.4.3.1 EIFS:** The following EIFS lamina may be installed over the exterior of the forms when applied using the reinforcing fabric or lath, base coat and finish coat materials described in their respective evaluation reports:

- BASF Construction Chemicals LLC Wall Systems Senerflex EIFS as described in [ESR-1794](#).
- STO Corp., StoTherm Essence, Classic and Premier EIFS as described in [ESR-1720](#).

**4.4.3.2 Exterior Plaster:** Metal lath and exterior plaster must comply with the applicable code, and the exterior plaster must be a minimum of 7/8 inch (22.2 mm) thick. The lath must be attached to the flanges of the cross-ties with fasteners as described in Section 4.2.3.1.

**4.4.3.3 Brick Veneer:** Anchored brick veneer must be attached to the flanges of the plastic ties with fasteners as described in Section 4.2.3.1. Installation of the 4-inch-thick (102 mm) brick veneer must comply with the applicable code, and the veneer must be installed with a minimum 1-inch (25.4 mm) air gap between the exterior face of the ICF and the brick. The brick must be installed with a steel shelf angle attached to the concrete, at each floor line and at the top of each window and door opening.

**4.4.4 Fireblocking:** For applications on buildings of any height, floor-to-wall intersections must be fireblocked in accordance with the applicable code to prevent the passage of flame, smoke and hot gases from one story to another. The foam plastic insulation on the interior side of the exterior walls and on both sides of interior walls must be removed so it is not continuous from one story to another. See Figure 2 for typical details.

**4.5 Special Inspection:**

**4.5.1 IBC:** Special inspection is required as noted in IBC Section 1704 for placement of reinforcing steel and

concrete, and for concrete cylinder testing. Special inspection in accordance with IBC Sections 1704.1 and 1704.12 is required when the EIFS wall covering system is applied. Duties of the special inspector include verifying field preparation of materials, expiration dates, installation of components, curing of components, and installation of joints and sealants.

**4.5.2 IRC:** For walls designed and constructed in accordance with Section 4.1.2 of this report, special inspection is not required. For walls designed in accordance with Section 4.1.3, special inspection in accordance with Section 4.5.1 of this report is required.

**5.0 CONDITIONS OF USE**

The Celblox® ICFs 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 Forms must be manufactured, identified and installed in accordance with this report and Cellox LLC published installation instructions and the applicable code. If there is a conflict between the manufacturer’s published installation instructions and this report, this report governs.
- 5.2 Forms must be separated from the building interior as described in Sections 4.2.2.1 and 4.4.2 of this report, except for crawl space construction as described in Section 4.2.2.2.
- 5.3 When use is as part of a fire-resistance-rated assembly, construction must be as described in Section 4.3.
- 5.4 Except as described in Section 4.4, use of the forms is limited to Type V construction as defined in IBC Chapter 6, and to construction in accordance with the IRC.
- 5.5 When used in buildings required to be of noncombustible construction, as described in Section 4.4, the forms must have at least one label as described in Section 7.0 visible in every 160 square feet (14.7 m<sup>2</sup>) of wall area, prior to the application of the wall covering.
- 5.6 When required by the code official, calculations showing compliance with the general design

requirements of IBC Chapter 16 must be submitted to the code official for approval, except calculations are not required when the building design is based on Section 4.1.2 of this report. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

- 5.7 Concrete quality, mixing and placement must comply with IBC Section 1905 or IRC Section R611.6.1, as applicable.
- 5.8 The use of 4-inch (102 mm) Celblox® ICFs is limited to above-grade construction in accordance with IRC Section R611.
- 5.9 Special inspection must be provided in accordance with Section 4.5.
- 5.10 ICFs that are identified as being produced from BASF Neopor beads are not recognized for use in crawl spaces.
- 5.11 The forms are produced by Cellox, LLC, at their manufacturing facility in Reedsburg, Wisconsin, under a quality control program with inspections by Intertek Testing Services NA, Ltd. (AA-690).

**6.0 EVIDENCE SUBMITTED**

Data in accordance with the ICC-ES Acceptance Criteria for Stay-in-place, Foam Plastic Insulating Concrete Form (ICF) Systems for Solid Concrete Walls (AC353), dated October 2007 (editorially revised April 2008).

**7.0 IDENTIFICATION**

A sufficient number of the ICF forms must be labeled such that the label will be visible every 160 square feet (14.9 m<sup>2</sup>) of wall area on both faces. The labels include the evaluation report number (ESR-1525).

In addition, each bundle or pallet of form units bears a label that includes the name and address of Cellox LLC; the manufacturing location; the evaluation report number (ESR-1525); the date code for traceability; and the name of the inspection agency (Intertek Testing Services NA, Ltd.).

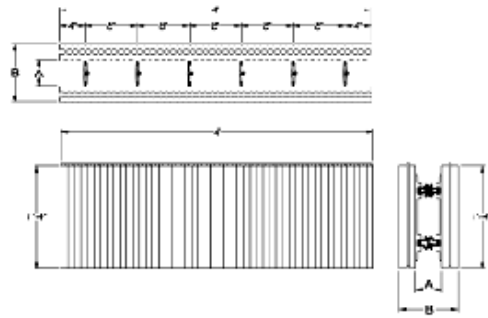
The ICFs packaging will also be labeled with the bead type when produced from BASF Neopor beads (see Section 5.10).

**TABLE 1—ALLOWABLE LATERAL AND WITHDRAWAL CAPACITIES OF FASTENERS IN CROSS-TIE FLANGES<sup>1</sup>**

FASTENER	ALLOWABLE CAPACITY (pounds)	
	Lateral	Withdrawal
No. 6, Type S, fine-thread gypsum wallboard screw	85	41
No. 6, Type W, coarse-thread gypsum wallboard screw	70	51

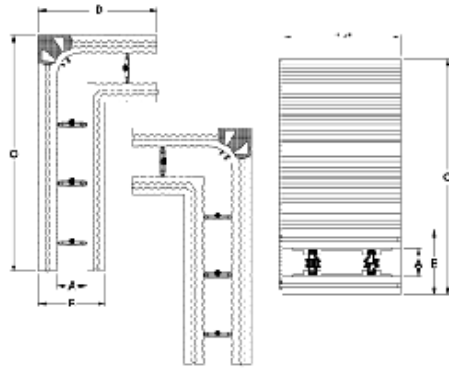
For SI: 1 pound = 4.45 N; 1 inch = 25.4 mm.

<sup>1</sup>Fasteners must be corrosion-resistant and have sufficient length to penetrate through the cross-tie flange at least 1/4 inch (6 mm).



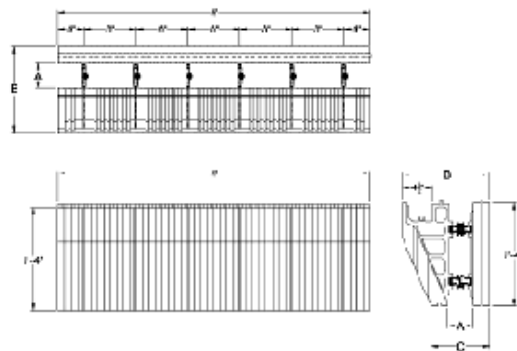
### Standard Straight Form

"A"	"B"
4"	9"
6"	11"
8"	13"
10"	15"
12"	17"



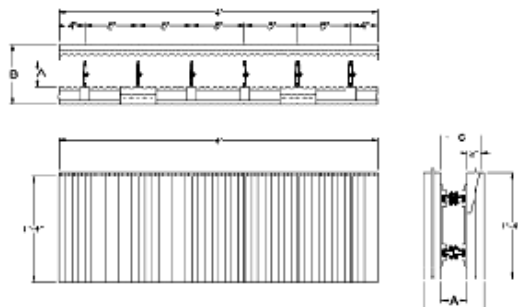
### 90-Degree Corner Form

"A"	"B"	"C"	"D"
4'	9"	2' 8"	1' 4"
6'	11"	2' 4"	1' 8"
8'	13"	2' 8"	1' 4"
10"	15"	2' 4"	1' 8"
12"	17"	2' 8"	1' 4"



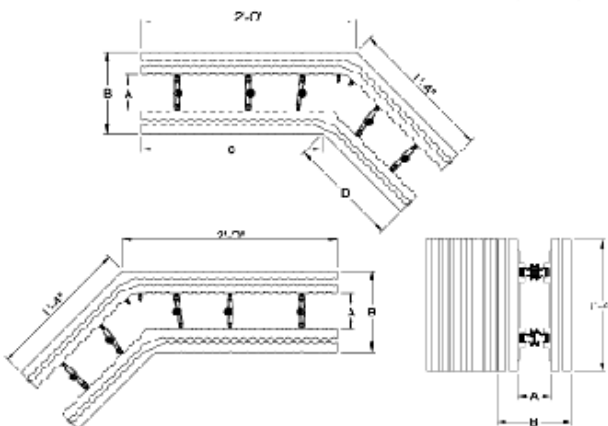
### Brick Ledge Form

"A"	"B"	"C"
4"	13.5"	9"
6"	15.5"	11"
8"	17.5"	13"
10"	19.5"	15"
12"	21.5"	17"



### Taper Top Form

"A"	"B"	"C"
4"	9"	6"
6"	11"	8"
8"	13"	10"
10"	15"	12"
12"	17"	14"



### 45-Degree Corner Form

"A"	"B"	"C"	"D"
4"	9"	20.25"	12.25"
6"	11"	20.25"	12.25"
8"	13"	18.5"	10.5"
10"	15"	18.5"	10.5"
12"	17"	18.5"	10.5"

FIGURE 1—ICF DESCRIPTIONS

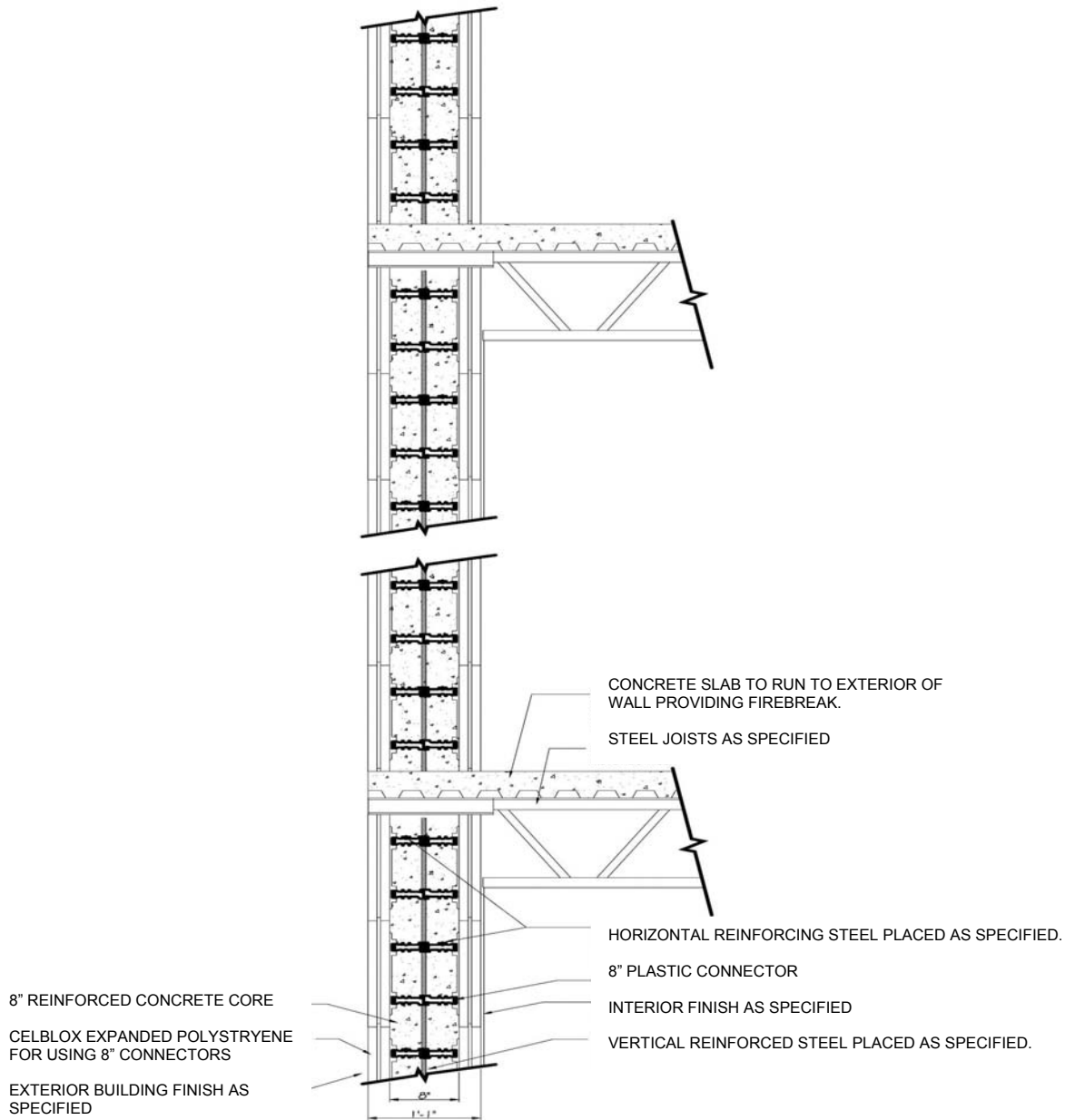


FIGURE 2—TYPICAL WALL-TO-FLOOR INTERSECTION FOR NONCOMBUSTIBLE CONSTRUCTION