



# ICBO Evaluation Service, Inc.

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## EVALUATION REPORT

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ER-5872

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**GREENBLOCK™ MONOLITHIC MODULAR UNITS**  
**GREENBLOCK™ WORLDWIDE CORPORATION**  
POST OFFICE BOX 749  
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### 1.0 SUBJECT

Greenblock™ Monolithic Modular Units.

### 2.0 DESCRIPTION

#### 2.1 General:

Greenblock Monolithic Modular Units are expanded polystyrene (EPS) interlocking rigid polystyrene foam plastic boards that serve as permanent formwork for reinforced concrete beams, lintels, exterior and interior walls, and foundation and retaining walls. The interior of a building constructed with the Greenblock Monolithic Modular Units must be protected with an approved thermal barrier, such as a 1/2-inch-thick (12.7 mm) regular gypsum wallboard, and the exterior surface must be covered with an approved exterior wall covering. The use of Greenblock units is limited to combustible construction. Recognition is under Section 104.2.8 of the 1997 *Uniform Building Code*™ (UBC), Section 104.11 of the 2000 *International Building Code*® (IBC), and Section R611 of the 2000 *International Residential Code*™ (IRC).

#### 2.2 Materials:

**2.2.1 Greenblock Monolithic Modular Units:** The Greenblock units consist of two EPS foam plastic boards separated by high-impact polystyrene (HIP) webs, which are pre-inserted in the EPS mold before molding so that the webs are partially embedded into the EPS boards. The HIP webs, which are spaced 5 inches (127 mm) on center, retain the opposing EPS boards at a fixed clear distance of 5 1/2 inches (140 mm). EPS boards are 9 7/8 inches (251 mm) high by 39 3/8 inches (964 mm) long. The EPS board facing the interior of the building is 2 inches (51 mm) thick, and the EPS board facing the exterior is 2 1/2 inches (63.5 mm) thick. When stacked in a running bond pattern, the Greenblock units form a cavity where steel reinforcement bars and concrete are placed.

The EPS foam boards are molded from NOVA Dylite 35 MB beads (ICBO ES ER-5770). The foam plastic has a nominal density of 1.45 pcf (23.2 kg/m<sup>3</sup>), and has a maximum flame-spread rating of 25 and a maximum smoke-density rating of 450 when tested in accordance with UBC Standard 8-1 or ASTM E 84-99. The foam plastic insulation complies as a Class II RCPS in accordance with ASTM C 578.

The HIP webs are manufactured from high-density polystyrene and are 8 1/2 inches (216 mm) wide and have a 1 5/8-inch-wide-by-6 1/2-inch-high (41.3 mm by 165 mm) flange. On the 2-inch-thick (51 mm) EPS board, the flange is recessed 1/2

inch (6.4 mm) below the outside surface, and on the 2 1/2-inch (63.5 mm) EPS board the flange is recessed 3/4 inch (19.1 mm) below the outer surface. The plastic flange embedded in the EPS foam boards provides a mechanism for attaching interior and exterior wall coverings. Refer to Figure 1 for details.

**2.2.2 Concrete:** Normal-weight concrete with maximum 3/8-inch-size (9.5 mm) aggregate must have a 28-day minimum compressive strength of 2,500 psi (17.2 MPa). If construction of the Greenblock Monolithic Modular System is based on the IRC, concrete must comply with Section R611.6.1 of the IRC.

**2.2.3 Reinforcement:** Deformed steel reinforcement bars must have a minimum yield stress of 40 ksi (275 kPa), and must comply with Section 1903 of the UBC or the IBC. If construction of the Greenblock Monolithic Modular Wall System is based on the 2000 IRC, reinforcing steel must comply with Section R611.6.2 of the IRC.

**2.2.4 Other Components:** Wood members, if not protected from the concrete, must be preservative-treated with an approved wood preservative and attached with anchor bolts complying with Section 2304.3 of the UBC or Section 2304.9.5 of the IBC or Section R323.3 of the IRC. 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 General:** Design of concrete in the Greenblock Monolithic Modular System must comply with Chapter 19 of the UBC or IBC. Walls must be anchored to floors and roofs in accordance with Section 1633.2.8 of the UBC or 1604.8.2 of the IBC.

**2.3.2 Alternate Design:** In lieu of calculations required by Section 2.3.1 of this report, the structural design of residential buildings constructed with the Greenblock Monolithic Modular Wall System and regulated by the UBC must 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 limits for a flat ICF wall system specified in that document. The PCA document must be made available to the building official upon request. Buildings constructed with the Greenblock Monolithic Modular Units and designed in accordance with this section must not exceed a height of two stories plus a basement, where the maximum unsupported wall height is 10 feet (3048 mm).

**2.3.3 Design in Accordance with the 2000 IRC:** Insulating concrete walls constructed with the Greenblock Monolithic Modular Units must be designed and constructed in accordance with Section R611 of the 2000 IRC.

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## 2.4 Installation:

The Greenblock Monolithic Modular Wall System must 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, must extend a minimum of 24 inches (610 mm) into the block wall system. The Greenblock units must be stacked in a running bond pattern such that the HIP webs, which are spaced 5 inches (127 mm) on center, align vertically. The HIP webs provide support for the interior and exterior wall finish material. Vertical and horizontal reinforcement bars must be placed as required by design and the code. All horizontal and vertical reinforcement bars must have minimum concrete protection in accordance with the UBC or IBC. Concrete quality, mixing, and placing must comply with Chapter 19 of the UBC or the IBC. Refer to Figure 2 for typical details.

When regulated by the 2000 IRC, reinforcing steel for Greenblock Walls used above grade must comply with Section R611 of the IRC.

Wood ledgers must be attached to the concrete wall by removing the face shell of the EPS units, with the height of the removed portion equal to the depth of the wood ledger. When concrete is poured into the wall system, the concrete-filled volume, provided for the anchor bolts, forms a solid concrete connection from the ledger board to the horizontal bond beam. The spacing and embedment depth of anchor bolts must comply with the design or code requirement, whichever governs. 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.

## 2.5 Interior Finish:

Greenblock Monolithic Modular System block units exposed to the interior of the building must be finished with an approved thermal barrier, such as minimum 1/2-inch-thick (12.7 mm) regular gypsum wallboard attached to the flanges of the HIP webs. The minimum 1/2-inch-thick (12.7 mm) regular gypsum wallboard must be installed vertically and attached to the plastic webs with 1 1/4-inch-long (31.7 mm), No. 6, Type S, coarse-thread gypsum wallboard screws spaced 10 inches (254 mm) on center, each way.

## 2.6 Exterior Finish:

**2.6.1 Above Grade:** Walls must be covered on the exterior with a weather-resistive barrier in accordance with Section 1402 of the UBC, Section 1403.2 of the IBC, or Section R703.2 of the IRC. The weather-resistive barrier when attached to the flanges of the HIP webs requires using either minimum 1 5/8-inch-long (41.3 mm), No. 6, Type S, fine-thread corrosion-resistant screws, or minimum 1 5/8-inch-long (41.3 mm), No. 6, Type W, coarse-thread corrosion-resistant screws.

An approved exterior wall covering must be designed and installed in accordance with the applicable code or an ICBO ES evaluation report. When the wall covering is required to be attached to structural members, the wall covering must be attached to the flanges of the HIP webs with either No. 6, Type W, coarse-thread drywall screws or No. 6, Type S, fine-thread drywall screws. The screws must be corrosion-resistant and have sufficient length to protrude through the flanges of the HIP webs a minimum of 1/4 inch (6.4 mm). The screws have the allowable pullout and lateral capacities shown in Table 1 when installed such that the screws protrude through the flange of the HIP web a minimum of 9/16 inch (14 mm).

Negative wind pressure capacity of the exterior finish material is to be the same as that recognized in the code for generic materials or a current ICBO ES evaluation report for proprietary materials.

**2.6.2 Below Grade:** Wall surfaces must be damp-proofed and, when required by the local building department, water-proofed in accordance with Appendix Chapter 18 of the UBC, or with Section 1806 of the IBC, or with Section R404.4.11 of the IRC. Damp-proofing and waterproofing materials must be approved by Greenblock WorldWide Corporation and the local building official, and must be free of solvents that will adversely affect the EPS foam boards.

## 2.7 Foundation Walls:

The 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 code. Compliance with Table 18-I-C is mandatory when regulation is by the IRC. Installation of Greenblock units as foundation walls must comply with Section R404 of the IRC.

## 2.8 Retaining Walls:

The Greenblock 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 Crawl Spaces:

The Greenblock Monolithic Modular Wall System located in underfloor crawl spaces is permitted to be exposed to the crawl space, subject to all of the following conditions:

1. Entry to the crawl space is only to service utilities, and no heat-producing appliances are permitted.
2. There are no interconnected basement areas.
3. Air in the crawl space is not circulated to other parts of the building.
4. Under-floor ventilation complies with the code.

## 2.10 Special Inspection:

Special inspection is required as noted in Section 1701 of the UBC, or 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 18-I-C of the UBC, or Table 1805.4.2 of the IBC. Additionally, when the building official approves and recognition is under the UBC, special inspection is not required when all of the following conditions are met:

1. Wall systems are a maximum of 8 feet high (2.4 m) and are limited to use in single-story construction of Group R, Division 3, or Group U Occupancies.
2. Maximum height of a concrete pour is 48 inches (1219 mm). Succeeding lifts must be placed in accordance with Section 1905.10.5 of the UBC.
3. Installation is by properly trained installers approved by Greenblock WorldWide Corporation.
4. The installation instructions indicate methods used to verify proper placement of concrete.
5. Specified compressive strength ( $f_c$ ) of concrete used in design is one-half of that specified.

## 2.11 Identification:

Each package bears a label specifying the name and address of the applicant for this evaluation report (Greenblock WorldWide Corporation; Woodland Park, Colorado). Additionally, product labels indicate the ICBO ES report number (ICBO ES ER-5872), and the name and logo of the quality control agency (Intertek Testing Services NA, Ltd.—Warnock Hersey).

## 3.0 EVIDENCE SUBMITTED

Data in accordance with the ICBO ES Acceptance Criteria for Concrete and Concrete Masonry Wall Systems (AC15), dated October 1999, and the ICBO ES Acceptance Criteria for Foam Plastic Insulation (AC12), dated July 2000.

4.0 FINDINGS

That the Greenblock Monolithic Modular Units described in this report comply 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 Foam blocks are manufactured, identified and installed in accordance with this report and the manufacturer’s installation instructions.
- 4.2 When regulated by the UBC or IBC, walls constructed with the Greenblock Monolithic Modular Units are considered Type V construction.
- 4.3 When required by the building official, plans and calculations showing compliance with this report are submitted to the building official for approval.
- 4.4 The EPS foam blocks 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 an index of 15 and an attachment complying with a current ICBO ES evaluation report, are acceptable.

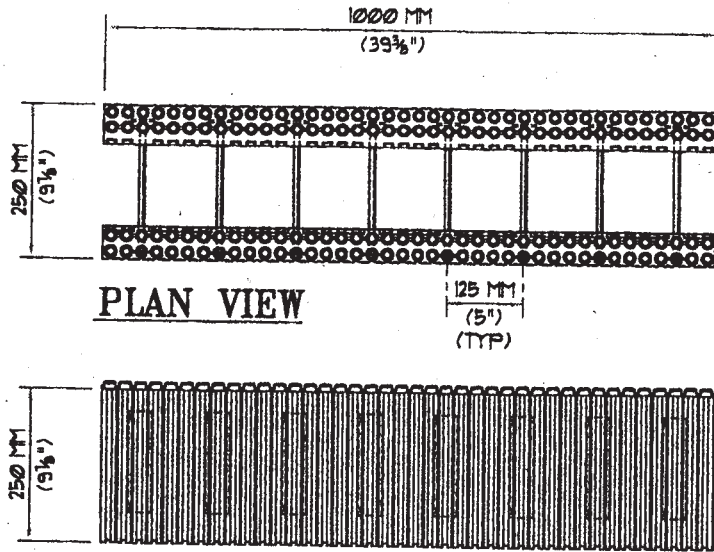
- 4.5 When regulation is by the UBC or IBC, special inspection is provided in accordance with Section 2.10 of this report.
- 4.6 When regulation is by the IRC, compliance with Section R324.4 must be demonstrated.
- 4.7 The Greenblock units are manufactured by Plastiques Cellulaires Polyforms, located in Granby, Quebec, Canada, for Greenblock WorldWide Corporation; under a quality control program with inspections conducted by Intertek Testing Services NA, Ltd.–Warnock Hersey (AA-647-2).

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

TABLE 1—ALLOWABLE PULLOUT AND LATERAL LOAD CAPACITIES OF SCREWS

SCREW TYPE	ALLOWABLE CAPACITY (lbs)	
	Pullout Capacity	Lateral Load Capacity
No. 6, Type S, fine-thread corrosion-resistant screw	39	50
No. 6, Type W, coarse-thread corrosion-resistant screw	39	55

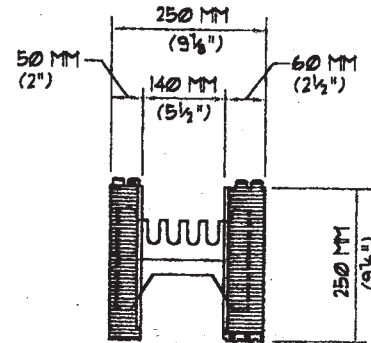
For SI: 1 lb = 4.45 N.



**PLAN VIEW**

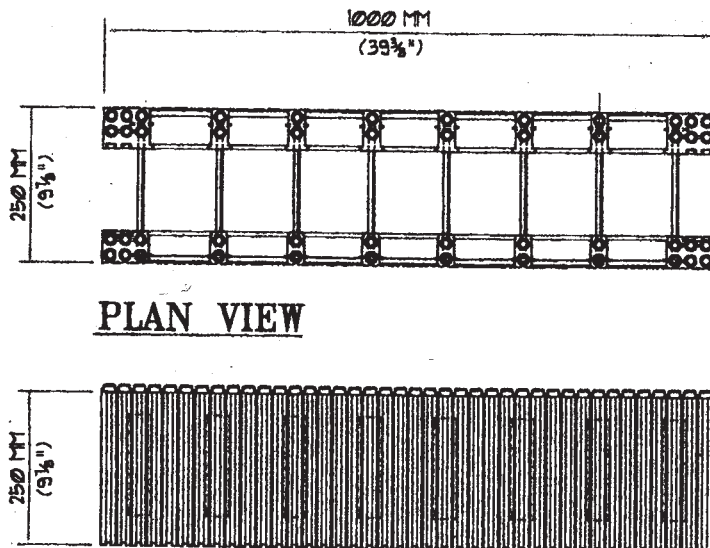
**SIDE VIEW**

**GREENBLOCK EPS - ICF  
STANDARD MMU**



**CROSS SECTION**

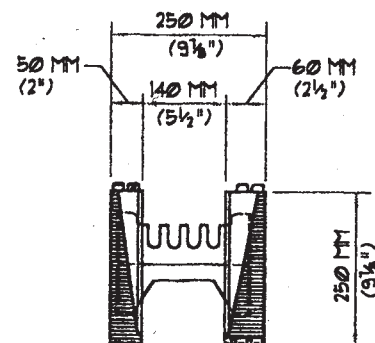
**NOTE:**  
METRIC DIMENSIONS SHOWN ARE  
THE CONTROLLING DIMENSIONS.  
ALL U.S. MEASUREMENTS IN  
INCHES ARE WITHIN 1/8"± (TYPICAL)



**PLAN VIEW**

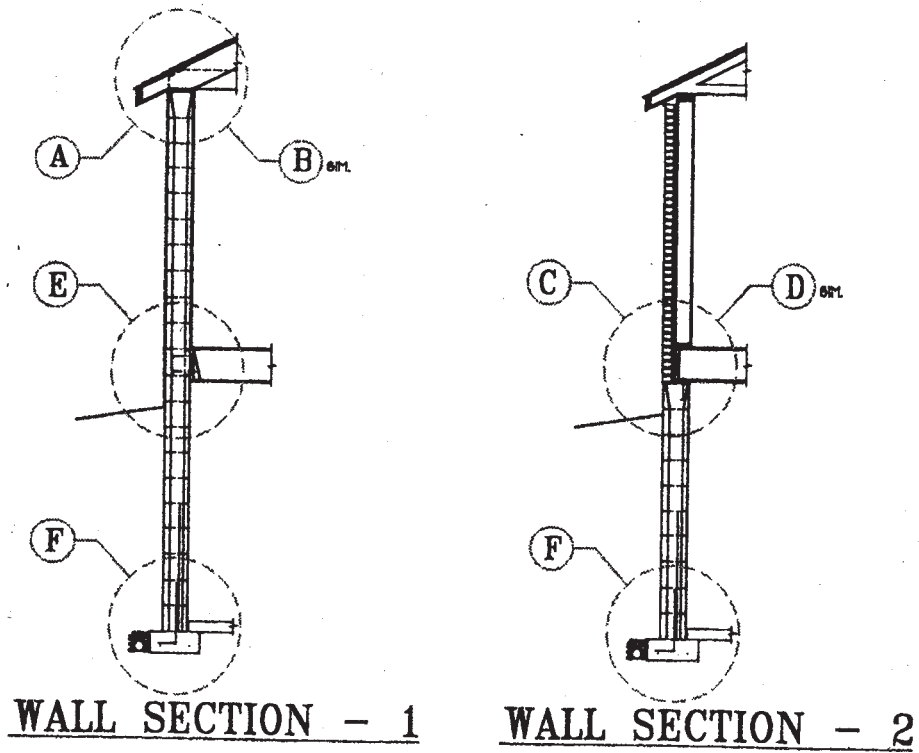
**SIDE VIEW**

**GREENBLOCK EPS - ICF  
STANDARD TOP MMU**

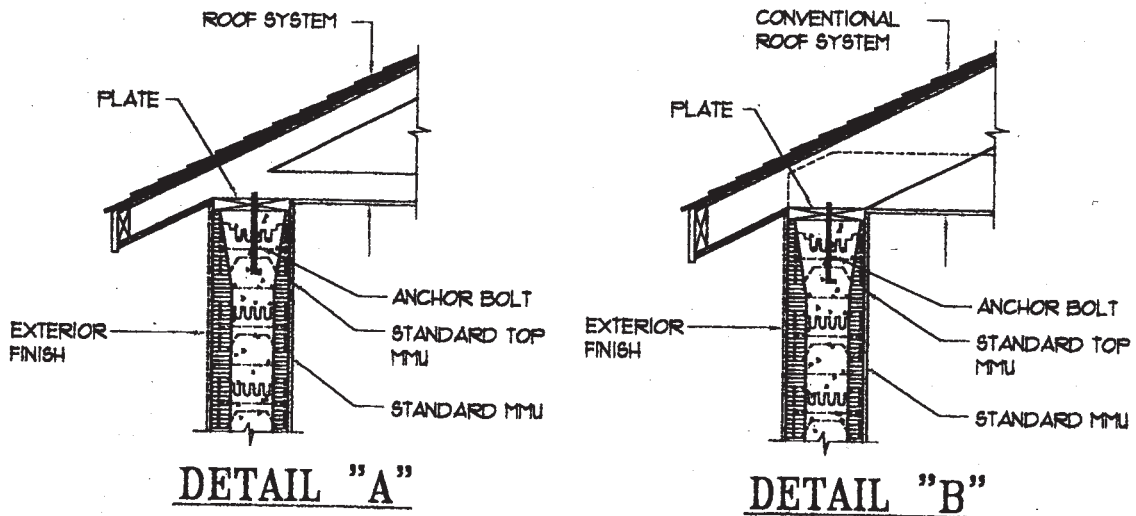


**CROSS SECTION**

FIGURE 1—GREENBLOCK MONOLITHIC MODULAR UNITS

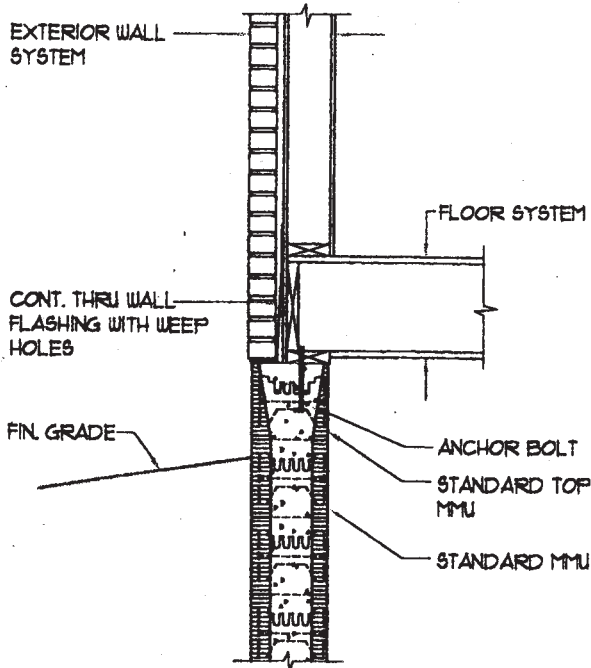


**GREENBLOCK EPS - ICF**

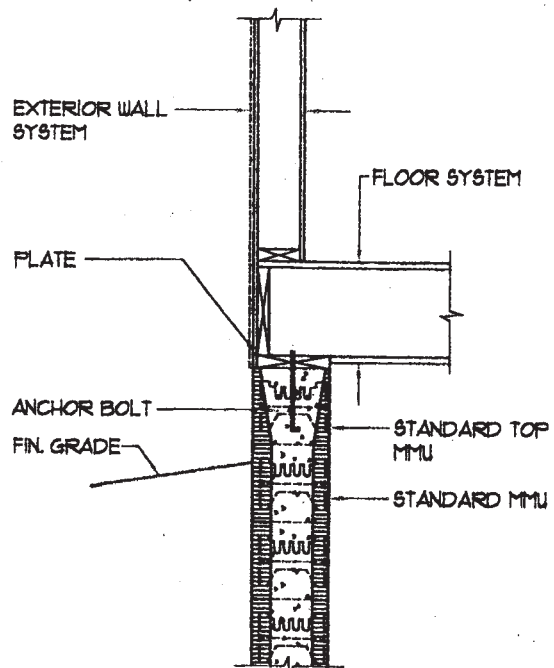


**GREENBLOCK EPS - ICF**

FIGURE 2—TYPICAL INSTALLATION DETAILS

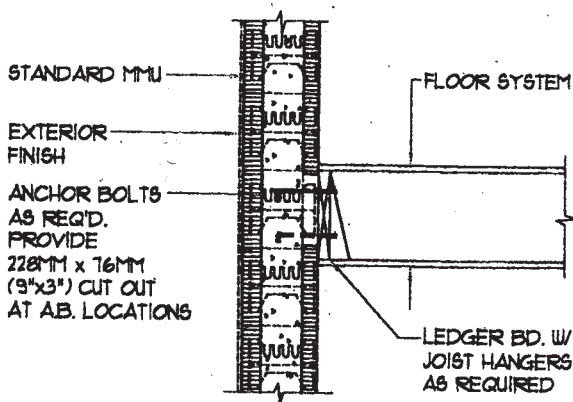


**DETAIL "C"**

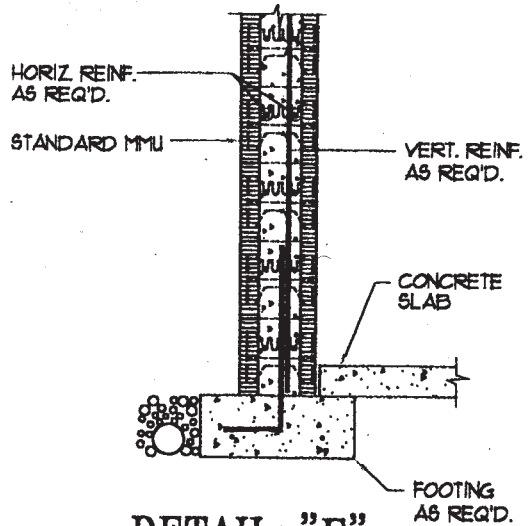


**DETAIL "D"**

**GREENBLOCK EPS - ICF**



**DETAIL "E"**



**DETAIL "F"**

**GREENBLOCK EPS - ICF**

FIGURE 2—TYPICAL INSTALLATION DETAILS—(Continued)