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RESEARCH REPORT: RR 25595
(CSI # 03100)

BASED UPON ICC EVALUATION SERVICE
LEGACY REPORT NO. ER-6163

REEVALUATION DUE DATE:
January 1, 2007

GENERAL APPROVAL - NUDURA Insulated Concrete Forms (ICF) Concrete Wall System.

DETAILS

The above products are approved under the description, identification and findings in Legacy Report No. ER-6163, dated January 1, 2005, of the ICC Evaluation Service, Incorporated. The report, in its entirety, is attached and made part of this general approval.

The parts of Report No. ER-6163 marked by the asterisk are deleted or revised by the Los Angeles Building Department from this approval.

The approval is subject to the following conditions:

1. Complete design and calculation shall be prepared by an engineer licensed in the State of California and approved by the structural plan check.
2. The form work shall be used in areas where combustible material are permitted by the codes.
3. The maximum allowable pour rate of the forms shall be 4 feet per hour.
4. Continuous inspection by Deputy Inspectors shall be provided for placement of reinforcing steel and concrete. Any exception shall be approved by structural plan check supervisors.

RR 25595
Page 1 of 2

NUDURA Corporaiton
RE: NUDURA Insulated Concrete Forms (ICF) Concrete Wall System

DISCUSSION

The approval is based on tests and analyses.

This general approval will remain effective provided the Evaluation Report is maintained valid and unrevised with the issuing organization. Any revisions to the report must be submitted to this Department, with appropriate fee, for review in order to continue the approval of the revised report.

This general approval of an equivalent alternate to the Code is only valid where an engineer and/or inspector of this Department has determined that all conditions of this Approval have been met in the project in which it is to be used.

Addressee to whom this Research Report is issued is responsible for providing copies of it, complete with any attachments indicated, to architects, engineers and builders using items approved herein in design or construction which must be approved by Department of Building and Safety Engineers and Inspectors.

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Attachments: ICC Legacy Report No. ER-6163 (6 Pages).



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Legacy report on the 1997 Uniform Building Code™, the 2000 International Building Code® and the 2000 International Residential Code® *

DIVISION: 03—CONCRETE
Section: 03130—Permanent Forms

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

NUDURA CORPORATION
27 HOOPER ROAD, UNIT 10
BARRIE, ONTARIO L4N 9S3
CANADA

1.0 SUBJECT

NUDURA™ Integrated Building Technology Insulated Concrete Form (ICF) Wall System.

2.0 DESCRIPTION

2.1 General:

The NUDURA Integrated Building Technology Insulated Concrete Form (ICF) Wall System, consisting of interlocking rigid expanded polystyrene foam plastic units, is a permanent formwork for reinforced concrete beams; lintels; exterior and interior, bearing and nonbearing walls; and foundation and retaining walls. The NUDURA wall system is a flat ICF wall system, and is limited to combustible construction. The interior of a building constructed with a NUDURA wall system shall be separated from the foam plastic insulation with an approved thermal barrier, such as a 1/2-inch-thick (12.7 mm) regular gypsum wallboard, and the exterior surface shall be covered with an approved exterior wall covering.

NUDURA ICFs are an alternative to forms described in Section 1906 of the 1997 Uniform Building Code™ (UBC) and Section 1906 of the 2000 International Building Code® (IBC). NUDURA ICFs comply with Section R611.3 of the 2000 International Residential Code® (IRC) as flat insulating concrete form wall systems.

2.2 Materials:

2.2.1 NUDURA Wall System: The NUDURA wall system consists of two expanded polystyrene (EPS) foam-plastic boards, each having a thickness of 2 5/8 inches (67 mm), that are connected together at regular intervals by hinged polypropylene cross-ties placed perpendicular to the EPS foam boards to form a NUDURA ICF unit. The cross-ties have a hinged connection at the interface of the EPS board and plastic web, permitting the NUDURA ICF units to be folded and unfolded. The forms are available in a standard length of

96 inches (2438 mm), a standard height of 18 inches (457mm), and five standard widths, of 9 1/4, 11 1/4, 13 1/4, 15 1/4, and 17 1/4 inches (235, 286, 337, 387, and 438 mm, respectively). The five widths provide for concrete wall widths of nominal 4, 6, 8, 10, and 12 inches (102, 152, 203, 254, and 305 mm). In addition to standard form units, the NUDURA ICF wall system includes premolded 45- and 90-degree corner units, tapered top units, brick ledge units and extension fittings, height adjuster fittings and end caps. See Figures 1 through 11 for details.

The NUDURA EPS foam plastic boards are molded from Starex SF Series polystyrene beads (Type 301-H), as recognized in evaluation report ER-5624; or from BASF BF or BFL 327 polystyrene beads, as recognized in evaluation report ER-3401. The foam plastic insulation has a nominal density of 1.25 pcf (20.0 kg/m³), complies with ASTM C 578, and has maximum flame-spread and smoke-density indexes of 25 and 450, respectively, when tested in accordance with UBC Standard 8-1 (ASTM E-84).

The polypropylene cross ties, spaced 8 inches (203 mm) on center, have openings permitting concrete to pass through, and have seats to support horizontal steel reinforcing bars. The polypropylene cross ties are attached by hinged connections to polypropylene fastening strips encased within the foam panels. The flanges of the polypropylene fastening strips are located 1/2 inch (12.7 mm) below the EPS surface and are used for attaching interior and exterior wall coverings. The fastening strips are 1 1/2 inches wide (38 mm) by 0.180 inch (4.6 mm) thick.

2.2.2 Concrete: Normal-weight concrete shall have a 28-day minimum compressive strength of 2,500 psi (17.2 MPa). The concrete shall have maximum 1/2-inch-size (12.7 mm) aggregate for 9 1/4- and 11 1/4-inch-wide (235 and 286 mm) NUDURA ICF units, and maximum 3/4-inch-size (19 mm) aggregate for 13 1/4-, 15 1/4-, and 17 1/4-inch-wide (337, 387, and 438 mm) NUDURA ICF units. If construction of the NUDURA wall system is based on the IRC, concrete shall comply with Section R611.6.1 of the IRC.

2.2.3 Reinforcement: Deformed steel reinforcement bars shall have a minimum yield stress of 40 ksi (275 kPa), and shall comply with Section 1903 of the UBC or the IRC. If construction of the NUDURA Wall System is based on the IRC, reinforcing steel shall comply with Sections R611.6.2 and R404.4.6 of the IRC.

2.2.4 Other Components: When required by the building official, wood members in contact with concrete for plates or

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* deleted by City of Los Angeles

window and door framing shall be preservative-treated with an approved wood preservative, and shall be attached with galvanized steel fasteners in accordance with Section 2304.3 of the UBC ~~or Section 2304.9.5 of the IBC~~. Materials other than wood, such as vinyl, are permitted for window and door framing if approved by the building official.

2.3 Design:

2.3.1 UBC ~~or IBC Method~~: Concrete members formed by the NUDURA Wall System shall be designed and constructed in accordance with Chapters 16 and 19 of the UBC ~~or the IBC~~, as applicable. Footings and foundations are designed and constructed in accordance with Chapter 18 of the UBC ~~or IBC~~, as applicable.

2.3.2 Alternate Design: In lieu of calculations required by Section 2.3.1 of this report, the structural design of reinforced concrete formed by the NUDURA Wall System for residential construction is permitted to comply with the *Prescriptive Method for Insulating Concrete Forms in Residential Construction* (publication No. EB118), dated May 1998, published by the Portland Cement Association (PCA), subject to all applicability and use limits for a flat ICF wall system specified in Table 1.1 in that document. The PCA document shall be made available to the building official upon request. Buildings constructed with the NUDURA Wall System and designed in accordance with this section (Section 2.3.2) shall not exceed a height of two stories plus a basement, where the maximum unsupported wall height is 10 feet (3048 mm).

~~**2.3.3 IRC Method:** Insulated concrete walls formed by the NUDURA Wall System comply with Figure R611.3 of the IRC as flat insulating concrete wall forms. Wall design, construction and materials shall comply with Section R404.4 or R611 of the IRC as applicable to flat insulating concrete form wall systems.~~

2.4 Installation:

The NUDURA Wall System shall be supported on concrete footings complying with Chapter 18 of the UBC ~~or IBC, or Chapter 4 of the IRC~~. Vertical rebars, embedded in the footing, shall extend a minimum of 8 inches (203 mm) or as required by design, whichever is greater, into the base of the wall system.

NUDURA ICF units shall be stacked in a running bond pattern, such that the polypropylene cross ties align vertically, enabling the vertical fastening strips to be connected together. The amount of reinforcing, placement and spacing required shall be determined for each project, based on the approved plans and the applicable code. Additional reinforcement around doors and windows is required to be described in the approved drawings. Concrete quality, mixing and placement must comply with Section 1905 of the UBC, Chapter 5 of ACI 318-99 (IBC) ~~and Section R611.6.1 of the IRC~~. All horizontal and vertical reinforcement bars shall have minimum concrete protection in accordance with the UBC ~~or IBC~~.

Window and door openings are built into the form units, 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 pouring of the concrete.

Wood ledgers, when used, shall be attached to the concrete wall by removal of a portion of the face shell of the form unit where each bolt attachment is required, with the height of the removed portion equal to the depth of the wood ledger. The spacing and embedment depth of anchor bolts shall comply with the design or code requirement, whichever governs. Anchor bolts used to connect the wood ledgers or plates to the concrete shall be cast-in-place, with the bolts sized and

spaced as required by design or code requirements, whichever governs.

When required by the building official, wood plates in contact with concrete shall be pressure-preservative-treated.

Refer to Figures 12 through 16 for typical details.

2.5 Interior Finish:

NUDURA Wall System EPS units exposed to the interior of the building shall be finished with an approved thermal barrier, such as minimum 1/2-inch-thick (12.7 mm) regular gypsum wallboard attached to the plastic cross-tie fastener strips. The minimum 1/2-inch-thick (12.7 mm) regular gypsum wallboard shall be installed vertically and attached to the plastic cross-tie fastener strips with 0.141-inch-diameter-by-1⁵/₈-inch-long (3.6 mm by 41.3 mm), No. 6, coarse-thread gypsum wallboard screws spaced 12 inches (305 mm) on center vertically and 16 inches (406 mm) on center horizontally in the field, and 8 inches (203 mm) at wallboard edges. Gypsum wallboard joints shall be taped and filled with joint compound.

2.6 Exterior Finish:

2.6.1 Above Grade: An approved exterior wall covering shall be designed and installed in accordance with the applicable code or a current evaluation report. When the wall covering is required to be attached to structural members, the wall covering shall be attached to the flanges of the polypropylene fastening strips with either No. 6, Type W, coarse-thread drywall screws or No. 6, Type S, fine-thread drywall screws. The screws shall be corrosion-resistant and have sufficient length to protrude through the flanges of the polypropylene fastening strips by a minimum of 1/4 inch (6.4 mm). The screws have the allowable pullout and lateral load capabilities shown in Table 1. The maximum spacing of the screws shall be designed to support the gravity loads of the wall covering and resist the negative wind pressures. Negative wind pressure capacity of the exterior finish material shall be the same as that recognized in the applicable code for generic materials, or in a current evaluation report for proprietary materials.

2.6.2 Below Grade: Wall surfaces shall be dampproofed and, when required by the building official, waterproofed in accordance with Appendix Chapter 18 of the UBC, ~~Section 1806 of the IBC, or Section R404.4.11 of the IRC~~. Dampproofing and waterproofing materials shall be approved by NUDURA Corporation and the building official, and shall be free of solvents that will adversely affect the EPS foam panels.

2.7 Foundation Walls:

The NUDURA wall system is permitted to be used as a foundation stem wall when supporting wood-framed construction and when the structure is supported on concrete footings complying with the applicable code. Compliance with UBC Table 18-I-C is mandatory when regulation is by the UBC. ~~Installation of the NUDURA wall system as foundation walls shall comply with Section R404 of the IRC when regulation is under the IRC.~~

2.8 Retaining Walls:

The wall system is permitted to be used as a retaining wall with reinforcement designed in accordance with accepted engineering principles and Section 2.3.1 of this report.

2.9 Special Inspection:

2.9.1 UBC: Special inspection is required as noted in Section 1701 of the UBC for placement of reinforcing steel and concrete, and for concrete cylinder testing, except that special inspection is not required for foundation stem walls

conforming to Table 18-I-C of the UBC. When approved by the building official, special inspection may be waived when all of the following conditions are met:

1. Walls are a maximum of 8 feet (2.4 m) high, and are limited to use in single-story construction of Group R, Division 3, or Group U, Division 1, Occupancies.
2. Maximum height of a concrete lift is 48 inches (1219 mm). Succeeding pours must be placed in accordance with Section 1905.10.5 of the UBC.
3. Installation is by installers approved by the NUDURA Corporation.
4. Half the allowable stresses or loads permitted by the UBC are used for the design of the walls.
5. Installation instructions indicate methods used to verify proper placement of concrete.

~~2.9.2 IBC: Special inspection is required as noted in Section 1704 of the IBC for placement of reinforcing steel and concrete, and for concrete cylinder testing, except that special inspection is not required for foundation stem walls conforming to Table 1805.4.2 of the IBC. When approved by the building official, special inspection may be waived for construction of Group R, Division 3, or Group U Occupancies under the limitations established by the building official. Quality assurance plans for seismic resistance and wind requirements shall be prepared in accordance with Sections 1705 and 1706 of the IBC, respectively, when required.~~

~~2.9.3 IRC: For walls designed in accordance with Section 2.3.3, special inspection is not required. For walls designed in accordance with the IBC, as permitted by Sections R104.11 and R301.1.2 of the IRC, special inspection in accordance with Section 2.9.2 of this report is required.~~

2.10 Identification:

Each package of forms carries a label bearing the name or trademark of the report holder (NUDURA Corporation); the evaluation report number (ER-6163); and the name or logo of the inspection agency (Intertek Testing Services NA Ltd.—Warnock Hersey).

3.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Concrete and Concrete Masonry Wall Systems (AC15), dated June 2003, and the ICC-ES Acceptance Criteria for Foam Plastic Insulation (AC12), dated July 2002; and a quality control manual.

4.0 FINDINGS

That the NUDURA™ Integrated Building Technology Insulated Concrete Form (ICF) Wall System described in this report complies with the 1997 Uniform Building Code™ (UBC), ~~the 2000 International Building Code® (IBC), and the 2000 International Residential Code® (IRC),~~ subject to the following conditions:

- 4.1 The ICF foam plastic units are manufactured, identified and installed in accordance with this report and the manufacturer’s installation instructions.
- 4.2 Walls constructed with the NUDURA Wall System are limited to Type V-N construction.
- 4.3 When required by the building official, calculations showing compliance with the general design requirements of Chapter 16 of the UBC ~~or IBC~~ are submitted to the building official for approval, except calculations are not required when the building design is based on Section 2.3.2 or 2.3.3 of this evaluation report.
- 4.4 The EPS foam units are separated from the building interior with an approved thermal barrier, such as minimum 1/2-inch-thick (12.7 mm) regular gypsum wallboard installed as specified in this report. Other thermal barriers, having a flame-spread index of 15, are acceptable, provided they are recognized in a current evaluation report.
- 4.5 When regulation is under the UBC ~~or IBC~~, special inspection is provided in accordance with Section 2.9 of this report.
- 4.6 ~~When regulation is under the IRC, compliance with IRC Section R324.4 shall be demonstrated.~~
- 4.7 NUDURA insulated concrete forms are manufactured by Plastiques Cellulaires Polyform Inc. in Granby, Quebec, Canada, and are produced under a quality control program with inspections conducted by Intertek Testing Services NA Ltd.—Warnock Hersey (AA-688).

This report is subject to re-examination in one year.

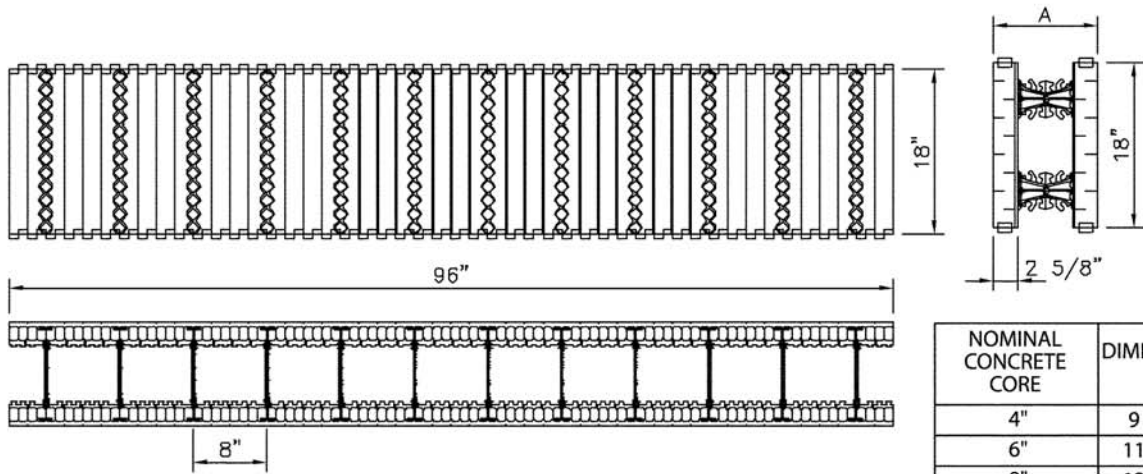
TABLE 1— ALLOWABLE PULLOUT AND LATERAL CAPACITIES OF SCREWS

SCREW TYPE	ALLOWABLE CAPACITY (lbs)	
	Pullout	Lateral
No. 6 Type S fine thread screw	37	74
No. 6 Type W coarse thread screw	40	87

For SI: 1 lb = 4.45 N.

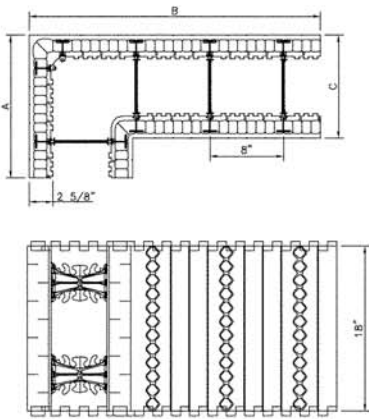
¹Tabulated allowable capacities are for screws installed in polypropylene cross ties described in Section 2.2.1 of this evaluation report.

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NOMINAL CONCRETE CORE	DIMENSION A
4"	9 1/4"
6"	11 1/4"
8"	13 1/4"
10"	15 1/4"
12"	17 1/4"

FIGURE 1—STANDARD FORM UNIT



NOMINAL CONCRETE CORE	DIMENSION		
	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"

FIGURE 2—90° CORNER FORM UNIT

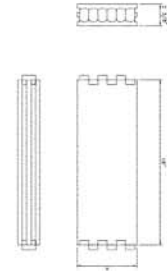
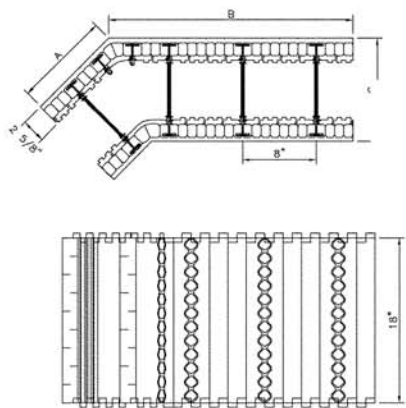


FIGURE 3—STANDARD END CAP



NOMINAL CONCRETE CORE	DIMENSION		
	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"

FIGURE 4—45° CORNER FORM UNIT

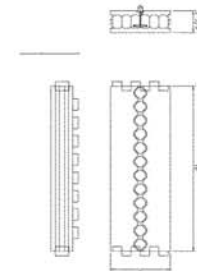
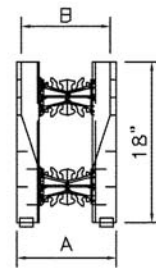
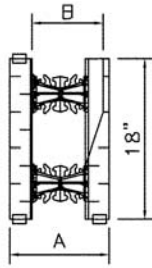
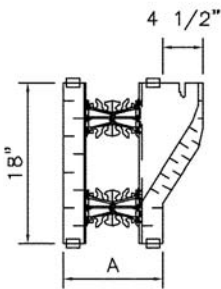
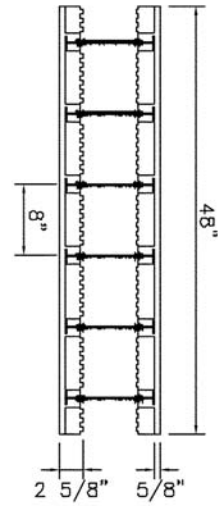
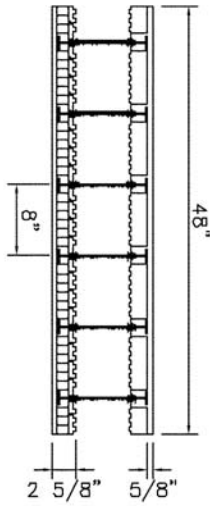
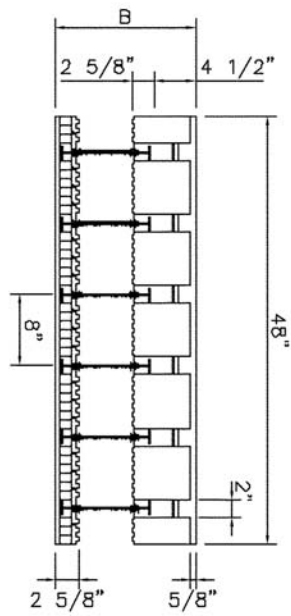


FIGURE 5—STANDARD END CAP WITH FASTENING STRIP



NOMINAL CONCRETE CORE	DIMENSION	
	A	B
4"	9 1/4"	13 3/4"
6"	11 1/4"	15 3/4"
8"	13 1/4"	17 3/4"
10"	15 1/4"	19 3/4"
12"	17 1/4"	21 3/4"

NOMINAL CONCRETE CORE	DIMENSION	
	A	B
4"	9 1/4"	6"
6"	11 1/4"	8"
8"	13 1/4"	10"
10"	15 1/4"	12"
12"	17 1/4"	14"

NOMINAL CONCRETE CORE	DIMENSION	
	A	B
4"	9 1/4"	8"
6"	11 1/4"	10"
8"	13 1/4"	12"
10"	15 1/4"	14"
12"	17 1/4"	16"

FIGURE 6—BRICK LEDGE FORM UNIT

FIGURE 7—TAPERED TOP FORM UNIT
—ONE SIDED

FIGURE 8—TAPERED TOP FORM UNIT
—TWO SIDED

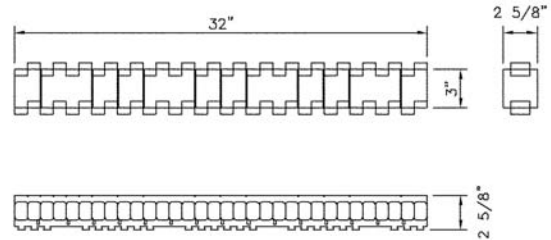
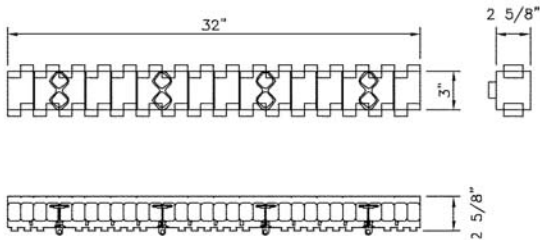


FIGURE 9—HEIGHT ADJUSTER WITH FASTENING STRIPS

FIGURE 10—STANDARD HEIGHT ADJUSTER

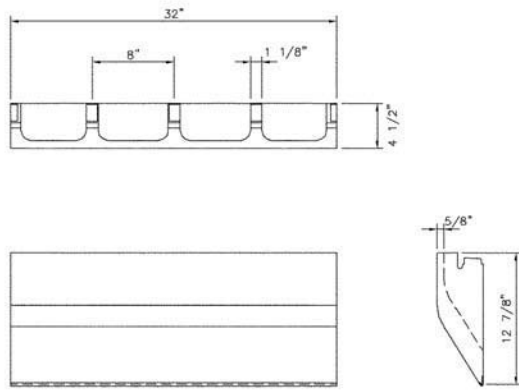


FIGURE 11—BRICK LEDGE EXTENSION

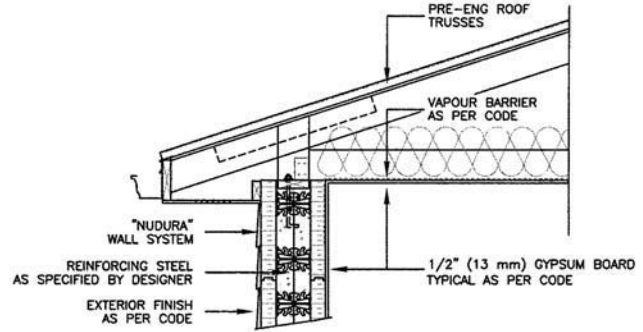


FIGURE 12—TYPICAL ROOF TRUSS CONNECTION DETAIL

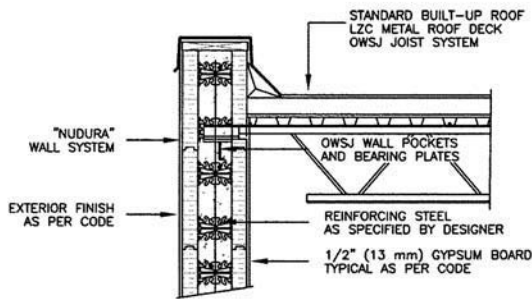


FIGURE 13—TYPICAL FLAT ROOF CONNECTION DETAIL

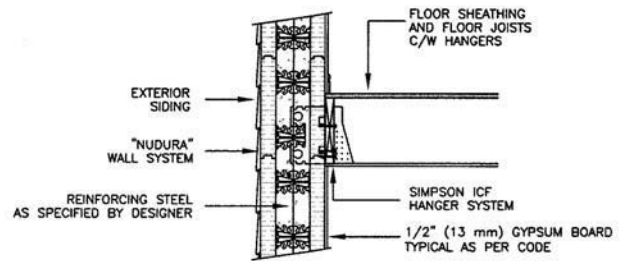


FIGURE 14—TYPICAL FLOOR CONNECTION DETAIL

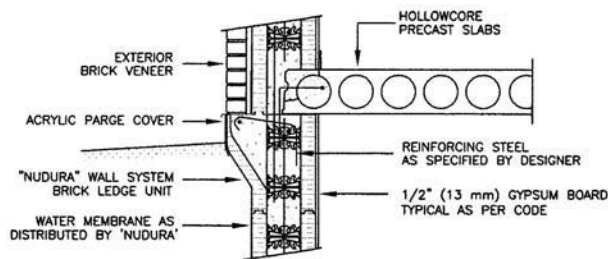


FIGURE 15—TYPICAL BRICK LEDGE DETAIL AT GRADE WITH HOLLOW CORE FLOOR OPTION

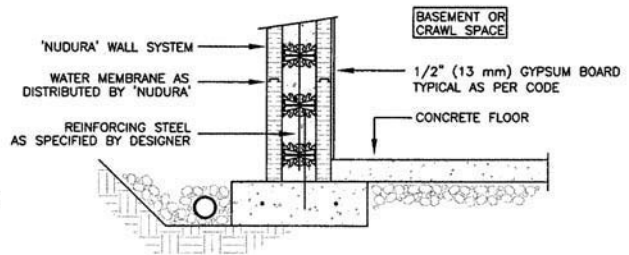


FIGURE 16—STANDARD STRIP FOOTING DETAIL