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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

QUAD-LOCK POLYSTYRENE FORMS FOR CONCRETE WALLS

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1.0 SUBJECT

Quad-Lock Polystyrene Forms for Concrete Walls.

2.0 DESCRIPTION

2.1 General:

Quad-Lock insulating concrete forms are expanded polystyrene (EPS) foam plastic panels serving as formwork for concrete bearing and nonbearing walls, shear walls, beams and lintels, foundation stem walls, basement walls and retaining walls. The EPS panels are stacked in a running bond pattern to create concrete formwork that remains in place after concrete curing. Walls made from the EPS panels must be covered with an approved interior thermal barrier, interior finish, and exterior wall covering system.

2.2 Material:

2.2.1 Quad-Lock Formwork: The Quad-Lock EPS panels are 12 inches (305 mm) high, 48 inches (1219 mm) long, and $2\frac{1}{4}$ inches (57 mm) thick. The EPS panels interlock on the top and bottom, and interconnect with plastic ties spaced at 12 inches (305 mm) on center. The ties retain the opposing EPS panels, which form a cavity where reinforcement bars and concrete are placed.

The EPS panels are molded from EPS beads. Recognized bead types are Styropor Type BFL327, manufactured by BASF Corporation (ER-3401); and Starex Type 301H, manufactured by Cheil Industries, Inc. (ER-5624). The EPS has a nominal density of 1.8 pounds per cubic foot (29 kg/m³) and complies with ASTM C 578, Type II, and has a flame-spread index of 25 or less and a smoke-density index of 450

or less, when tested in accordance with UBC Standard 8-1 or ASTM E 84.

Two types of interconnecting ties, the full tie and half tie, connect the EPS panels, and are made of high-density polyethylene. The ties are $7\frac{1}{2}$, $9\frac{1}{2}$, $11\frac{1}{2}$, $13\frac{1}{2}$ and $15\frac{1}{2}$ inches (191, 241, 292, 343 and 394 mm) long, permitting the cavity formed by the EPS panels to be, respectively, $3\frac{3}{4}$, $5\frac{3}{4}$, $7\frac{3}{4}$, $9\frac{3}{4}$ or $11\frac{3}{4}$ inches (95, 146, 197, 248 or 298 mm) wide. The ties have $1\frac{1}{2}$ -inch-wide-by-5-inch-long (38 mm by 127 mm) flanges, which are located $\frac{5}{16}$ inch (8 mm) below the exterior EPS surface. The plastic tie flanges provide a mechanism for attaching interior and exterior wall coverings. Metal corner brackets are used in the assembly of 90-degree corners, and metal tracks are used at the base to start the wall. Figure 1 provides additional details.

2.2.2 Concrete: Normal-weight concrete must comply with Chapter 19 of the 1997 *Uniform Building Code*[™] (UBC) or the 2000 *International Building Code*[®] (IBC), and have a 28-day minimum compressive strength of 2,000 psi (13.8 MPa). Maximum aggregate size shall be $\frac{3}{4}$ inch (19 mm). If construction of the Quad-Lock systems is based on the 2000 *International Residential Code*[®] (IRC), concrete shall comply with Section R611.6.1 of the IRC.

2.2.3 Reinforcement: Concrete members shall be reinforced with minimum No. 4 deformed steel reinforcing bars having a minimum yield strength of 40,000 psi (275.8 MPa), and shall comply with Section 1903 of the UBC or Chapter 3 of ACI-318-99 (IBC). If construction 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: When required by the building official, wood members in contact with concrete shall be 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, shall be allowed for window and door framing if permitted by the applicable code or approved by the building official.

2.3 Design:

2.3.1 General: Concrete members formed by the Quad-Lock EPS form units shall be designed and constructed in accordance with Chapter 19 of the UBC or IBC. Wall design loading shall be in accordance with Chapter 16 of the UBC or IBC. Stem walls complying with Section 2.6 are permitted without a design.

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2.3.2 Alternate Design: In lieu of calculations required by Section 2.3.1 of this report, for use under the UBC or IBC, or where an engineered design is submitted in accordance with Section R301.1.2 of the IRC, the structural design of reinforced concrete formed by Quad-Lock EPS form units 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 of that document. The PCA document shall be made available to the building official upon request. Buildings constructed with the Quad-Lock system and designed in accordance with this section (Section 2.3.2) 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 IRC: Insulating concrete walls constructed with the Quad-Lock system shall be designed and constructed in accordance with Section R611 or Section R404.4 of the IRC.

2.4 Interior Finish:

Quad-Lock Forms exposed to the building interior shall be finished with an approved thermal barrier such as minimum 1/2-inch-thick (12.7 mm) regular gypsum wallboard, and attached to the plastic bridging flanges with 0.152-inch-diameter-by-1.5-inch-long (3.9 mm by 38 mm), coarse-thread, Type S gypsum wallboard screws spaced 12 inches (305 mm) on center horizontally and 12 inches (305 mm) on center vertically. The wall board edges shall be aligned with the plastic flanges to assure perimeter attachment.

2.5 Exterior Finish:

2.5.1 Above Grade: The form units shall be covered on the exterior with an approved water-resistive barrier and exterior wall covering in accordance with the applicable code or current evaluation report. The wall covering shall be attached to the plastic ties with 0.152-inch-diameter (3.9 mm), coarse-thread gypsum wallboard screws. The screws shall be corrosion-resistant and have sufficient length to penetrate the plastic ties at least 3/4 inch (19 mm). Fasteners have an allowable pullout capacity of 38 pounds (169 N) and an allowable lateral capacity of 77 pounds (342 N). Negative wind pressure capacity of the exterior finish material is recognized in the applicable code for generic wall-covering materials, and in a current evaluation report for proprietary wall-covering materials.

In addition to wall coverings described in the applicable code, suitable wall covering materials include R-Wall Exterior Wall Insulation and Finish Systems (ER-3617), manufactured by STO Industries, Division of STO Corporation; Dryvit Outsulation System (ER-2728), manufactured by Dryvit Systems, Inc.; INSUL-FLEX Exterior Wall Insulation and Finish Systems (ER-3559), manufactured by El Rey Stucco Company; or FASTWALL™ Fiber-reinforced Stucco Wall System (ER-5129). The base coat, finish coat, and fabric are applied over the EPS panels in accordance with the referenced evaluation report.

2.5.2 Below Grade: Materials used to dampproof basement walls are specified by Quad-Lock Building Systems and shall be compatible with the Quad-Lock form foam plastic components.

2.6 Foundation Stemwalls:

Under the UBC, Quad-Lock wall systems may be used as a foundation stem wall when supporting wood-framed construction when the wall and concrete footings supporting the wall comply with UBC Table 18-I-C. Compliance with UBC Table 18-I-C is mandatory when regulation is by the UBC.

Under the IBC, Quad-Lock wall systems may be used as a foundation stem wall supporting light-framed construction when the wall and concrete footings supporting the wall comply with IBC Table 1805.4.2. Under the IRC, installation of the Quad-Lock wall system as foundation walls shall comply with Section R404 of the IRC.

2.7 Crawl Spaces:

The form units located in underfloor crawl spaces are permitted to be exposed to the crawl space, subject to 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 applicable code.

2.8 Installation:

The Quad-Lock systems including the concrete need to 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, extend a minimum of 24 inches (610 mm), or a development length complying with Section 1912 of the UBC or Chapter 12 of ACI 318-99 (IBC or IRC), into the concrete wall system. The form units shall be installed in a running bond pattern, with the plastic full ties spaced 12 inches (305 mm) on center. The ties shall be vertically aligned to support the interior and exterior finish materials. Placement and cover of vertical and horizontal steel reinforcement bars shall comply with the applicable code and the approved design. Basement walls designed to retain soil are not backfilled until the concrete has cured and the complete floor system is in place. Concrete quality, mixing and placing comply with Chapter 19 of the UBC and IBC, and Section R611 of the IRC. Figure 2 provides typical details.

Wood ledgers are attached to the concrete wall by removing the face shell of the form units around the anchor bolts, with the height of the removed portion being equal to the depth of the wood ledger. Wood plates are anchored to the top of the wall. Anchor bolts used to connect the wood ledgers or plates to the concrete are cast in-place, with the bolts sized and spaced as required by design. Other methods may be acceptable when specified/approved by an evaluation report or a qualified engineer.

2.9 Fire-resistive Construction:

Concrete walls formed by the Quad-Lock system have the fire-resistance ratings listed in Item 7-1.1 of Table 7-B of the UBC when meeting the stated construction specifications.

2.10 Special Inspection:

Special inspection is required as noted in Section 1701 of the UBC and Section 1704 of the IBC, for placement of reinforcing steel and concrete, and for concrete cylinder testing, except 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. Special inspection is not required for walls constructed in accordance with Section R404.4 or R611 of the IRC. For walls designed in accordance with the IBC, as permitted by IRC Sections R104.11 and R301.1.2, special inspection in accordance with the IBC is required.

When approved by the building official, special inspection under the UBC 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, Division 1, Occupancies.
2. Maximum height of a concrete pour is 48 inches (1219 mm). Succeeding lifts must be placed in accordance with Section 1905.10 of the UBC.
3. Installation is by installers approved by Quad-Lock Building Systems.
4. The installation instructions must 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 of form panels and ties bear a stamped label that includes the name and address of Quad-Lock Building Systems, the evaluation report number (ER-5188), and the name of the inspection agency (Intertek Testing Services NA Inc.).

3.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Foam Plastic Insulation (AC12), dated June 2004, and in accordance with the ICC-ES Acceptance Criteria for Concrete Floor, Roof and Wall Systems and Concrete Masonry Wall Systems (AC15), dated June 2003, including reports of room fire tests in accordance with UBC Standard 26-3 and reports of small-scale fire testing in accordance with UBC Standard 7-1 (ASTM E 119); and a quality control manual.

4.0 FINDINGS

That the Quad-Lock Building Systems described in this report comply with the 1997 *Uniform Building Code*TM (UBC), the 2000 *International Building Code*[®] (IBC), and the 2000 *International Residential Code*[®] (IRC), subject to the following conditions:

- 4.1 Quad-Lock form units are manufactured, identified, and installed in accordance with this report and the manufacturer's published installation instructions.
- 4.2 When regulated by the UBC or IBC, walls constructed with the Quad-Lock System are considered combustible construction.
- 4.3 Calculations showing compliance with the general design requirements of Chapter 16 of the UBC or the 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 forms are separated from the building interior with an approved thermal barrier, such as minimum 1/2-inch-thick (12.7 mm) gypsum wallboard installed as specified in this report. Other thermal barriers, having an index of 15 or higher, 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 2.10 of this report.
- 4.6 When regulation is under the IRC, compliance with Section R324.4 of the IRC must be demonstrated.
- 4.7 Manufacturing of Quad-Lock form units is by Aqua-Pak Styro Containers Ltd., 7398 132nd Street, Surrey, British Columbia, Canada, under a quality control program with inspections by Intertek Testing Services NA Inc. (AA-647).

This report is subject to re-examination in two years.

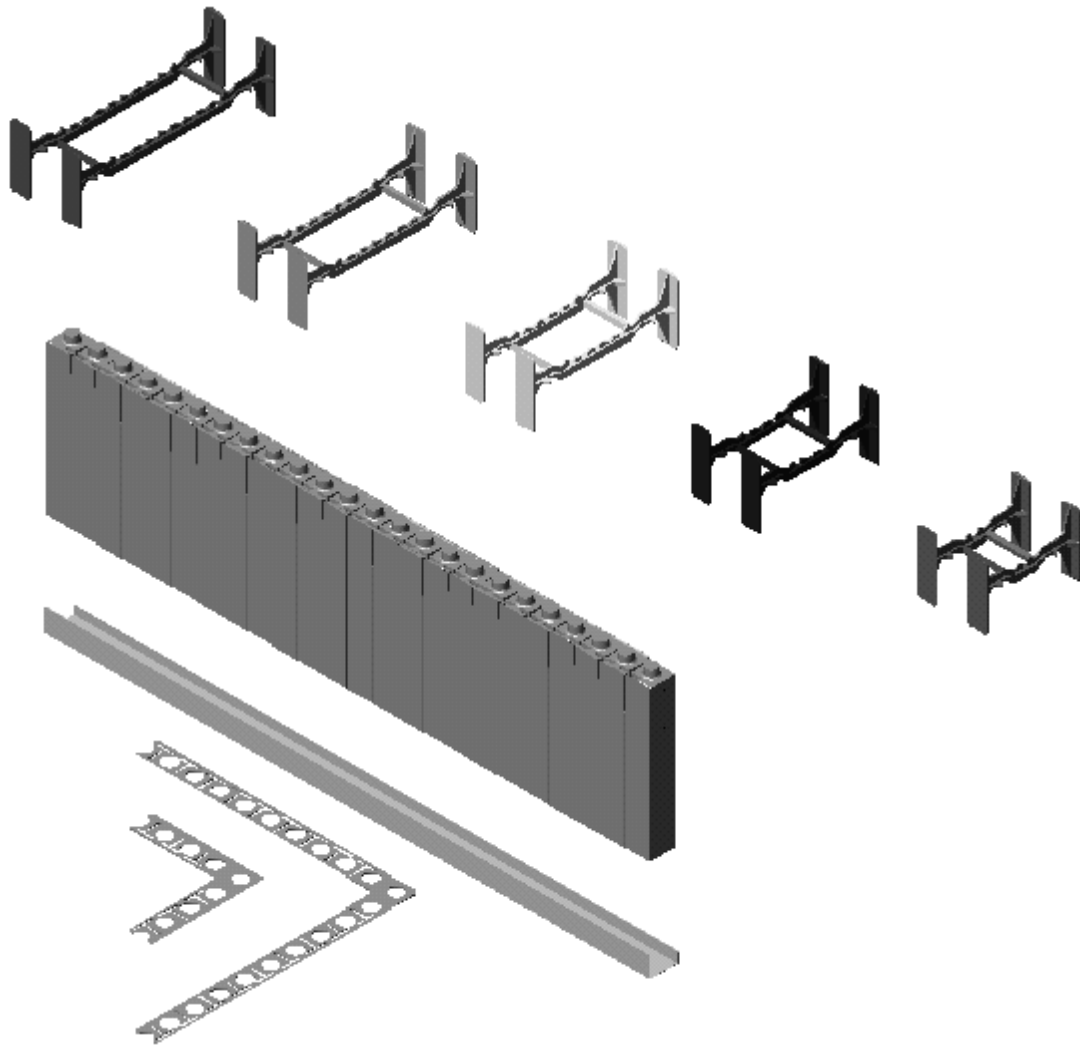


FIGURE 1—SYSTEM COMPONENTS

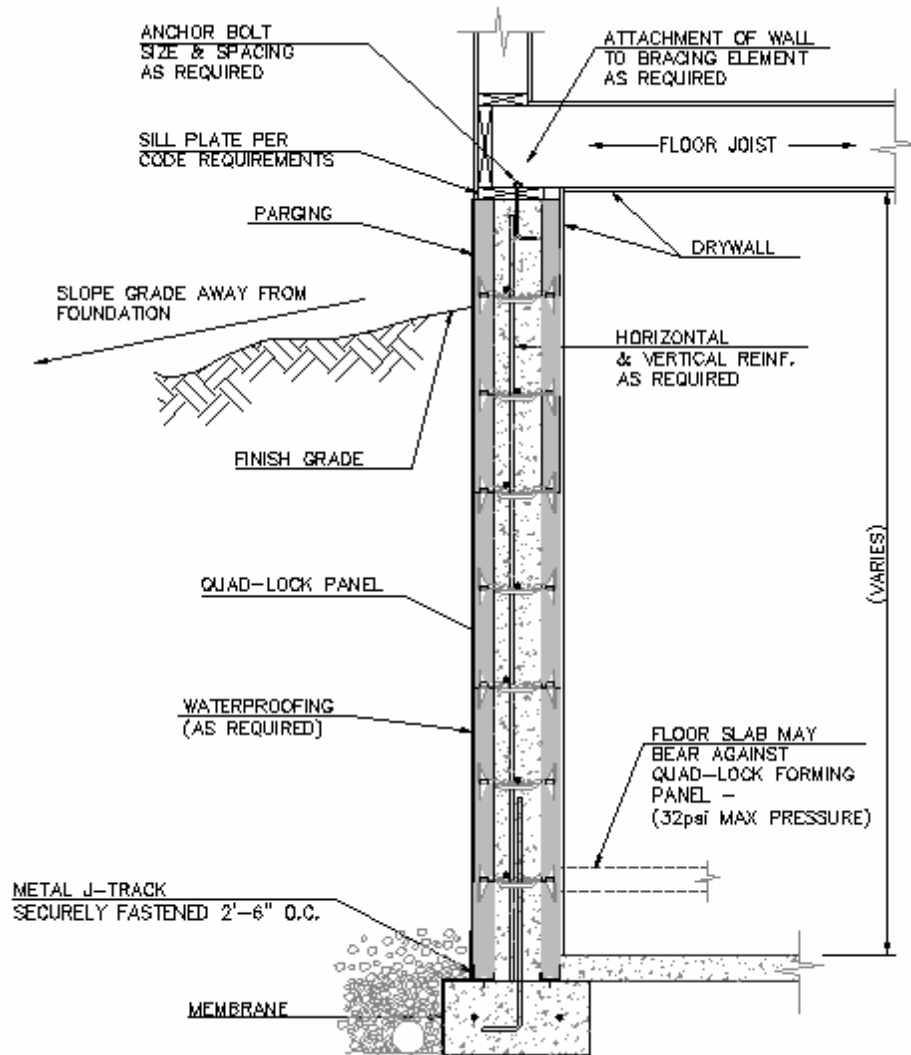


FIGURE 2—TYPICAL WALL SECTION