



Evaluation # 200721-I

Safety & Buildings Division
201 West Washington Avenue
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Wisconsin Building Products Evaluation

Material

Logix Insulated Concrete Form

Manufacturers

AMC Foam Technologies, Inc.
151 Paramount Rd.
Winnipeg, MB R2X2W6
Canada

Plymouth Foam Inc.
13900 Industry Ave.
Becker, MN 55308
USA

SCOPE OF EVALUATION

GENERAL: This report evaluates the use of the Logix Insulated Concrete Form Wall System, manufactured by AMC Foam Technologies, Inc., and Plymouth Foam Inc., evaluated as permanent form work and insulation system for reinforced concrete beams, lintels, exterior and interior walls, and foundation and retaining walls. The Logix 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 Logix Insulated Concrete Form Wall System was evaluated in accordance with the fire safety requirements of s. Comm 21.11.
Structural: The Logix Insulated Concrete Form Wall System was evaluated in accordance with the structural requirements of ss. Comm 21.02, and 21.02(3)(c).

This review includes the cited International Building Code (IBC) requirements below in accordance with the Wisconsin Amended IBC Code:

- Foam Plastic: The Logix 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 Logix Insulated Concrete Form Wall System was evaluated in accordance with the requirements of IBC Chapter 16.

- **Fire Endurance:** The Logix Insulated Concrete Form Wall System was evaluated in accordance with the requirements of ss. **IBC 2603.4, 2603.5.1, and 2603.5.2.**
- **Fire-Resistance Rating and Fire Tests:** The Logix Insulated Concrete Form Wall System was evaluated in accordance with the requirements of ss. **IBC 703.1 and 703.2 [Comm 62.0703].**

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

General: The Logix Insulated Concrete Form Wall System consists of expanded polystyrene (EPS) forms which are stacked in running bond and serve as forms for a 4-inch-thick, 6.25-inch-thick, 8-inch-thick, 10-inch-thick or 12-inch-thick reinforced concrete wall. The EPS forms remain in place to provide insulation for the wall. The reinforced concrete wall system may be used as a foundation wall, basement wall, shear wall, exterior load-bearing wall and lintel section.

The Logix EPS forms are 48 inches long and 16 inches high. The 4-inch Logix form for 4-inch-thick reinforced concrete walls is 9 1/2 inches wide. The 6.25-inch Logix form for 6-inch-thick reinforced concrete walls is 11 3/4 inches wide. The 8-inch Logix form for 8-inch-thick reinforced concrete walls is 13 1/2 inches wide. The 10-inch Logix form for 10-inch-thick reinforced concrete walls is 15 1/2 inches wide. The 12-inch Logix form for 12-inch-thick reinforced concrete walls is 17 1/2 inches wide. The forms are available as solid-form blocks or knock-down blocks. The solid-form blocks consist of opposing form panels connected by 6 polypropylene web ties embedded into the panels forming a solid form block. The knock-down blocks consist of opposing form panels connected by 6 polypropylene snap-in-place ties. The polypropylene plastic web ties are spaced 8 inches on center and black in color.

Material: Logix Form Blocks are molded from modified expandable polystyrene beads. Manufacturer include:

Product	Manufacturer
BFL-422	BASF Corporation (Beaver Plastics Ltd.)

The blocks are manufactured to a nominal density of 1.68 pounds per cubic foot.

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 2,500 psi.

Reinforcement: The concrete is reinforced with Nos. 3, 4, 5 and 6 deformed steel reinforcing bars, Type A615, Grade No. 40, with a minimum yield strength of 40,000 psi and Grade No. 60, with a minimum yield strength of 60,000 psi. All steel reinforcement shall be in accordance with s. **IBC 1903.5.**

Each pallet of Logix forms shall bear a label with the manufacturer's name, and the quality control inspection agency (Underwriter's Laboratory Certification).

TESTS AND RESULTS

The tests and results listed below cover both the current WI Building Code **Comm** and future **IBC** requirements:

Intertek Testing Services, ETL SEMKO, conducted testing on the Logix forms. The Logix insulated concrete forms produced by Foam Technologies, Inc., and Plymouth Foam Inc., have been subject to and complied with the following testing:

- 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.
- Meets 4-hour fire rating in accordance with ASTM E119 and CAN/ULC S10 conducted by Underwriter's Laboratories, See Design No. U933 located at the end of this report.

Assembly Rating, h	Minimum ICF Cavity Thickness, in.
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2	4
3	6.25 (4-hr. rating with 5/8" drywall)
4	Greater than or equal to 8

NOTE: 1. Unless noted otherwise, ratings are based on wall assembly having 1/2" drywall on fire exposed side.
 2. Load bearing during test = 36,000lb/ft.

- Room fire Test Standard for Interior of Foam Plastics Systems in accordance with ASTM D1929, D635 and D2843.
- Crawl Space evaluation conducted in accordance with ICBOES requirements.
- Conforms to ASTM C578, with equivalency CAN/ULC S701 (standard Specification for Rigid, Cellular Polystyrene Thermal Insulation).
- Fastener Withdrawal Evaluation in accordance with ASTM D1761.
- Fastener Lateral Resistance tested in accordance with ASTM D1761.
- Polypropylene web material conforms to CC1 Plastic material when tested in accordance with ASTM D1929, D635, and D2843.

The Rigid Cellular (RCPS) Polystyrene Thermal Insulation was tested for apparent density, compressive properties, and flexural properties in accordance with ASTM C578-95 "Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation," using the following test methods:

- **Apparent Density:** ASTM D1622-98 "Standard Test Method for Apparent Density of Rigid Cellular Plastics".

Type	Test Result	Minimum Requirement	Status
Type II	1.68	1.35 lbs/ft ³	Complied

- **Compressive Properties:** ASTM C165-00 "Standard Test Method for Measuring Compressive Properties of Thermal Insulation".

Type	Test Result	Minimum Requirement	Status
Type II	24.5 psi	15.0 psi	Complied

- **Flexural Properties:** ASTM C203-99 "Standard Test Method for Breaking Load and Flexural Properties of Block-Type Thermal Insulation"

Type	Test Result	Minimum Requirement	Status
SC Type II	44.9 psi	40.0 psi	Complied

Physical properties testing of polypropylene reinforcing web material was performed in general accordance with the following test methods:

- **Screw Withdrawal:** ICBO ES AC 116 (July 2001) "Acceptance Criteria for Nails and Spikes," in conjunction with ASTM D1761-88 (Re-approved 2000) "Standard Test Methods for Mechanical Fasteners in Wood," Sections 1 through 12 (two types of fasteners were tested: a type 'W' coarse thread drywall screw, and a type 'S' fine thread drywall screw)

	Fastener Type	Withdrawal	Lateral
		Max Load (lbs)	Max Load (lbs)
Average	Type 'W' Coarse Thread Drywall Screw	166	367
COV	Type 'W' Coarse Thread Drywall Screw	10.6 %	8.4 %
Average	Type 'S' Fine Thread Drywall Screw	169	328
COV	Type 'S' Fine Thread Drywall Screw	8.4 %	4.1 %

- **Lateral Screw Resistance:** ICBO ES AC 116 (July 2001) "Acceptance Criteria for Nails and Spikes," in conjunction with ASTM D1761-88 (Re-approved 2000) "Standard Test Methods for Mechanical Fasteners in Wood," Sections 1 through 20

	Ultimate Tensile Strength (lbs)
Average	842
COV	1.7 %

- **Tensile Strength:** ASTM D638-01 "Standard Test Method for Tensile Properties of Plastics"

DISCUSSION: ICBO ES AC 116 references ASTM D1761 for lateral and withdrawal testing. The ASTM D6117 and ASTM D1761 are very similar in methodology, however ASTM D6117 is used for solid sections of plastic members and not for sheets of plastic material. In addition to this, the ICBO ES AC 116 document gives guidance on establishing allowable loads, which ASTM D6117 does not provide. In the absence of a standard that more specifically addresses this issue, ITS recommends that AC 116 is more appropriate.

It is ITS's opinion that it is appropriate to state specific loads for this material. ASTM D5456-99 clause A2.6.1 states, "The equivalent specific gravity is determined from Table 12.21 or Ref. (3) such that the table value for the tested nail does not exceed the average ultimate withdrawal resistance in pounds per inch (N/mm) from A2.4 divided by 5.0..." The safety factor for withdrawal in ASTM D5456 matches that of AC 116, again justifying its applicability to this issue. ASTM D5456 does not have a comparable safety factor for lateral load resistance. In the absence of a standard that more specifically addresses this issue, we suggest that AC 116 is more appropriate.

Given the low C.O.V. of the web tensile test results, it is the opinion of ITS that a safety factor of approximately three is appropriate. We chose to use the lateral resistance factors of AC 116 for consistency.

CALCULATIONS:

- Web Tensile:** 842 lbs. x 0.75 = 631 lbs. (Proportional limit assumed to be the same as ultimate load – brittle failure)
842 lbs. ÷ 3.2 = 263 lbs. (Based on average ultimate load)

2. Fastener Testing:

- (A) **Withdrawal Resistance:** Type "S" Screw $F_{allow} = 178 \text{ lbs.} \div 5 = 35 \text{ lbs.}$
Type "W" Screw $F_{allow} = 166 \text{ lbs.} \div 5 = 33 \text{ lbs.}$

- (B) **Lateral Resistance:** Type "S" Screw $F_{allow} = F \div 3.2 = 328 \text{ lbs.} \div 3.2 = 102.5 \text{ lbs.}$
Type "W" Screw $F_{allow} = F \div 3.2 = 367 \text{ lbs.} \div 3.2 = 114 \text{ lbs.}$

CONCLUSIONS:

1. Physical Properties of Polypropylene Reinforcing Webs

The polypropylene reinforcing webs were found to have the following allowable loads, as recommended by ITS when analyzed in accordance with ICBO ES AC 116 (July 2001) "Acceptance Criteria for Nails and Spikes." (The withdrawal resistance utilized a safety factor of five as per ICBO ES AC 116, Section 4.2. The lateral resistance of both the Type "W" screws and the Type "S" screws utilize a safety factor of 3.2 when analyzed in accordance with ICBO ES AC 116, Section 4.1.):

- Withdrawal resistance of a Type "S" fine thread drywall screw is 35 lbs.
- Withdrawal resistance of a Type "W" coarse thread drywall screw is 33 lbs.
- Lateral resistance of a Type "S" fine thread drywall screw is 102 lbs.
- Lateral resistance of a Type "W" coarse thread drywall screw is 114 lbs.

The polypropylene reinforcing web tensile strength is recommended by ITS to be 263 lbs., based on a safety factor of 3.2 analyzed in accordance with ICBO ES AC 116, Section 4.1. The maximum negative wind pressure for a cladding system attached to the EPS foam plastic panels is based on the maximum fastener values connected into the polypropylene reinforcing webs. For a screwed system into the webs, 8 inches on center vertically, and 6 inches on center horizontally, the allowable negative withdrawal is 99 lbs./ft². This withdrawal capacity can be converted to a wind speed based on the following formula extrapolated from the 1997 Uniform Building Code Table 16-F at a standard height of 33 feet:

$$q_s = Kv^2$$

- where: q_s = wind pressure (psf)
and: v = basic wind speed (mph)
and: $K = 0.00256$
thus: $v = (q_s \div 0.00256)^{1/2}$
given: $q_s = 99 \text{ lbs./ft}^2$ (allowable negative withdrawal)
then: $v = 197 \text{ mph}$

- **Three Hour Fire Endurance Test:** ASTM E119-98, "Standard Test Methods for Fire Tests of Building Construction and Materials"

The objective of the test: to determine whether the polypropylene reinforcing web, a component of the form system,

would melt out and cause a loss of support for the non-fire side standard ½-inch gypsum thermal barrier and consequently create a through opening in the concrete wall, and/or flaming of the polypropylene reinforcing web and expanded polystyrene foam on the unexposed side, or create openings in the concrete wall that would result in the ignition of cotton waste.

The fire test sample was constructed to be representative of the code requirements for a foam insulated concrete wall system. The Beaver Plastics Ltd. Insulating concrete form system was tested in accordance with UBC 26-3, Room Fire Test Standard for Interior of Foam Plastic Systems, (refer to ITS/Warnock Hersey report #3020964(a)), and met the conditions of acceptance for a 15 minute index.

- See Design No. U932 located at the end of this report.

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 ICF wall system is approved for use with a 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. Logix Form Blocks are 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 Logix Form Blocks are approved as structural building elements.
 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. 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.
 5. Below grade walls shall be damp-proofed when required by the local building department.
 6. Damp-proofing and water-proofing materials shall be approved by AMC Foam Technologies, Inc., and Plymouth Foam Inc., and the local building official, and shall be free of solvents that will adversely affect the EPS foam.

NOTE: The Logix Insulated Concrete Form 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 **IBC** limitations below are in accordance with the current **Wisconsin Amended IBC 2000 Code:**

- **Foam Plastic:** The Logix ICF wall system is approved for use with a 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**, when the Logix ICF is used within the attic or crawl space 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 ¼" 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 of 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 Logix Forms must 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 must 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. 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.
 6. 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.
 7. Design of shear walls shall be in accordance with **ss. IBC 1901.2 and 1910**.
 8. Structures are **limited** to two stories in height plus a basement.
 9. Below grade walls shall be damp-proofed when required by the local building department, water-proofed in accordance with **s. IBC 1806**.
 10. Damp-proofing and water-proofing materials shall be approved by AMC Foam Technologies, Inc., and Plymouth Foam Inc., and the local building official, and shall be free of solvents that will adversely affect the EPS foam.
 11. 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**.
 - a) Wall systems are a maximum of 8 feet high and are limited to use in single-story construction of Group R-3, 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 AMC Foam Technologies, Inc., and Plymouth Foam Inc.
 - d) The installation instructions indicate methods used to verify proper placement of concrete.
 12. Walls constructed with Logix ICF are considered Type V Construction.

***Alternate Design:** In lieu of calculations, the structural design of reinforced concrete formed by Logix Insulated Concrete Form Wall System insulated concrete form blocks 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). Buildings constructed with the Logix Insulated Concrete Form Wall System insulated concrete form system and designed in accordance with the alternate design, will not exceed a height of two stories plus a basement, where the maximum unsupported wall height is 10 feet.

NOTE: The Logix Insulated Concrete Form Wall System was **not** evaluated for compliance with the thermal requirements of **s. Comm 63.1018**.

Identification: Each package bears a label specifying the name and address of the manufacturer (AMC Foam Technologies, Inc., Winnipeg, MB R2X2W6, Canada or, Plymouth Foam Inc., Becker, MN 55308, USA). Additionally, product labels indicate the Wisconsin Building Product Evaluation Number (**200721-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 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: January 22, 2008

By: _____

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

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