Code Compliance Research Report
CCRR-0353

Issue Date: 02-10-2020
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Renewal Date: 02-28-2027

DIVISION: 03 00 00 – CONCRETE
Section: 03 11 19 – Insulating Concrete Forming

REPORT HOLDER:
Stronghold Insulation Systems, Inc.
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REPORT SUBJECT:
Stronghold Insulated Concrete Form (ICF) Systems

1.0 SCOPE OF EVALUATION

1.1 This Research Report addresses compliance with the following Codes:

- 2024, 2021, 2018 *International Building Code®* (IBC)
- 2024, 2021, 2018 *International Residential Code®* (IRC)

NOTE: This report references the most recent code editions cited. Section numbers in earlier editions of the codes may differ.

1.2 Stronghold ICF Systems have been evaluated for the following properties (see Table 1):

- Physical properties
- Surface-burning characteristics

1.3 Stronghold ICF Systems have been evaluated for the following uses:

- Stay-in-place formwork for structural concrete load-bearing and non-load-bearing exterior and interior walls, concrete beams, lintels, foundation walls, and retaining walls
- Attic and crawl space fire evaluations
- Fire-resistance-rated construction
- Exterior walls in Types I, II, III, and IV construction

See Table 1 for applicable Code sections related to these properties and uses.

2.0 STATEMENT OF COMPLIANCE

The Stronghold ICF Systems comply with the Codes listed in Section 1.1, for the properties stated in Section 1.2, and applicable uses stated in Section 1.3, when installed as described in this report, including the Conditions of Use stated in Section 5.0.

2.1 2024 IBC and IRC Evaluation Reports: The Intertek CCRR is an Evaluation Report for approval of an alternate material, design, or method of construction in accordance with Section 104.2.3.6.1 of the 2024 IBC and Section R104.2.2.6.1 of the 2024 IRC.

3.0 DESCRIPTION

3.1 Stronghold ICF Systems, FX Series: Stronghold ICF Systems, FX Series consist of two 2-3/4-inch-thick expanded polystyrene (EPS) foam plastic panels, separated by injection-molded polypropylene plastic cross-ties that are partially embedded into the EPS panels. The cross-ties maintain the EPS panel facings at a clear distance of 4, 6, 8, 10, or 12 inches. The FX Series ICF system complies with ASTM E2634-18 and is a flat ICF system as defined in IBC Section 1903.4 and IRC Sections R608.3 and R608.4.4. In addition to straight forms, 45-degree angle, 90-degree corner, corbel ledge, taper top, T-block, curb, and 6-inch radius forms are also available. See Figure 1 for an illustration of the forms.

3.2 Stronghold ICF Systems, KD Series: Stronghold ICF Systems, KD Series consist of two 2-3/4-inch-thick expanded polystyrene (EPS) foam plastic panels, separated by injection-molded polypropylene plastic cross-ties that are partially embedded into the EPS panels. The cross-ties are of a reversible, interlocking design, and are collapsible. The cross-ties maintain the EPS panel facings at a clear distance of 4, 6, 8, 10, or 12 inches. The KD Series ICF system complies with ASTM E2634 and is a flat ICF system as defined in IBC Section 1903.3 and IRC Sections R608.3 and R608.4.4. In addition to straight forms, 45-degree angle, 90-degree corner, corbel ledge, taper top, T-block, curb, and 6-inch radius forms are also available. See Figure 1 for an illustration of the forms.

3.3 Foam Plastic Panels: The EPS foam plastic panels have a nominal density of 1.5 pcf and meet the requirements of IBC Section 2603.3 and IRC Section R303 for a flame-spread index of 25 or less and a smoke-developed index of 450 or less, when tested in accordance with UL 723. The foam plastic complies with Type II requirements when tested in accordance with ASTM C578.

3.4 Cross-ties: The polypropylene cross-ties for the FX Series and KD Series are spaced at 8 inches on center and connect the EPS panels at a fixed clear distance. The cross-ties consist of a flange that is embedded in the foam plastic panel during the molding process and a web that connects the two flanges. The cross-ties have openings to permit concrete placement and have slots to support horizontal steel reinforcing bars. The plastic flange for the FX Series is recessed 1/2 inch below the outer EPS surface. The plastic flange for the KD Series is recessed 1/2 inch below the outer EPS surface. The flanges are used to attach exterior and interior finish materials and are 1-1/2 inches wide by 16 inches high by 0.22 inches thick.

3.5 Concrete: Concrete must be normal-weight concrete complying with the IBC, with a maximum 3/4-inch aggregate size. Concrete must have a minimum compressive strength of 3000 psi at 28 days, except as required for fire-resistance-rated construction described in Section 5.8. Under the IRC, concrete must comply with IRC Sections R404.1 (foundation walls and retaining walls) and R608.5.1 (walls), as applicable.

3.6 Reinforcement: Deformed steel reinforcement bars must have a minimum yield stress of either 40 ksi or 60 ksi, depending on the structural design. Under the IBC, the deformed steel bars must comply with Section 3.5.3.1 of ACI 318 and IBC Section 1903. If construction is based on the IRC, reinforcement must comply with IRC Sections R404.1.3.3 (foundation walls and retaining walls) and R608.5.2 (walls).

4.0 INSTALLATION

4.1 General: The Stronghold ICF Systems must be installed in accordance with the manufacturer's published installation instructions, the applicable Code, and this Research Report. A copy of the manufacturer's instructions must be available on the jobsite during installation.

4.2 Application:

4.2.1 IBC Method: Solid concrete walls must be designed and constructed in accordance with IBC Chapters 16 and 19, as applicable. Footings and foundations must be designed in accordance with IBC Chapter 18.

4.2.2 Alternative IBC Wind Design Method: Solid concrete walls may be designed and constructed in accordance with the provisions of Section 209 of ICC 600, subject to the limitations found in IBC Section 1609.1.1.1, in accordance with Exception 1 to Section 1609.1.1. Design and construction under the provisions of ICC 600 are limited to resisting wind forces.

4.2.3 IRC Method: Solid concrete walls, footings, and foundations must be designed in accordance with IRC Sections R608 and R404.1.3, as applicable for flat wall systems.

4.2.4 Alternative IRC Methods: When used to construct buildings that do not conform to the applicability limits of IRC Sections R404.1.3 and R608, construction must be in accordance with the prescriptive provisions of the 2017 Prescriptive Design of Exterior Concrete Walls for One- and Two-family Dwellings (PCA 100), or the structural analysis and design of the concrete must be in accordance with ACI 318, ACI 332, and IBC Chapters 16, 18, and 19.

4.3 Interior Finish:

4.3.1 General: ICF units exposed to the building interior must be finished with an approved 15-minute thermal barrier, such as minimum 1/2 inch thick regular gypsum board complying with ASTM C1396, installed horizontally or vertically, and attached to the cross-tie flanges with minimum 1-1/2 inch long No. 6, Type S, fine-thread gypsum board screws spaced a maximum of 12 inches on center vertically and 16 inches on center horizontally. The screws must penetrate a minimum of 1/4 inch through the flange. Gypsum board joints and screw heads must be taped and finished with joint compound in accordance with ASTM C840 or GA216. See Section 5.3.2 for installation details for crawl space applications without an ignition barrier on the interior face.

4.3.2 Attic and Crawl Space Installation: When the ICFs are used for walls of attic or crawl spaces, an ignition barrier complying with IBC Section 2603.4.1.6, or IRC Sections R303.5.3 or R303.5.4, is required, except when all of the following conditions are 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
- Under-floor (crawl space) ventilation is provided that complies with IBC Section 1202.4 or IRC Section R408, as applicable
- Attic ventilation is provided when required by IBC Section 1202 or IRC R806, as applicable
- Combustion air is provided in accordance with IMC (International Mechanical Codes) Section 701
- The ICFs must have at least one label as described in Section 8.0 visible in every 160 square feet of wall area

4.4 Exterior Finish:

4.4.1 Above Grade: The exterior surface of the ICF must be covered with an approved wall covering in accordance with the applicable Code or a current evaluation report. Concrete walls are deemed to comply with the air barrier requirements of IECC Section C402.4 and R402.4 provided joints are sealed.

When the wall covering is mechanically attached to structural members, the wall covering must be attached to the flanges of the embedded cross-ties with fasteners, described in Table 2, having sufficient length to penetrate through the flange a minimum of 1/4 inch. The fasteners have an allowable fastener withdrawal and lateral shear strength as noted in Table 2.

The fastener spacing must be designed to support the gravity loads of the wall covering and to resist the negative wind pressures. The negative wind pressure capacity of the exterior finish material must be the same as that recognized in a current evaluation report for proprietary materials and must not exceed the maximum withdrawal capacity of the fasteners listed in Table 2.

4.4.2 Below Grade: Materials used to dampproof or waterproof basement walls must be acceptable to Stronghold Insulation Systems, Inc., the designer, or the contractor, and must comply with applicable Code or a current evaluation report. The material must be compatible with the ICF foam plastic units, and free of solvents that will adversely affect the EPS foam plastic panels. Dampproofing, waterproofing, and drainage requirements must comply with the applicable Code. No backfill may be applied against the wall until the complete floor system is in place or the wall is adequately braced, unless the wall is designed as a freestanding wall that does not rely on the floor system for structural support.

4.5 Foundation Walls: The ICF system may be used as a foundation wall when supporting wood-framed construction, provided the structure is supported on concrete footings complying with the applicable Code. For jurisdictions adopting the IRC, compliance with Section R404 is required.

4.6 Retaining Walls: The ICF system may be used to construct retaining walls, with reinforcement designed in accordance with accepted engineering principles, Section 5.2 of this report, and the applicable Code.

4.7 Protection Against Termites: Where the probability of termite infestation is defined by the Code official as "very heavy", the foam plastic must be installed in accordance with IBC Section 2603.8 or IRC Section R305.4, as applicable. Areas of very heavy termite infestation must be determined in accordance with IBC Figure 2603.8 or IRC Figure R305.4.

4.8 Fire-resistance-rated Construction: The 6, 8, 10, and 12 inch forms may be used to construct fire-resistance-rated wall assemblies as described in Intertek Design Listing STR/ICF 180-01.

4.9 Use in Buildings Required to be of Types I, II, III, and IV Construction:

4.9.1 General: Exterior walls constructed with the ICFs for use in buildings required to be of Type I, II, III, or IV construction must comply with the applicable conditions cited in Sections 4.9.2 through 4.9.4.

4.9.2 Interior Finish:

4.9.2.1 Buildings of Any Height: The ICFs must be finished on the interior with an approved 15-minute thermal barrier, such as 1/2-inch-thick gypsum board, as required by the IBC. The gypsum board must be installed and attached as described in Section 4.3.1.

4.9.3 Exterior Finish:

4.9.3.1 Buildings of Any Height: The ICFs must be finished on the exterior with materials described in Sections 4.9.3.1, 4.9.3.2, 4.9.3.3, 4.9.3.4, and 4.9.3.5. The ICFs must have at least one label as described in Section 8.0 visible in every 160 square feet of wall area prior to applying the wall covering.

4.9.3.2 Exterior Finish – EIFS and One-coat Stucco: EIFS and one-coat stucco wall coverings may be applied over the ICF, provided the wall covering system is recognized in a current evaluation report and is recognized for use in Types I, II, III, and IV construction. The wall covering system must be installed in accordance with the respective evaluation report, and the maximum mass per wall surface (in lbs/ft^2) qualified in the wall covering evaluation report must be greater than 0.361 lbs/ft^2 (which is the maximum-tolerance mass of the EPS panel on the exterior side of the concrete wall). Acceptable EIFS wall coverings include the following:

- Dryvit Systems, Inc. Outsulation® System as described in ESR-1232;
- Sto Corp. StoTherm Classic Premier and Essence as described in ESR-1720;
- Sto Corp. StoTherm® ci® as described in ESR-1748.

4.9.3.3 Exterior Plaster: Exterior plaster must comply with the applicable Code, and the exterior plaster must be a minimum of 7/8 inch thick. The lath must be attached to the flanges of the cross-ties with fasteners described in Section 5.4.1.

4.9.3.4 Exterior Finish – Brick Veneer: Anchored brick veneer must be attached to the flanges of the cross-ties with fasteners described in Section 5.4.1. The 4-inch-thick brick veneer must comply with the IBC and must be installed with a minimum 1-inch air gap between the face of the exterior EPS panel and the brick. The brick must be installed with a steel shelf angle attached to the concrete and installed at each floor line and at the top of each window and door opening.

4.9.3.5 Other Exterior Wall Coverings: Other wall coverings must be shown to the satisfaction of the building official, as meeting the requirements of IBC Section 2603.5. Assemblies tested in accordance with NFPA 285 must include EPS having a maximum mass per wall surface area (in lbs/ft^2) greater than 0.361 lbs/ft^2 (1.76 kg/m^2) (which is the maximum-tolerance mass of the EPS panel on the exterior side of the concrete wall).

4.9.4 Fireblocking: In accordance with IBC Section 718.2 and IRC Section R302.11, foam plastic on the interior side of exterior walls and on both sides of the interior walls must be discontinuous at floor lines. The intersections must be constructed to prevent the passage of flame, smoke, and hot gases from one floor to another.

4.10 Special Inspection:

4.10.1. IBC: Special inspection is required as noted in IBC Section 1705 for placement of reinforcing steel and concrete, and for concrete cylinder testing. When an EIFS wall covering is applied, special inspection in accordance with IBC Sections 1704.1 and 1705.17 is required.

4.10.2 IRC: For walls designed in accordance with Section 5.2.3 or PCA 100 (Section 4.2.4), special inspection is not required. When walls are designed in accordance with the IBC, as described in Section 4.2.4, special inspection is required as described in Section 4.10.1.

5.0 CONDITIONS OF USE

5.1 The ICFs must be manufactured, identified, and installed in accordance with this Research Report, the manufacturer's published installation instructions, and the applicable Code. The provisions in this report take precedence over the provisions in the manufacturer's instructions.

5.2 When required by the Code official, calculations showing compliance with the general design requirements of the applicable Code must be submitted to the building official for approval, except where calculations are not required under IRC Section R608.1. 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.

5.3 When required by the Code Official, calculations and details showing compliance with IRC Section R608.5.3 and R404.1.3.3.6 must be submitted, establishing that the ICFs provide sufficient strength to contain concrete during placement, and the cross-ties are capable of resisting the forces created by fluid pressure of fresh concrete. 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.

5.4 The ICFs must be separated from the building interior with an approved 15-minute thermal barrier, except for attic and crawl space construction as described in Section 4.3.2.

5.5 The plastic cross-ties must be stored indoors away from direct sunlight.

5.6 Special inspection must be provided in accordance with Section 4.10 of this report.

5.7 The Stronghold ICF Systems are manufactured by Stronghold Insulation Systems, Inc. in Watertown, SD; Post Falls, ID; Ottawa, OH; Jerome, ID; and Ponoka, AB. The forms are produced under a quality control program with inspections conducted by Intertek Testing Services NA, Inc.

6.0 SUPPORTING EVIDENCE

6.1 Reports of tests in accordance with ASTM E2634-18.

6.2 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.

6.3 Intertek Listing Report "Stronghold Insulated Concrete Form (ICF) Systems", on the Intertek Directory of Building Products.

7.0 IDENTIFICATION

The Stronghold ICF Systems are identified with the manufacturer's name (Stronghold Insulation Systems, Inc.), address and telephone number, the product name (Stronghold Insulated Concrete Form), the Intertek Mark as shown below, and the Code Compliance Research Report number (CCRR-0353).

CODE COMPLIANCE
C ETL US
Intertek

8.0 OTHER CODES

This section is not applicable.

9.0 CODE COMPLIANCE RESEARCH REPORT USE

9.1 Approval of building products and/or materials can only be granted by a building official having legal authority in the specific jurisdiction where approval is sought.

9.2 Code Compliance Research Reports shall not be used in any manner that implies an endorsement of the product by Intertek.

9.3 Reference to the https://bpdirectory.intertek.com is recommended to ascertain the current version and status of this report.

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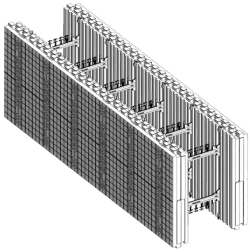
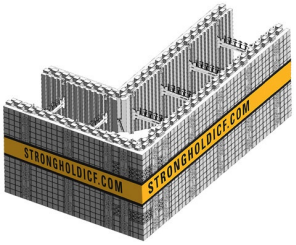
TABLE 1 - PROPERTIES EVALUATED

PROPERTY	IBC SECTION	IRC SECTION
Physical Properties	1903.3	R404.1.3.3.6.1 and R608.4.4
Surface Burning Characteristics	2603.3	R303.3
Attic and Crawl Space Applications	2603.4.1.6 and 2603.9	R303.5.3, R303.5.4 and R303.6
Fire Resistance	703.2	R302.1
Exterior Walls in Types I – IV Construction	2603.5	N/A

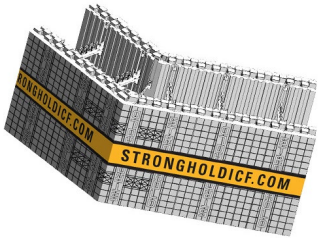
TABLE 2 – ALLOWABLE WITHDRAWAL AND LATERAL CAPACITIES OF FASTENERS IN CROSS-TIE FLANGES

FASTENER	ALLOWABLE LOAD CAPACITY (lbf)	
	Lateral	Withdrawal
2 inch long, No. 10 Wood Screw	76	43
2 inch long, No. 6 Coarse-thread Drywall Screw	53	40

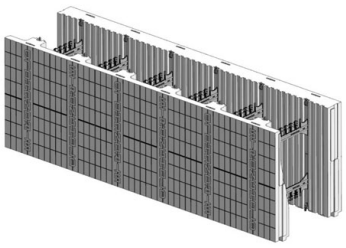

Straight Block



90-Deg Corner Block



45-Deg Corner Block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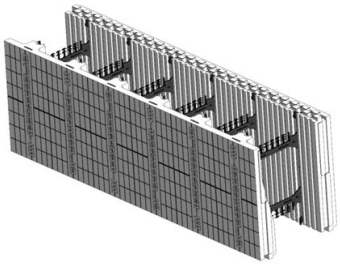
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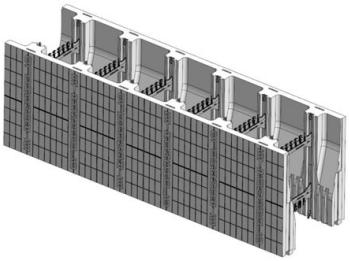
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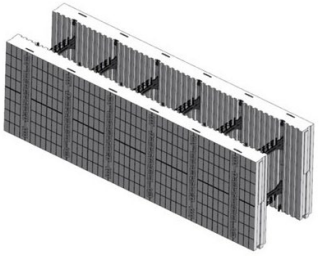
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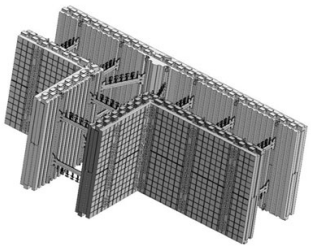
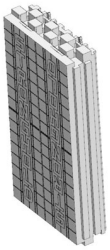

T-Block


Height Adjuster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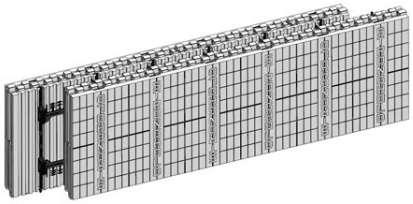
KD Series

Figure 1: Stronghold FX and KD Series Illustrations