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Evaluation #

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Safety & Buildings Division
201 West Washington Avenue
P.O. Box 2658
Madison, WI 53701-2658

Wisconsin Building Products Evaluation

Material

GREENBLOCK™ Monolithic Modular Unit™ (MMU™)
Insulated Concrete Formwork

Manufacturer

GREENBLOCK Worldwide Corporation
333 W. Lake Ave., Ste. 3
P.O. Box 749
Woodland Park, CO 80866

SCOPE OF EVALUATION

GENERAL: This report evaluates the use of the Monolithic Modular Unit™ (MMU™) insulated concrete form wall system, manufactured by GREENBLOCK Worldwide Corporation evaluated as permanent form work and insulation system for reinforced concrete beams, lintels, exterior and interior walls, foundation and retaining walls. The Monolithic Modular Unit™ (MMU™) insulated concrete form wall system, was evaluated for safety requirements of the foam plastic and structural requirements for the codes listed below.

This review includes the cited **Comm** code requirements below in accordance with the current **Wisconsin Uniform Dwelling Code for 1 & 2 family dwellings (UDC):**

- **Foam Plastic:** The Monolithic Modular Unit™ (MMU™) insulated concrete form wall system was evaluated in accordance with the fire safety requirements of **s. Comm 21.11**.
- **Structural:** The Monolithic Modular Unit™ (MMU™) insulated concrete form wall system was evaluated in accordance with the structural requirements of **ss. Comm 21.02, and 21.02(3)(c)**.

The **IBC** requirements below in accordance with the current **Wisconsin Amended ICC Code:**

- **Foam Plastic:** The Monolithic Modular Unit™ (MMU™) insulated concrete form wall system was evaluated in accordance with the fire safety requirements **ss. IBC 2603.1, 2603.2, and 2603.3**.
- **Structural:** The Monolithic Modular Unit™ (MMU™) insulated concrete form wall system was evaluated in accordance with the requirements of **IBC Chapter 16**.

Note: Structural calculations shall be submitted (job-to-job basis) in accordance with IBC Chapter 16 for Live, Ground Snow, Roof, Wind, and Seismic Loads.

DESCRIPTION AND USE

GREENBLOCK™ Monolithic Modular Unit™ (MMU™) is the trade name for the EPS -ICF™ Building System product line. EPS -ICF™ means Expanded Polystyrene Insulated (ing) Concrete Formwork. The GREENBLOCK™ Monolithic Modular Unit™ (MMU™) wall is nominal 6-inch concrete plus 4.5-inch EPS.

The GREENBLOCK™ EPS -ICF™ Building System concept has six features. The Expanded Polystyrene (EPS) panel portion on the MMU™ is the **formwork**. The completed wall is a solid, uniform thickness, monolithic 5-3/4-inch (nominal 6-inch) concrete slab with no penetrations and no undulations except 1/4-inch locking grooves every inch to permanently anchor the EPS to the concrete. The EPS formwork is not stripped after pouring. The EPS panels are permanently anchored to the concrete and stay-in-place providing **insulation** on both sides of the solid concrete slab, with no thermal bridging. The complete concrete wall (Exterior Assembled Wall) with insulation in place acts as the **vapor and air barrier**. Recessed vertical flanges chemically affixed to the EPS avoid both thermal bridging and the opportunity for water leakage (wicking or capillary action or movement along an interface) through the wall. Simultaneously, these flanges/paddles also act as **strapping** (furring) for mechanical anchorage of wall finish materials of choice. These flanges are part of the Rebar Support Unit™ (RSU™) which provide **automatic rebar placement and locking** of rebar without the necessity of tying.

All GREENBLOCK™ MMU™ s standard block units are 9 7/8-inches wide, and 9 7/8-inches high. Four (4) Standard MMU™ blocks stacked four high equal 10.76 square feet of wall surface area (one Standard MMU™ creates 2.69 square feet exterior wall surface). Each MMU™ has a total of 4.5-inches EPS rigid insulation, 2-inches being the interior panel, 2.5-inches being the exterior panel.

Materials: The GREENBLOCK™ Monolithic Modular Unit™ EPS -ICF™ Building System:

Concrete: Normal-weight concrete complying with **s. Comm 21.02(3)(b)**, and **s. IBC 1903.1** with maximum aggregate size of 3/4 inch and a minimum compressive strength of 3,000 psi.

Reinforcement: The concrete is reinforced with Nos. 3, 4, 5, and 6 deformed steel reinforcing bars, Type A615, Grade No. 40, with minimum yield strength of 40,000 psi. All steel reinforcement shall be in accordance with **s. IBC 1903.5**.

EPS Foam: The EPS foam boards are molded from NOVA Dylite 35 MB beads. The foam plastic has a nominal density of 1.45 pcf.

Web Material: The HIP webs are manufactured from high-density polystyrene and are 8 ½ inches wide and have a 1 5/8-inch-wide-by-6 ½-inch-high flange. On the 2-inch-thick EPS board, the flange is recessed ½-inch below the outside surface, and on the 2 ½-inch EPS board the flange is recessed ¾-inch below the outer surface. The plastic flange embedded in the EPS foam boards provides a mechanism for attaching interior and exterior wall coverings.

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 **s. IBC 2304.9.5**.

Each pallet of GREENBLOCK™ Monolithic Modular Unit™ EPS -ICF™ forms shall bear a label with the manufacturer's name, and the quality control inspection agency, Warnock Hersey (WHI).

TESTS AND RESULTS

EPS used to make the GREENBLOCK™ Monolithic Modular Unit™ EPS -ICF™ Building System is manufactured by the companies listed in the DESCRIPTION AND USE section of this approval. The EPS has a maximum flame-spread rating of 25 and a maximum smoke-developed rating of 450. Testing was done in accordance with **ASTM E 84**.

Signed and sealed structural calculations (design concept) are on file with the department. Design calculations are based upon details in the GREENBLOCK™ Monolithic Modular Unit™ EPS -ICF™ Building System Manual.

The predicted thermal resistance of a 9-3/4-inch thick GREENBLOCK™ wall is 17 hr•ft²•°F/Btu. The thermal resistance of the wall including air films on the inside and outside is 17.8 hr•ft²•°F/Btu. The resistance of an inside or outside finish material can also be added to this value. This is a high thermal resistance and exceeds MEC and

ASHRAE 90.2 single and multi-family residential building requirements, without considering the beneficial effects of thermal mass.

LIMITATIONS OF APPROVAL

The limitations below are in accordance with the current **Wisconsin Uniform Dwelling Code (UDC), for 1 & 2 family dwellings:**

- **Foam Plastic:** The GREENBLOCK™ Monolithic Modular Unit™ wall system is approved for use with an approved thermal barrier to separate the blocks from interior spaces in accordance with **s. Comm 21.11(1)**. Where a 1-inch thickness of masonry does not separate the polystyrene blocks from the building interior, including at the top of the wall, a thermal barrier, which has a finish rating of at least 15 minutes, shall be provided.
 1. GREENBLOCK™ Monolithic Modular Unit™ is approved for use in combustible non-rated construction in accordance with **s. Comm 21.11**. In one- or two-family dwellings, thermal barriers shall be provided to separate the forms from the occupied space of the dwellings per **s. Comm 21.11**.
 2. The exterior face of the blocks shall be finished with an approved weather covering and must be protected from ultraviolet light.

- **Structural:** The GREENBLOCK™ Monolithic Modular Unit™ is approved as a structural building element.
 1. The units are approved for use as concrete forms for basement walls and exterior walls when the resulting concrete core thickness satisfies **Table 21.18-A** for one- or two-family dwellings, or when structural calculations for the product are submitted for review.
 2. Walls shall be anchored to all floors and roofs. Walls shall be interconnected at corners by embedding and lapping the reinforcement.
 3. Structures are **limited** to two stories in height.
 4. Structural calculations are submitted to the department by a Wisconsin registered professional engineer or architect.
 5. Below grade walls shall be damp-proofed when required by the local building department.
 6. Damp proofing and waterproofing materials shall be approved by GREENBLOCK Worldwide Corporation and the local building official, and shall be free of solvents that will adversely affect the EPS foam.

NOTE: The GREENBLOCK™ Monolithic Modular Unit™ wall system was **not** evaluated for compliance with the thermal requirements of Subchapter VI, ss. **Comm 22.20, 22.21, 22.23, 22.25, 22.27, 22.28, and 22.31** of the current UDC.

The forms are approved for use as concrete forms for basement walls, exterior walls and retaining walls when The **IBC** limitations below are in accordance with the current **Wisconsin Amended IBC 2000 Code:**

- **Foam Plastic:** The GREENBLOCK™ Monolithic Modular Unit™ wall system is approved for use with an approved thermal barrier to separate the blocks from interior spaces in accordance with **s. IBC 2603.4**.
 1. In accordance with **s. IBC 2603.4.1.6**, GREENBLOCK™ Monolithic Modular Unit™ when used within the attic, crawl space or, where entry is made only for service utilities, the foam plastic insulation shall be protected against ignition by 1-1/2" thick mineral fiber insulation, a 1/4" thick wood structural panel, particleboard or hardboard, gypsum wallboard, corrosion-resistant steel or other approved material installed so that the foam plastic is not exposed.
 2. The protective covering shall be consistent with the requirements for the Type V Construction.
 3. The exterior face of the blocks shall be finished with an approved weather covering and must be protected from ultraviolet light.
 4. The crawl space shall not be used for storage or air handling purposes, there are no interconnected basement areas and entry to the crawl space is only for service of utilities.

- **Structural:** Design of concrete formed by GREENBLOCK™ Monolithic Modular Unit™ shall comply with **IBC Chapter 19** with the following requirements:

1. The forms are approved for use as concrete forms for basement walls, exterior walls and retaining walls when structural calculations are submitted to the department by a Wisconsin registered professional engineer or architect.
2. Design calculations of walls shall comply with **s. IBC 1901.2**. Use of the empirical design approach specified in **s. 2109.1 [Comm 62.2109(1)]** is prohibited.
3. Design of lintels shall comply with the applicable provisions of **IBC Chapter 16**.
4. Wall loading shall be in accordance with **IBC Chapter 16**.
5. Walls shall be anchored to floors and roofs in accordance with **s. IBC 1604.8.2**.
6. Minimum wall reinforcement shall conform to **s. IBC 1901.2**. When the code requires that vertical and horizontal reinforcement be spaced no further apart than 18 inches or three times the wall thickness, whichever is less, the maximum concrete wall thickness along the length of the wall is permitted to be used to determine rebar spacing.
7. Walls shall be anchored to floors and roofs in accordance with **s. IBC 1604.8.2**. Walls shall be interconnected at corners by embedding and lapping reinforcement in accordance with the code.
8. Design of shear walls shall be in accordance with **ss. IBC 1901.2 and 1910**.
9. Structures are **limited** to two stories in height plus a basement.
10. Below grade walls shall be damp-proofed when required by the local building department, water-proofed in accordance with **s. IBC 1806**.
11. Damp proofing and waterproofing materials shall be approved by GREENBLOCK Worldwide Corporation and the local building official, and shall be free of solvents that will adversely affect the EPS foam.
12. Special inspection is required as noted in **s. IBC 1704**, 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**. Additionally, when the building official approves, special inspection is not required when all of the following conditions are met:
 - a) Wall systems are a maximum of 8 feet high and are limited to use in single-story construction of Group R3, or Group U Occupancies.
 - b) Maximum height of a concrete pour is 48 inches. Succeeding lifts must be placed in accordance with **s. IBC 1905.10**.
 - c) Installation is by properly trained installers approved by GREENBLOCK Worldwide Corporation.
 - d) The installation instructions indicate methods used to verify proper placement of concrete.
13. Walls constructed with GREENBLOCK™ Monolithic Modular Unit™ are considered Type V Construction.

Alternate Design: In lieu of calculations, the structural design of reinforced concrete formed by GREENBLOCK™ Monolithic Modular Unit™ insulated concrete form wall system insulated concrete form blocks for residential construction is shall comply with the *Prescriptive Method for Insulating Concrete Forms in Residential Construction* publication No. EB118, dated May 1998, and published by the Portland Cement Association (PCA). Buildings constructed with the GREENBLOCK™ Monolithic Modular Unit™ insulated concrete form wall system and designed in accordance with the alternate design, shall not exceed a height of two stories plus a basement, where the maximum unsupported wall height is 10 feet.

NOTE: The GREENBLOCK™ Monolithic Modular Unit™ wall system was not evaluated for compliance with the thermal requirements of **s. Comm 63.1018**.

Identification: Each package of GREENBLOCK™ Monolithic Modular Unit™ shall bear a label specifying the name and address of the manufacturer (GREENBLOCK Worldwide Corporation; 333 W. Lake Ave., Ste. 3, P.O. Box 749, Woodland Park, CO 80866). Additionally, product labels indicate the Wisconsin Building Product Evaluation Number (**200708-I**), and the name and logo of the quality control agency.

This approval will be valid through December 31, 2012, unless manufacturing modifications are made to the product or a re-examination is deemed necessary by the department. The product approval is applicable to projects approved under the current edition of the applicable codes. This approval may be void for project approvals made under future applicable editions. The Wisconsin Building Product Evaluation number must be provided when plans that include this product are submitted for review.

DISCLAIMER

The department is in no way endorsing or advertising this product. This approval addresses only the specified applications for the product and does not waive any code requirement not specified in this document.

Revision Date:

Approval Date: August 17, 2007 By: _____

Lee E. Finley, Jr.
Product & Material Review
Integrated Services Bureau

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