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## ICC-ES Evaluation Report

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**ESR-2092**

Reissued 11/2018

This report is subject to renewal 11/2020.

DIVISION: 03 00 00—CONCRETE

SECTION: 03 11 19—INSULATING CONCRETE FORMING

REPORT HOLDER:

**NUDURA INC.**

EVALUATION SUBJECT:

**NUDURA® INTEGRATED BUILDING TECHNOLOGY™ INSULATING CONCRETE FORM  
(ICF) WALL SYSTEM**



"2014 Recipient of Prestigious Western States Seismic Policy Council (WSSPC) Award in Excellence"

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# ICC-ES Evaluation Report

**ESR-2092**
*Reissued November 2018*
*This report is subject to renewal November 2020.*
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*A Subsidiary of the International Code Council®*
**DIVISION: 03 00 00—CONCRETE**
**Section: 03 11 19—Insulating Concrete Forming**
**REPORT HOLDER:**
**NUDURA CORPORATION**
**EVALUATION SUBJECT:**
**NUDURA® INTEGRATED BUILDING TECHNOLOGY™  
INSULATING CONCRETE FORM (ICF) WALL SYSTEM**

## 1.0 EVALUATION SCOPE

### 1.1 Compliance with the following codes:

- 2015, 2012 and 2009 *International Building Code®* (IBC)
- 2015, 2012 and, 2009 *International Residential Code®* (IRC)
- 2006 *International Building Code®* (2006 IBC)\*
- 2006 *International Residential Code®* (2006 IRC)\*

\*Codes indicated with an asterisk are addressed in Section 8.0.

### Properties evaluated:

- Structural
- Surface-burning characteristics
- Attic and crawl-space installation
- Fire-resistance-rated construction
- Types I through IV (noncombustible) construction

### 1.2 Evaluation to the following green code:

2016 California Green Building Standards Code (CALGreen), Title 24, Part 11

### Attributes verified:

See Section 3.1.

## 2.0 USES

NUDURA® Integrated Building Technology™ Insulating Concrete Forms (ICFs) are used as stay-in-place formwork for structural concrete, load-bearing and non load-bearing, below-grade and above-grade walls. The forms are used in construction of plain and reinforced concrete beams, lintels, exterior and interior walls, and foundation and retaining walls. The forms remain in place after the concrete cures and must be covered by an approved interior and exterior wall-finish material, as described in Sections 4.2.2 and 4.2.3, respectively. The forms may be used in fire-resistance-rated construction, provided installation is in accordance with Section 4.3. The forms

may be used in Type V construction. For use in buildings of Types I, II, III or IV (noncombustible) construction, installation must be in accordance with Section 4.4.

## 3.0 DESCRIPTION

### 3.1 General:

NUDURA® Integrated Building Technology™ ICFs consist of expanded-polystyrene (EPS) foam-plastic panels connected with plastic cross-ties. The forms are classified as a flat ICF wall system in accordance with ASTM E2634 as specified in the 2015 IBC Section 1903.4, 2012 IBC Section 1903.3, 2015 IRC Sections R404.1.3.3.6.1 and R608.4.4, 2012 IRC Sections R404.1.2.3.6.1 and R611.4.4 and 2009 IRC Section R611.3.1.

The attribute of the NUDURA® ICFs have been verified as conforming to the provision of CALGreen Section A4.404.3.3 for premanufactured building systems. Note that decisions on compliance for those areas rest with the user of this report. The user is advised of the project-specific provisions that may be contingent upon meeting specific conditions, and the verification of those conditions is outside the scope of this report. These codes or standards often provide supplemental information as guidance.

### 3.2 NUDURA® Insulating Concrete Forms (ICFs):

NUDURA® ICFs are available in a standard length of 96 inches (2438 mm) and a standard height of 18 inches (457 mm). NUDURA® ICFs are available in widths of 9 $\frac{1}{4}$ , 11 $\frac{1}{4}$ , 13 $\frac{1}{4}$ , 15 $\frac{1}{4}$  and 17 $\frac{1}{4}$  inches (235, 286, 337, 388 and 438 mm) to enable formation, respectively, of 4-, 6-, 8-, 10- and 12-inch-thick (102, 152, 203, 254 and 305 mm), flat, monolithic concrete walls.

Forty-five-degree and 90-degree angle form units, "T"-form units, brick ledge forms, brick ledge extensions, height adjusters (with fastening ties) and end caps are also available for each thickness of form unit offered. The corner and "T"-form units are used to construct wall intersections. The brick ledge forms and brick ledge extensions are used to construct concrete corbels for support of brick or stone veneer exterior finishes or for supporting interior floor construction.

The 3-inch (76 mm) height adjuster panels are fitted on their interior surface with shorter length polystyrene fastening strips that are designed in the same manner as the full-height form unit polystyrene fastening strips. In turn, these can be interconnected across the form cavity using a series of 3-inch-high (76 mm) "slide-in" polypropylene ties that have been designed for use with the height adjuster forms, using the same integrally molded "slide-in" pin design as is featured in the corner form insert web. As with the full-height insert webs, the height adjuster

ties are supplied in 4-, 6-, 8-, 10- and 12-inch (102, 152, 203, 254 and 305 mm) cavity widths.

### 3.3 Materials:

**3.3.1 Foam Plastic:** The forms consist of two uniform-thickness EPS foam-plastic panels manufactured to a nominal EPS foam density of 1.35pcf (21.6 kg/m<sup>3</sup>). The EPS foam plastic complies with ASTM C578. The EPS foam plastic has a flame-spread index of 25 or less and a smoke-developed index of 450 or less when tested in accordance with ASTM E84.

**3.3.2 Plastic Cross-Ties:** The EPS panels are connected together with cross-ties consisting of either integrally molded, foldable, high-density polypropylene, hinged web/fastening strips (flanges) or injection-molded, high-impact polystyrene fastening strips (flanges) interlinked with high-density, polypropylene insert webs, depending upon the web location and required function.

The web/fastening strips run the full height of the form panels and are embedded within the EPS at a horizontal spacing of 8-inch (203 mm) intervals, are recessed  $\frac{5}{8}$  inch (15.9 mm) from the EPS surface, and provide a fastening flange that measures  $1\frac{1}{2}$  inches (38 mm) in width. The webs connected to the flanges also have openings to permit concrete to pass through, and feature a variety of seat options for support and to lock the horizontal steel reinforcing bars in place. Either configuration of cross-ties serves to separate the EPS panels at a prescribed uniform core distance and provide an anchorage location for attachment of interior and exterior finishes.

The EPS panels and cross-ties are molded with preformed reversible interlock and vertical clip-locking mechanisms on their top and bottom edges to facilitate stacking and vertical interlocking of the form units.

**3.3.3 Concrete:** Concrete must be normal-weight concrete complying with the applicable code, having a maximum aggregate size of  $\frac{1}{2}$  inch (12.7 mm) for use with 4- and 6-inch (102 and 152 mm) cavity width ICFs; and  $\frac{3}{4}$  inch (19.1 mm) for use with 8-inch (203 mm) and larger cavity width ICFs. The concrete must have a minimum compressive strength of 2,500 psi (17 MPa) at 28 days, except for fire-resistance-rated construction, as noted in Section 4.3. Under the IRC, concrete must comply with 2015 IRC Sections R404.1 and R608.5.1, 2012 and 2009 IRC Sections R404.1 and R611.5.1, as applicable.

**3.3.4 Reinforcement:** Deformed steel reinforcement bars must have a minimum specified yield stress of either 40 ksi (275 kPa) or 60 ksi (413 kPa), depending on the structural design, and under the IBC, must comply with 20.2.1.3 of ACI 318-14 under the 2015 IBC (and Section 3.5.3.1 of ACI 318-11 or -08 and 2012 and 2009 IBC) and IBC Section 1903; under the IRC, reinforcement must comply with 2015 IRC Sections R404.1.3.3.7 and R608.5.2, 2012 and 2009 IRC Sections R404.1.2.3.7 and R611.5.2.

**3.3.5 Other Components:** Wood members in contact with concrete for plates or windows and door framing must be treated with an approved wood preservative or be of a naturally durable species, and must be attached with hot-dipped galvanized steel fasteners complying with 2015 IBC Section 2304.10.5, 2012 and 2009 IBC Section 2304.9.5 or IRC Section R317.3, as applicable. Materials other than wood, such as vinyl, are permitted for window and door framing, if approved by the code official.

## 4.0 DESIGN AND INSTALLATION

### 4.1 Design:

**4.1.1 IBC Design, Including Alternative IBC Wind Design in Accordance with ICC 600:** Concrete walls

formed by the NUDURA® Integrated Building Technology 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.

Solid concrete walls formed by the NUDURA® Integrated Building Technology ICFs may be designed and constructed in accordance with the prescriptive provisions of Section 409 of the ICC Standard for Residential Construction in High Wind Regions (ICC 600-14) under the 2015 IBC, or Section 209 of the ICC Standard for Residential Construction in High Wind Regions (ICC 600-2008) under the 2012 and 2009 IBC, as applicable, subject to the limitations found in Exception 1 of IBC Sections 1609.1.1 and 1609.1.1.1. Design and construction under the provisions of ICC 600-14 or -08 are limited to resistance to wind forces.

**4.1.2 IRC Method:** Insulating concrete walls formed by the NUDURA® Integrated Building Technology ICFs must be designed and constructed in accordance with 2015 IRC Sections R404.1.3 and R608, or 2012 and 2009 IRC Sections R404.1.2 and R611, as applicable, for flat wall systems. ICFs not complying with the dimensional requirements found in 2015 IRC Table R608.3 and Figure R608.3(1) or 2012 and 2009 IRC Table R611.3 [i.e., solid concrete walls thicker than 10 inches (254 mm)], as applicable, must be designed and constructed in accordance with the provisions of Section 4.1.1 of this report.

Use of the ICFs for foundation walls is limited to the 6-, 8- and 10-inch-thick (152, 203 and 254 mm) core-width ICFs, in accordance with 2015 IRC Section R404.1.3 or 2012 and 2009 IRC Section R404.1.2. Use of the ICFs for above-grade construction is limited to the 4-, 6-, 8- and 10-inch-thick (102-, 152-, 203- and 254-mm) core-width ICFs, in accordance with 2015 IRC Section R608 or 2012 and 2009 IRC Section R611.

**4.1.3 Alternate IRC Method:** When the NUDURA® Integrated Building Technology ICFs are used to construct buildings that do not conform to the applicability limits in 2015 IRC Sections R404.1.3 and R608.2 or 2012 and 2009 IRC Sections R404.1.2 and R611.2, construction must be in accordance with the prescriptive provisions of the 2012 Prescriptive Design of Exterior Concrete Walls for One-and Two-family Dwellings (PCA 100-12) under the 2015 IRC; (PCA 100-10 for the 2012 IRC or PCA 100-07 for the 2009 IRC, as applicable), or the structural analysis and design of the concrete must be in accordance with ACI 318 and IBC Chapters 16, 18 and 19.

### 4.2 Installation:

**4.2.1 General:** NUDURA® Integrated Building Technology™ ICFs must be installed in accordance with the NUDURA® 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 the instructions must be available at all times on the jobsite during installation.

The NUDURA® Integrated Building Technology 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 reinforcement bars embedded in footings must extend into the base of the wall system the minimum development length, and into concrete walls with a minimum lap splice length conforming to Chapter 25 of ACI 318-14 under the 2015 IBC, Chapter 12 of ACI 318-11 or -08 under the 2012 and 2009 IBC or 2015 IRC Section R608.5.4 or 2012 and 2009

IRC Section R611.5.4, as applicable. Additional reinforcement around doors and windows must be described in the approved construction documents. Concrete quality, mixing and placement must comply with IBC Chapter 19 or 2015 IRC Sections R404.1.3.3 and R608.5.1 or 2012 and 2009 IRC Sections R404.1.2.3 and R611.5.1, as applicable. Window and door openings must be built into the forms, with frames of the same dimensions as the "rough stud opening" specified by the window or door manufacturer, prior to the placement of concrete. Connections of concrete walls to footings, floors, ceilings and roofs must be in accordance with 2015 IRC Section R608.9 or 2012 and 2009 IRC Section R611.9, as applicable, or be engineered in accordance with the IBC, whichever code is applicable. Anchor bolts used to connect wood ledgers and 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, 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, except as described in Section 4.2.2.2. NUDURA® Integrated Building Technology™ ICFs exposed to the interior of the building must be finished with an approved 15-minute thermal barrier, such as minimum  $\frac{1}{2}$ -inch-thick (12.7 mm) regular gypsum wallboard complying with ASTM C36 or ASTM C1396. The gypsum wallboard may be installed vertically or horizontally and must be attached to cross-tie flanges with minimum  $\frac{5}{8}$ -inch-long (41 mm), No. 6, coarse-thread (Type W) gypsum wallboard screws, spaced 16 inches (406 mm) on center horizontally and vertically. The screws must comply with ASTM C954 or ASTM C1002. The screws must penetrate through the flange a minimum of  $\frac{1}{4}$  inch (6.4 mm). Gypsum wallboard joints and screw heads must be taped and filled with joint compound in accordance with ASTM C840 or GA 216.

**4.2.2.2 Attic and Crawl Space Installation:** When the NUDURA® Integrated Building Technology™ ICFs are used as walls of attic and crawl spaces and no ignition barrier is applied to the interior space side of the foam plastic, all of the following conditions must be met:

- Entry to the attic or crawl space is only to service utilities, and no storage is permitted.
- There are no interconnected attic or basement areas.
- Air in the attic or crawl space is not circulated to other parts of the building.
- Attic ventilation is provided when required by IBC Section 1203.2 or IRC Section R806, as applicable.
- Under-floor (crawl space) ventilation is provided when required by 2015 IBC Section 1203.4, 2012 and 2009 IBC Section 1203.3 or IRC Section R408.1, as applicable.
- Combustion air is provided in accordance with IMC (*International Mechanical Code*®) Section 701.

#### **4.2.3 Exterior Finish:**

**4.2.3.1 Above Grade:** The forms must be covered on the exterior with an approved wall covering in accordance with the applicable code or a current ICC-ES evaluation report. Under the IRC, walls must be flashed in accordance with 2015 IRC Section R703.4 and 2012 and 2009 IRC Section R703.8.

The approved wall covering must be fastened to the flanges of the cross-ties with the fasteners listed in Table 1. The screws must be corrosion-resistant and must have sufficient length to penetrate the flanges of the plastic bridge inserts a minimum of  $\frac{1}{4}$  inch (6.4 mm). The fasteners have the allowable withdrawal and lateral capacity 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. Negative wind pressure capacity of the exterior wall covering must be the same as that recognized in the applicable code for a generic wall covering or in a current ICC-ES evaluation report for proprietary materials.

**4.2.3.2 Below Grade:** Materials used to dampproof or waterproof basement walls must be specified by NUDURA; must comply with the applicable code or a current ICC-ES evaluation report; and must be compatible with the foam plastic forms. Dampproofing and waterproofing must comply with IBC Section 1805 or IRC Section R406. Drainage must comply with IBC Section 1805.4 or IRC Section R405.1. No backfill is permitted to be 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:** Foundation stem walls constructed from the ICFs that support wood-framed or concrete construction must be supported on concrete footings complying with the applicable code. Design and installation of the ICFs as foundation stem walls must comply with IBC Section 1807.1.5, IRC Section R404, 2015 IRC Section R404.1.3 or 2012 and 2009 IRC Section R404.1.2, as applicable. For concrete foundation walls under the IBC, vertical reinforcement size and spacing must be in accordance with IBC Section 1807.1.6.2. For concrete foundation walls under the IRC, vertical reinforcement size and spacing must be in accordance with IRC Tables R404.1.2(2), R404.1.2(3), R404.1.2.(4) and R404.1.2(8). Under the IRC, alternate design and construction may be in accordance with ACI 318, ACI 332 or PCA 100.

**4.2.5 Retaining Walls:** The ICFs may be used to construct a retaining wall, provided the retaining wall is designed in accordance with accepted engineering principles, Section 4.1 and the applicable code.

**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 2015 and 2009 IBC Section 2603.8 or 2012 IBC Section 2603.9 or IRC Section R318.4, as applicable. Areas of very heavy termite infestation must be determined in accordance with 2015 and 2009 IBC Figure 2603.8, 2012 IBC Figure 2603.9 or IRC Figure R301.2(6), as applicable.

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

NUDURA® Integrated Building Technology™ ICFs used to construct fire-resistance-rated wall assemblies shall be as follows:

**4.3.1 General:** The normal-weight concrete of a sand-limestone mix must have a minimum density of 145 pcft  $\pm$  5 pcft ( $2300 \text{ kg/m}^3 \pm 50 \text{ kg/m}^3$ ) with a minimum compressive strength of 2,900 psi (20 MPa). The minimum reinforcement must be No. 4 (10M) reinforcing bars. Reinforcing bars must be placed vertically in the center of the wall and spaced 16 inches (405 mm) on center. Horizontal reinforcing bars must be spaced 18 inches (457 mm) on center and be staggered on either side of the vertical bars, from course to course of the forms. For the ICFs with 4-inch-thick (102 mm) concrete walls the

maximum superimposed axial compression load must be limited to 7 percent of the capacity determined in accordance with IBC Chapter 19. For ICFs with 6-inch (152 mm) or thicker concrete walls the maximum superimposed axial compression load must be limited to 41.8 kips per foot (610 kN/m). The load limitations are based on testing of 10-foot (3.05 m) high walls.

**4.3.2 Two- and Four-hour Fire-resistance-rated Wall Assemblies:** The fire-resistance ratings are as follows for the assemblies noted in Sections 4.3.1, 4.3.2.1 and 4.3.2.2:

- Four-inch-thick (102 mm) concrete wall assembly has a fire-resistance rating of two hours
- Six-inch (152 mm) and greater thickness concrete wall assemblies have a fire-resistance rating of four hours.

**4.3.2.1 Exterior Wall Assembly:** The interior face of the forms is covered with minimum  $\frac{1}{2}$ -inch-thick (12.7 mm) gypsum wallboard complying with ASTM C36 or ASTM C1396. The wallboard must be attached to the cross-tie flanges with 2-inch-long (51 mm), No. 6, coarse-thread (Type W) gypsum wallboard screws, spaced 16 inches (406 mm) on center vertically and 8 inches (203 mm) on center horizontally. When ICF is used as an exterior wall for fire-resistance rating from both sides, the gypsum wallboard on the exterior face may be substituted with minimum 1-inch (25.4 mm) thick concrete or masonry mechanically attached to supporting ICF concrete wall. When ICF is only fire-resistance rated from the interior, the exterior face of the ICFs must be covered with an exterior finish as described in Section 4.2.3.

**4.3.2.2 Interior Wall Assembly:** Both faces of the ICFs must be covered with minimum  $\frac{1}{2}$ -inch-thick (12.7 mm) gypsum wallboard complying with ASTM C36 or ASTM C1396. The wallboard must be attached to the cross-tie flanges with 2-inch-long (51 mm), No. 6, coarse-thread (Type W) gypsum wallboard screws, spaced 16 inches (406 mm) on center vertically and 8 inches (203 mm) on center horizontally.

#### 4.4 Installation in Buildings Required to Be of Types I, II, III or IV Construction:

**4.4.1 General:** Exterior walls constructed with NUDURA® Integrated Building Technology™ ICFs for use in buildings required to be Types I, II, III or IV construction must comply with the applicable conditions cited in Sections 4.4.2 through 4.4.6.

#### 4.4.2 Interior Finish:

**4.4.2.1 Buildings of Any Height:** The forms must be separated from the interior of the building in accordance with Section 4.2.2.1.

**4.4.2.2 Alternate Interior Finish for One-story Buildings:** For one-story buildings, the interior finish may be in accordance with IBC Section 2603.4.1.4, provided all the conditions in that section are met.

**4.4.3 EIFS and One-coat Stucco-Exterior Finish:** The following EIFS or one-coat stucco lamina must be installed over the exterior of the forms using the reinforcing fabric or lath, base coat and finish coat materials described in the respective ICC-ES evaluation reports:

- Dryvit Systems, Inc., Dryvit Outswalton EIFS as described in [ESR-1232](#).
- Omega Products International, Inc., Omega Diamond Wall or Diamond Wall PM Insulating Exterior Stucco System as described in [ESR-1194](#).
- Sto Corp. StoTherm Classic NExT or StoTherm Essence NExT EIFS as described in [ESR-1748](#).

- Sto Corp. StoTherm Essence EIFS as described in [ESR-1720](#).

**4.4.4 Exterior Finish—Brick Veneer:** Anchored brick veneer must be attached to the flanges of the cross-ties with fasteners as described in Section 4.2.3.1. The brick veneer must comply with the IBC and must be installed with a minimum 1-inch (25.4 mm) air gap between the face of the exterior EPS formwork and the brick. The brick must be installed with a steel shelf angle that is fire caulked to the face of a minimum  $1\frac{1}{2}$ -inch (38 mm) thick concrete reveal protection cap of the exterior foam plastic panel of the ICF form, extending the full width of the top of each window and door opening (See Figure 17). In multi-story construction, above 1 story in height, steel shelf angles supporting brick veneer must be installed for structural support in accordance with the code.

**4.4.5 Exterior Finish—Exterior Plaster:** Metal lath and exterior plaster must comply with the applicable code, and the exterior plaster must be a minimum of  $\frac{7}{8}$  inch (22 mm) thick. The lath must be attached to the flange of the cross-ties with fasteners as described in Section 4.2.3.1.

**4.4.6 Fireblocking:** Floor-to-wall intersections must be fireblocked in accordance with the IBC to prevent the passage of flame, smoke and hot gasses from one floor to another. Foam plastic on the interior side of exterior walls and on both sides of interior walls must be discontinuous from one story to another at floor lines. See Figure 18.

#### 4.5 Special Inspection:

**4.5.1 IBC:** Special inspection is required, in accordance with 2015 and 2012 IBC Section 1705 or 2009 IBC Section 1704, for concrete construction, including placement of reinforcing steel and concrete, and for concrete cylinder testing. When an EIFS wall covering is applied, special inspection in accordance with 2015 IBC Sections 1704.2 and 1705.16, 2012 IBC Sections 1704.2 and 1705.15, or 2009 IBC Sections 1704.1 and 1704.14, as applicable, is required, and the duties of the special inspector include verifying field preparation of materials, expiration dates, installation of components, curing of components, treatment of joints and application of sealants.

**4.5.2 IRC:** For walls designed in accordance with Section 4.1.2, or designed in accordance with PCA 100 as described in Section 4.1.3, special inspection is not required. Under the IRC, when walls are designed in accordance with the IBC, as described in Sections 4.1.2 and 4.1.3, special inspection in accordance with Section 4.5.1 of this report is required.

#### 5.0 CONDITIONS OF USE

The NUDURA® Integrated Building Technology™ Insulating Concrete Form (ICF) Wall System 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 The ICFs are manufactured, identified and installed in accordance with this report and the NUDURA published installation instructions. If there is a conflict between the NUDURA published installation instructions and this report, this report governs.
- 5.2 Plastic cross-ties must be stored away from direct sunlight.
- 5.3 The ICFs must be separated from the interior of the building as described in Section 4.2.2.1 of this report, except for attic and crawl space construction as described in Section 4.2.2.2.

- 5.4** When used in attics and crawl space construction as described in Section 4.2.2.2, the ICFs must have at least one label as described in Section 7.0 visible in every 160 square feet ( $15 \text{ m}^2$ ) of exposed interior wall area.
- 5.5** When used as part of a fire-resistance-rated assembly, construction must be as described in Section 4.3.
- 5.6** When use is in buildings required to be of Type I, II, III or IV construction, as described in Section 4.4, the ICFs must have at least one label as described in Section 7.0 visible in every 160 square feet ( $15 \text{ m}^2$ ) of wall area, prior to the application of the wall covering.
- 5.7** When required by the code official, calculations showing compliance with the design requirements of Section 4.1.1 of this report must be submitted to the code official for approval, except that calculations are not required when the building design is based on the prescriptive methods noted in Sections 4.1.2 and 4.1.3. 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.
- 5.8** When required by code official, calculations showing compliance with 2015 IRC Sections R404.1.3.3.6 and R608.5.3, or 2012 and 2009 IRC Sections R611.5.3 and R404.1.2.3.6, as applicable, must be submitted to the code official for approval. The calculations and details, establishing that the ICFs provide sufficient strength to contain concrete during placement and that the cross-ties are capable of resisting the forces created by fluid pressure of fresh concrete, must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.
- 5.9** In areas where the probability of termite infestation is defined as "very heavy" and when ICFs are used with wood construction, the foam plastic must be installed in accordance with Section 4.2.6.
- 5.10** Concrete quality, mixing and placement must comply with Section 4.2.1 of this report.
- 5.11** Special inspection must be provided in accordance with Section 4.5 of this report.
- 5.12** The forms are produced in Columbus, Georgia, USA, and Granby, Quebec, Canada, under a quality control program with inspections by ICC-ES.

## 6.0 EVIDENCE SUBMITTED

- 6.1** For the 2015 and 2012 IBC and IRC: 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 2012 (Editorially revised October 2015).
- 6.2** For recognition under the 2009 IBC and IRC: Data in accordance with AC353 dated October 2010.

## 7.0 IDENTIFICATION

- 7.1** One face of each ICF is labeled with the product name (NUDURA) and the evaluation report number (ESR-2092). Each package of ICFs must be labeled with the company name (NUDURA Corporation), address and telephone number; manufacturing location; manufacturing date; lot number; the evaluation report number (ESR-2092), and the phrase, "Acceptable for use in attic and crawl spaces".

Cross-ties that are shipped separately from the ICFs are provided in boxes that are marked with the manufacturing date and lot number. Cross-ties are molded with the word "NUDURA" to identify them as a component of the wall system.

When use is in buildings required to be of Type I, II, III or IV construction, as described in Section 4.4, or when use is in an attic or crawl space without an ignition barrier, as described in Section 4.2.2.2, one label as described in this section must be visible in every 160 square feet ( $14.7 \text{ m}^2$ ) of the wall area.

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

**NUDURA CORPORATION**  
**27 HOOPER ROAD, UNIT 10**  
**BARRIE, ONTARIO L4N 9S3**  
**CANADA**  
**(866) 468-6299**  
[www.nudura.com](http://www.nudura.com)  
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## 8.0 OTHER CODES

### 8.1 Evaluation Scope:

The products described in this report were also evaluated for compliance with the requirements of the following codes:

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

The products comply with the above-noted codes as follows:

### 8.2 Uses:

See Section 2.0.

### 8.3 Description:

See Section 3.0, except for the following revisions:

- Revise Section 3.1 to say the NUDURA® Integrated Building Technology ICFs are classified as a flat ICF wall system in accordance with 2006 IRC Section R611.3.
- Revise Section 3.2.3 to say that concrete must comply with 2006 IRC Sections R404.4 and R611.6.1, as applicable.
- Revise Section 3.2.4 to say that steel reinforcement must comply with 2006 IRC Sections R404.4.6 and R611.6.2, as applicable.
- Revise Section 3.2.5 to say that attachment of wood members in contact with concrete must comply with 2006 IRC Section R319.3.

### 8.4 Design and Installation:

#### 8.4.1 Design:

**8.4.1.1 IBC Method:** Concrete walls formed by the NUDURA® Integrated Building Technology ICFs must be designed and constructed in accordance with 2006 IBC Chapters 16 and 19, as applicable. Footings and foundations must be designed and constructed in accordance with 2006 IBC Chapter 18.

**8.4.1.2 IRC Method:** Concrete walls formed by the NUDURA® Integrated Building Technology ICFs must be designed and constructed in accordance with 2006 IRC Sections R404.4 and R611 for flat ICF wall systems. Footings and foundations must be designed and constructed in accordance with 2006 IRC Chapter 4.

**8.4.1.3 Alternate IRC Method:** When buildings constructed under the 2006 IRC provisions do not conform

to the applicability limits of 2006 IRC Sections R404.4.1 and R611.2, the structural analysis and design of the concrete must be in accordance with ACI 318 and 2006 IBC Chapter 19. The empirical design approach specified in ACI 318 Section 14.5 is applicable to the design of concrete walls formed by the NUDURA® Integrated Building Technology ICFs.

**8.4.2 Installation:** Same as Section 4.2, except for the following revisions:

- Revise Section 4.2.1 to say that concrete quality, mixing and placement must comply with 2006 IBC Section

1905 or 2006 IRC Section R611.6.1, as applicable. Anchorage of wood ledger boards supporting bearing ends of joists or trusses to flat ICF walls must be in accordance with 2006 IRC Section R611.8.2, or must be engineered in accordance with the IBC, whichever code is applicable.

- Revise Section 4.2.2.2 to say that combustion air is provided in accordance with 2006 IMC Sections 701 and 703.
- Revise Section 4.2.3.2 to say that compliance is required with drainage requirements in 2006 IBC Section 1807.4 or 2006 IRC Section R405.1, as applicable.
- Revise Section 4.2.4 to say that design and installation of foundation stem walls must comply with 2006 IBC Section 1805.5 or 2006 IRC Sections R404 and R404.1.2, as applicable.
- Revise Section 4.2.6 to say that where the probability of termite infestation is defined as "very heavy" by the code official, the foam plastic must be installed in accordance with 2006 IBC Section 2603.8 or 2006 IRC Section R320.5, as applicable.

**8.4.3 Fire-resistance-rated Construction:** See Section 4.3.

**8.4.4 Types I, II, III or IV Construction:** See Section 4.4.

**8.4.5 Special Inspection:**

**8.4.5.1 IBC:** Special inspection is required as noted in 2006 IBC Section 1704 for concrete construction, including placement of reinforcing steel and concrete, and for

concrete cylinder testing. Special inspection, in accordance with 2006 IBC Sections 1704.1 and 1704.12, is required when an EIFS wall covering 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.

**8.4.5.2 IRC:** For walls designed and constructed in accordance with Section 8.4.1.2, special inspection is not required. For walls designed for use under the IRC, in accordance with Section 8.4.1.3, special inspection in accordance with Section 8.4.5.1 is required.

### 8.5 Conditions of Use:

Same as Section 5.0, except for the following revisions:

- Revise Section 5.6 to say that calculations are not required when the building design is based on the prescriptive method noted in Section 8.4.1.2 or 8.4.1.3. 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.
- Revise Section 5.8 to say that in areas where the probability of termite infestation is defined as "very heavy" and when ICFs are used with wood construction, the foam plastic must be installed in accordance with Section 8.4.2.1
- Revise Section 5.9 to say that concrete quality, mixing and placement must comply with 2006 IBC Section 1905 or 2006 IRC Section R611.6.1, as applicable.
- Revise Section 5.10 to say that special inspection must be in accordance with Section 8.4.5.1 or 8.4.5.2, as applicable.
- Section 5.8 is not applicable.

### 8.6 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 2000 (editorially revised April 2008).

### 8.7 Identification:

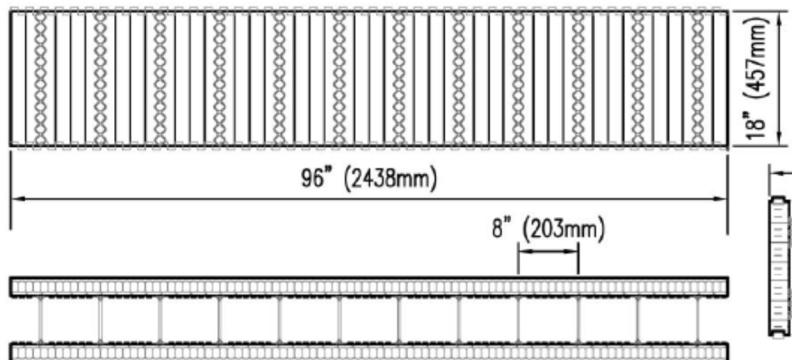
See Section 7.0.

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

FASTENER	ALLOWABLE LOAD CAPACITY (lbf)	
	Lateral	Withdrawal
No. 6 Type W coarse thread screw by 2 inches	65	40
No. 8 metal screws by 2 inches	55	44
No. 8 cement board screws by 1 <sup>3</sup> / <sub>4</sub> inches	83	47
No. 10 metal screw by 2 inches	76	47
No. 10 wood screw by 2 inches	89	51
No. 10 hex head with washer, coarse thread self-tapping screw by 2 inches	109	51
No. 12 metal screw by 2 inches	89	49
No. 14 ZA SMS screw by 2 inches	73	55
1 <sup>1</sup> / <sub>4</sub> – 14 AB screw by 1 <sup>3</sup> / <sub>4</sub> inches	103	50

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

<sup>1</sup>Fasteners must be corrosion-resistant and have sufficient length to penetrate the flanges of the cross-ties at least 1<sup>1</sup>/<sub>4</sub>-inch.



NOMINAL CONCRETE CORE	DIMENSION A (IMP)	DIMENSION A (MET)
4"	9 1/4"	235mm
6"	11 1/4"	286mm
8"	13 1/4"	337mm
10"	15 1/4"	387mm
12"	17 1/4"	438mm

STANDARD FORM UNIT

FIGURE 1 - STANDARD FORM UNIT

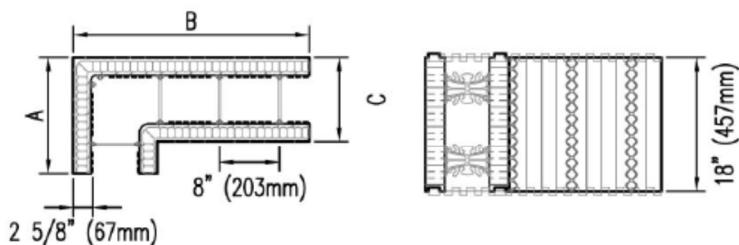


FIGURE 2 - 90° CORNER FORM UNIT

NOMINAL CONCRETE CORE	DIMENSION (IMP)		
	A	B	C
4"	15 5/8"	31 5/8"	9 1/4"
6"	15 5/8"	31 5/8"	11 1/4"
8"	17 5/8"	33 5/8"	13 1/4"
10"	19 5/8"	35 5/8"	15 1/4"
12"	21 5/8"	37 5/8"	17 1/4"

	DIMENSION (MET)		
	A	B	C
102mm	397mm	803mm	235mm
152mm	397mm	803mm	286mm
203mm	448mm	854mm	337mm
254mm	494mm	905mm	387mm
305mm	549mm	956mm	438mm

90° CORNER FORM UNIT

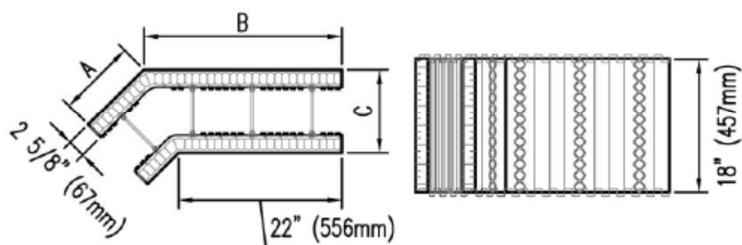


FIGURE 3 - 45° CORNER FORM UNIT

NOMINAL CONCRETE CORE	DIMENSION (IMP)		
	A	B	C
4"	10 1/2"	26 1/2"	9 1/4"
6"	10 1/2"	26 1/2"	11 1/4"
8"	10 1/2"	26 1/2"	13 1/4"
10"	12 1/2"	28 1/2"	15 1/4"
12"	14 1/2"	30 1/2"	17 1/4"

	DIMENSION (MET)		
	A	B	C
102mm	267mm	673mm	235mm
152mm	267mm	673mm	286mm
203mm	267mm	673mm	337mm
254mm	318mm	724mm	387mm
305mm	368mm	775mm	438mm

45° CORNER FORM UNIT

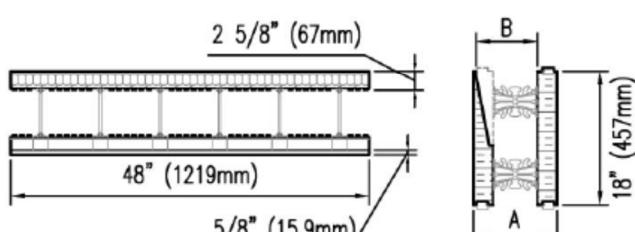


FIGURE 4 - TAPERED TOP FORM UNIT ONE SIDED

NOMINAL CONCRETE CORE	DIMENSION A (IMP)	DIMENSION B (IMP)	DIMENSION A (MET)	DIMENSION B (MET)
4"	9 1/4"	6"	235mm	102mm
6"	11 1/4"	8"	286mm	152mm
8"	13 1/4"	10"	337mm	203mm
10"	15 1/4"	12"	387mm	254mm
12"	17 1/4"	14"	438mm	305mm

TAPERED TOP FORM UNIT

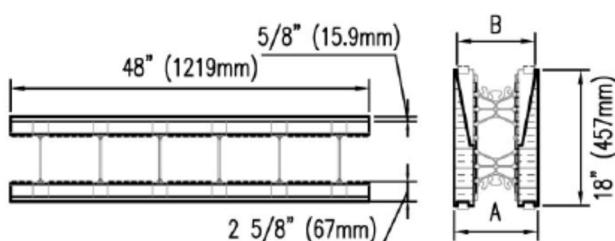
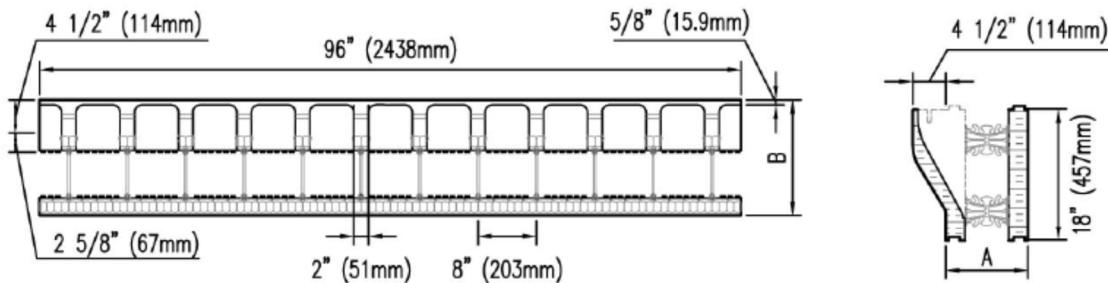


FIGURE 5 - TAPERED TOP FORM UNIT TWO SIDED

NOMINAL CONCRETE CORE	DIMENSION A (IMP)	DIMENSION B (IMP)	DIMENSION A (MET)	DIMENSION B (MET)
4"	9 1/4"	8"	235mm	203mm
6"	11 1/4"	10"	286mm	254mm
8"	13 1/4"	12"	337mm	305mm
10"	15 1/4"	14"	387mm	356mm
12"	17 1/4"	16"	438mm	406mm

DOUBLE-SIDED TAPERED TOP FORM UNIT



NOMINAL CONCRETE CORE	DIMENSION A (IMP)	DIMENSION B (IMP)	DIMENSION A (MET)	DIMENSION B (MET)
4"	9 1/4"	13 3/4"	235mm	349mm
6"	11 1/4"	15 3/4"	286mm	400mm
8"	13 1/4"	17 3/4"	337mm	451mm
10"	15 1/4"	19 3/4"	387mm	502mm
12"	17 1/4"	21 3/4"	438mm	552mm

FIGURE 6 - BRICK LEDGE FORM UNIT

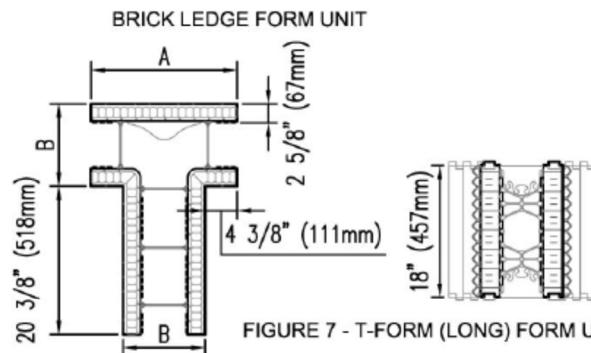


FIGURE 7 - T-FORM (LONG) FORM UNIT

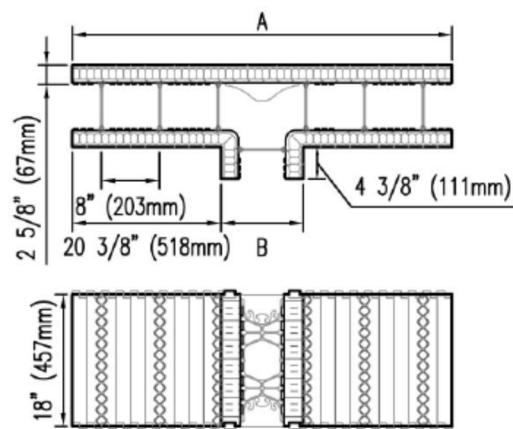


FIGURE 8 - T-FORM (SHORT) FORM UNIT

NOMINAL CONCRETE CORE	DIMENSION A (IMP)	DIMENSION B (IMP)	DIMENSION A (MET)	DIMENSION B (MET)
4"	18"	9 1/4"	457mm	235mm
6"	20"	11 1/4"	508mm	286mm
8"	22"	13 1/4"	559mm	337mm
10"	24"	15 1/4"	610mm	387mm
12"	26"	17 1/4"	660mm	438mm

T-FORM (LONG) FORM UNIT

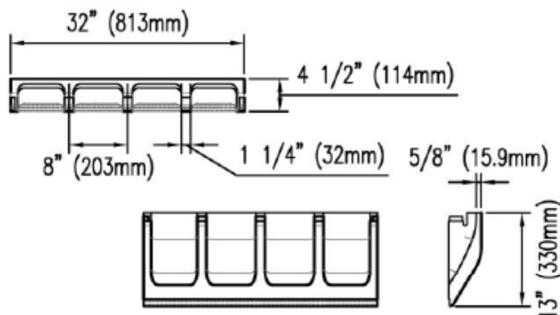


FIGURE 9 - BRICK LEDGE EXTENSION

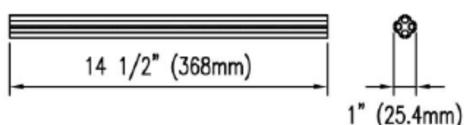


FIGURE 11 - 4 WAY WEB CONNECTOR

NOMINAL CONCRETE CORE	DIMENSION A (IMP)	DIMENSION B (IMP)	DIMENSION A (MET)	DIMENSION B (MET)
4"	50"	9 1/4"	1270mm	235mm
6"	52"	11 1/4"	1321mm	286mm
8"	54"	13 1/4"	1372mm	337mm
10"	56"	15 1/4"	1422mm	387mm
12"	58"	17 1/4"	1473mm	438mm

T-FORM (SHORT) FORM UNIT

DIMENSION A (IMP)	DIMENSION A (MET)
4"	102mm
6"	152mm
8"	203mm
10"	254mm
12"	305mm

FIGURE 10 - STANDARD END CAP WITH FASTENING STRIP

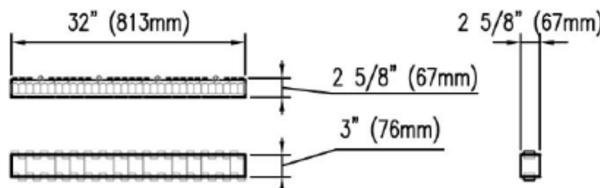


FIGURE 12 - HEIGHT ADJUSTER WITH FASTENING STRIPS

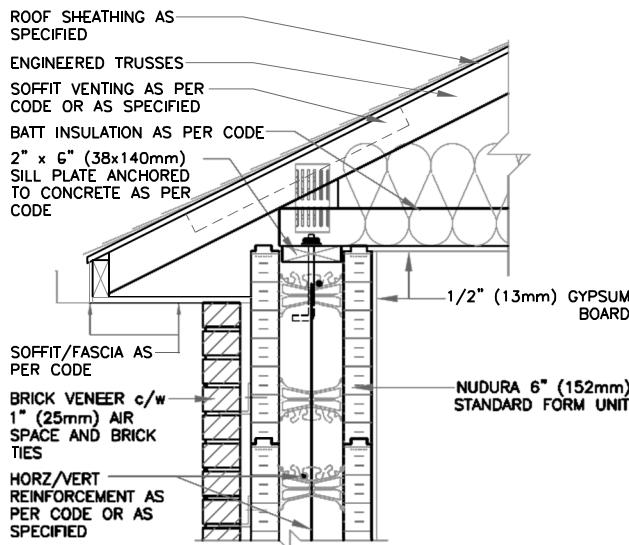


FIGURE 13—TYPICAL ROOF TRUSS CONNECTION DETAIL

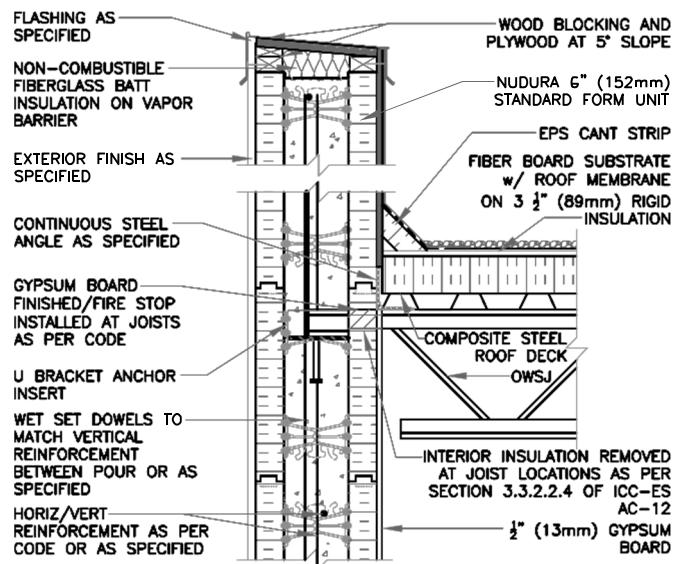


FIGURE 16—TYPICAL FLAT ROOF CONNECTION DETAIL

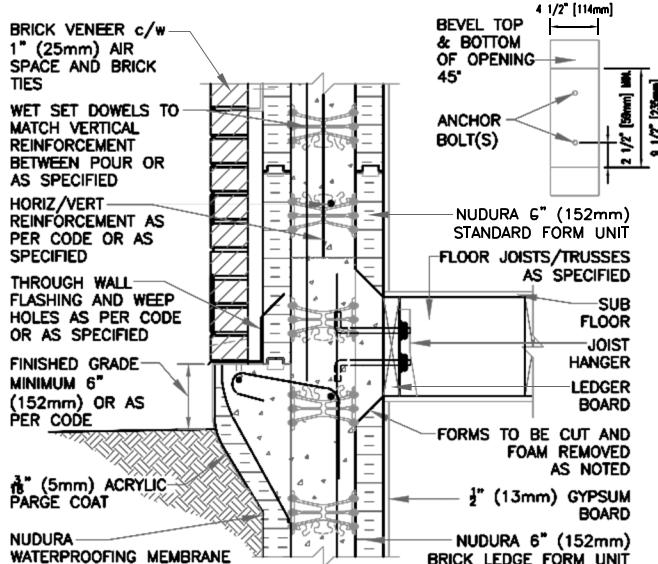


FIGURE 14—TYPICAL FLOOR CONNECTION DETAIL WITH BRICK LEDGE

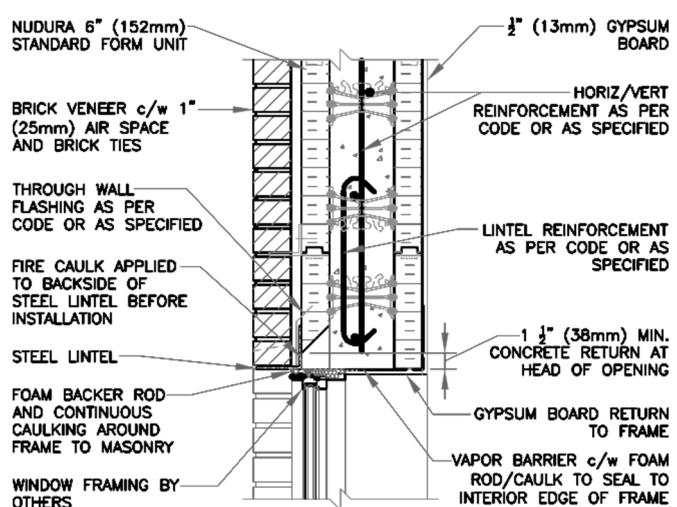


FIGURE 17—WINDOW HEAD CONDITION FOR BRICK INSTALLATION—TYPE 1 – IV CONSTRUCTION

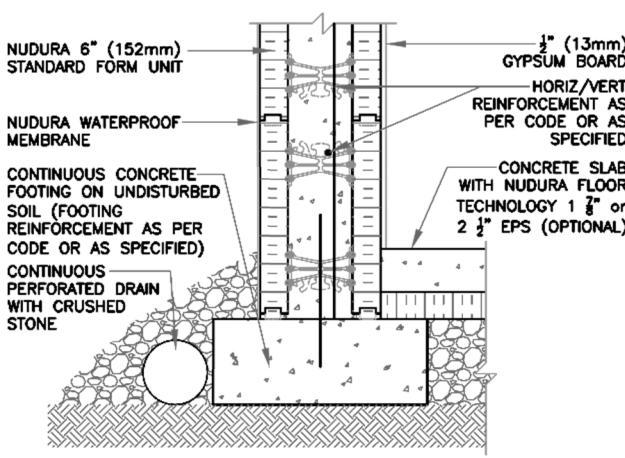


FIGURE 15—STANDARD STRIP FOOTING (INSULATION OPTIONAL)

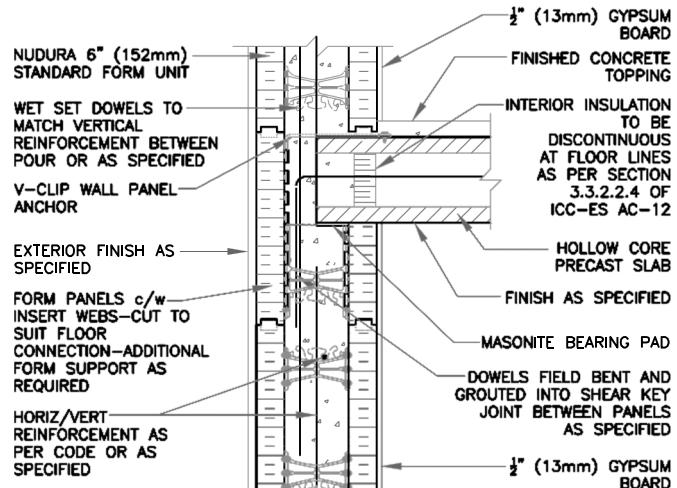


FIGURE 18—INTERMEDIATE FLOOR CONNECTION LOAD BEARING HOLLOW CORE / STRUCTURAL SLAB



## ICC-ES Evaluation Report

## ESR-2092 CBC and CRC Supplement

Reissued November 2018

This report is subject to renewal November 2020.

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A Subsidiary of the International Code Council®

DIVISION: 03 00 00—CONCRETE

Section: 03 11 19—Insulating Concrete Forming

REPORT HOLDER:

NUDURA CORPORATION

EVALUATION SUBJECT:

NUDURA® INTEGRATED BUILDING TECHNOLOGY™ INSULATING CONCRETE FORM (ICF) WALL SYSTEM

### 1.0 REPORT PURPOSE AND SCOPE

#### Purpose:

The purpose of this evaluation report supplement is to indicate that Nudura Integrated Building Technology Insulating Concrete Form (ICF) wall system, recognized in ICC-Es master evaluation report ESR-2092, has also been evaluated for compliance with Chapters 17, 17A, 18, 18A, 19, 19A and 26 of the CBC and Chapters 3, 4 and 6 of the CRC of the codes noted below.

#### Applicable code editions:

- 2013 California Building Code (CBC)
- 2013 California Residential Code (CRC)

### 2.0 CONCLUSIONS

#### 2.1. CBC:

The Nudura Integrated Building Technology Insulating Concrete Form (ICF) wall system described in Sections 2.0 through 7.0 of the master report ESR-2092 complies with Chapters 17, 17A, 18, 18A, 19, 19A and 26 of the CBC, provided the design and installation are in accordance with the 2012 *International Building Code*® (IBC) provisions noted in the master report and Chapters 17, 18, 19 and 26 of the IBC.

The ICF wall systems have not been evaluated under CBC Chapter 7A, for use in the exterior design and construction of new buildings located in any Fire Hazard Severity Zone within State Responsibility Areas or any Wildland–Urban Interface Fire Area.

#### 2.2. CRC:

The Nudura Integrated Building Technology Insulating Concrete Form (ICF) wall system described in Sections 2.0 through 7.0 of the master report ESR-2092 complies with Chapters 3, 4 and 6 of the CRC, provided the design and installation are in accordance with the 2012 *International Residential Code*® (IRC) provisions noted in the master report.

The ICF wall systems have not been evaluated under CRC Section R327, for use in the exterior design and construction of new buildings located in any Fire Hazard Severity Zone within State Responsibility Areas or any Wildland–Urban Interface Fire Area.

The ICF wall systems have not been evaluated for compliance with the *International Wildland–Urban Interface Code*®.

This supplement expires concurrently with the master report, reissued November 2018.

## ICC-ES Evaluation Report

## ESR-2092 FBC Supplement

Reissued November 2018

This report is subject to renewal November 2020.

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A Subsidiary of the International Code Council®

DIVISION: 03 00 00—CONCRETE

Section: 03 11 19—Insulating Concrete Forming

REPORT HOLDER:

NUDURA CORPORATION

EVALUATION SUBJECT:

NUDURA® INTEGRATED BUILDING TECHNOLOGY™ INSULATING CONCRETE FORM (ICF) WALL SYSTEM

### 1.0 REPORT PURPOSE AND SCOPE

#### Purpose:

The purpose of this evaluation report supplement is to indicate that Nudura® Integrated Building Technology™ Insulating Concrete Forms (ICFs), recognized in ICC-ES master evaluation report ESR-2092, has also been evaluated for compliance with the codes noted below.

#### Applicable code editions:

- 2014 Florida Building Code—Residential
- 2014 Florida Building Code—Building

### 2.0 CONCLUSIONS

The Nudura® Integrated Building Technology™ Insulating Concrete Forms (ICFs) described in Sections 2.0 through 7.0 of the master evaluation report ESR-2092, complies with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design and installation are in accordance with the International Building Code (IBC) and International Residential Code (IRC) provisions noted in the master report under the following conditions:

- In Section 4.1 of the master report, for applications subject to the *Florida Building Code—Building*, Chapters 16, 18, and 19 of the *Florida Building Code—Building* are used in lieu of Chapters 16, 18, and 19 of the 2012 IBC. For applications subject to the *Florida Building Code—Residential*, Section R611 of the *Florida Building Code—Residential* is used in lieu of Section R611 of the 2012 IRC.
- In Section 4.2 of the master report, for applications subject to the *Florida Building Code—Building*, Section 1203.3, Chapter 18, Chapter 19, and Section 2603.9 of the *Florida Building Code—Building* are used in lieu of Section 1203.3, Chapter 18, Chapter 19, and Section 2603.9 of the 2012 IBC. For applications subject to the *Florida Building Code—Residential*, Section R318, Chapter 4, Section R611, R703.8, and R806 of the *Florida Building Code—Residential* are used in lieu of Chapter 4, Section R611, R703.8, and R806 of the 2012 IRC.
- In Section 4.4.3 of the master report, only Sto Corp. StoTherm Classic NExT and StoTherm Essence NExT EIFS ([ESR-1748](#)) and Sto Corp. StoTherm Essence EIFS ([ESR-1720](#)) are included in this supplement.

Use of the Nudura® Integrated Building Technology™ ICFs for compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential* has not been evaluated and is outside the scope of this supplement report.

For products falling under Florida Rule 9N-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the master report, reissued November 2018.