



# ICBO Evaluation Service, Inc.

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## EVALUATION REPORT

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### CONFORM® SMARTBLOCK™ POLYSTYRENE FORMS FOR REINFORCED CONCRETE WALLS

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#### 1.0 SUBJECT

ConForm® SmartBlock™ Polystyrene Forms for Reinforced Concrete Walls.

#### 2.0 DESCRIPTION

##### 2.1 General:

The ConForm SmartBlock concrete form wall system consists of expanded polystyrene units which serve as insulation and forms for load-bearing and nonload-bearing walls, shear walls, basement walls, retaining walls and foundation walls. The units are manufactured in two basic types, Standard Forms (SF series) and Variable Width Forms (VWF series). The face shell thickness of the forms is  $1\frac{3}{4}$  inches for the SF series and 2 or  $2\frac{1}{8}$  inches for the VWF series.

The SF series units are 10 inches high by 10 inches wide by 40 inches long with tongue-and-groove attachment at the top and bottom. When laid up, the units form  $7\frac{1}{2}$ -inch-by- $6\frac{1}{2}$ -inch rectangular vertical cores at 10 inches on center and  $6\frac{1}{2}$ -inch-by- $6\frac{1}{4}$ -inch rectangular horizontal cores at 10 inches on center. The form units remain in place after setting of the concrete and must be protected by approved interior and exterior finish materials.

The VWF series units are 10 or 12 inches high by 40 inches long and have variable widths depending on the thickness of the finished concrete wall, which is from  $3\frac{3}{4}$  to  $7\frac{3}{4}$  inches. The tongue-and-groove units are interconnected with polypropylene bridge inserts. See Figures 1, 2 and 3 for further details.

##### 2.2 Material:

**2.2.1 Conform Units:** ConForm's SmartBlock units are molded from expanded polystyrene beads manufactured by BASF Corporation (NER-479) or Huntsman Chemical Corporation (NER-384), having a density of 1.5 to 2.0 pounds per cubic foot with a maximum flame-spread rating and smoke-density rating of 25 and 450, respectively, when tested in accordance with UBC Standard 8-1.

**2.2.2 Concrete:** Concrete with  $\frac{3}{8}$ -inch aggregate for both the SF and the VWF series has a minimum compressive strength of 2,000 pounds per square inch.

**2.2.3 Reinforcement:** Walls are reinforced with minimum No. 4 deformed bars conforming with ASTM A 615-94, A 616-93, A 617-93 or A 706-92b, having a minimum yield strength of 40,000 psi, or Nos. 5, 6 and 7 deformed bars con-

forming with ASTM A 615-94, A 616-93, A 617-93 or A 706-92b, having minimum yield strength of 60,000 psi.

**2.2.4 Other:** Wood members for plates or window and door framing are preservative-treated lumber secured in place with galvanized anchor bolts.

##### 2.3 Design:

**2.3.1 VWF Series:** Concrete walls using the Variable Width Form series units are designed in accordance with Chapter 19 of the *Uniform Building Code*™.

**2.3.2 SF Series:** Concrete walls using the Standard Form series units are designed in accordance with the following requirements:

**2.3.2.1 Height Limitations:** Structures are limited to maximum two stories or maximum one basement and one story and maximum 10-foot unsupported wall heights.

**2.3.2.2 Axial Load Limitations:** Parameter for determining allowable axial load is one of the following:

1. Maximum allowable axial load of 1,500 pounds per foot length of wall.
2. Maximum total roof live and dead load of 50 psf, maximum total floor live and dead load of 50 psf and maximum bearing wall spacing of 20 feet.

**2.3.2.3 Wind Load Limitations:** Parameter for determining allowable transverse wind load is one of the following:

1. Walls may be constructed in areas with maximum basic wind speed of 100 miles per hour, Exposure C as defined in Section 1616 of the code, provided vertical and horizontal reinforcement is No. 4 bars at maximum 10 inches on center.
2. Moments and shear do not exceed allowable values in Tables 1 and 2.

**2.3.3 Opening Reinforcement:** Wall openings are vertically and horizontally reinforced with two No. 5 bars extending 24 inches beyond the corners.

**2.3.4 Roof and Floor Anchorage:** Roofs and floors are anchored and supported at the wall in accordance with Section 1611 of the code. See Figure 4 for typical details.

**2.3.5 Shear Wall Limitations:** Allowable in-plane shear capacity is 4,800 pounds per linear foot. Maximum wall height to width ratio is 2.5:1 with a minimum shear wall length of 4 feet.

**2.3.6 Foundation Anchorage:** Anchorage to foundation complies with Section 1915.8 of the code.

##### 2.4 Interior Finish:

Walls must be finished on the interior with  $\frac{1}{2}$ -inch-thick gypsum wallboard mechanically attached, using self-tapping screws, to  $1\frac{1}{2}$ -inch-wide, No. 26 gage galvanized steel

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(0.0179-inch) or No. 24 gage (0.02-inch) aluminum strips secured to concrete with 16d nails. The nails are inserted into holes in the metal strip, pushed through the conform unit and are secured with speed washers to prevent withdrawal until the concrete has set. Spacing of anchor plates and fasteners and installation of the gypsum wallboard must comply with Section 2511 of the code. Gypsum board must also be attached to window and door frames.

### 2.5 Exterior Finish:

Walls are covered on the exterior with a weather-resistive covering in accordance with the code and/or an evaluation report. Suitable finishes include, but are not limited to: STO Corp. R-wall Finish (Evaluation Report ER-3617) and STO Corp. STO Exterior Wall Finish (Evaluation Report ER-3906). Exterior wall covering must be recognized in individual evaluation reports for the required design wind pressures.

### 2.6 Foundation Walls:

See Figures 5 and 6 for typical foundation walls constructed with SF series units.

### 2.7 Retaining Walls:

The walls may be used as retaining walls with reinforcement, provided they are designed in accordance with accepted engineering principles. See Tables 4, 6 and 8 for reinforcing requirements.

### 2.8 Basement Walls:

ConForm SmartBlock units may be used for basement walls. When the SF series units are used, the basement is considered the first story of the two-story limitation specified in Section 2.3.2, Item 1. See Tables 3, 5 and 7 for reinforcing requirements. Waterproofing and damp-proofing of basement walls must be in accordance with Appendix Chapter 18 of the code and the manufacturer's instructions. Products to be used for waterproofing are Sealtight Mel-Rol waterproofing and liquid membrane without primers or mastics manufactured by W. R. Meadows Inc., or Henry No. 107 asphalt emulsion manufactured by Henry Company or Polyguard 650 without primers manufactured by Polyguard Products, Inc. See Figures 7 and 8 for further details.

### 2.9 Crawl Spaces:

ConForm units exposed to the inside may be used for walls forming underfloor crawl spaces, contingent on the following conditions:

1. Entry to the crawl space is only to service utilities.
2. There are no interconnected basement areas.
3. Air in the crawl space is not circulated to other parts of the building.
4. Ventilation complies with Section 2306.7 of the code.
5. Block units exposed to crawl spaces are limited to those manufactured with BASF Styropor or Huntsman expandable polystyrene beads.

### 2.10 Fire-resistive Construction:

Concrete walls constructed with VWF series 5<sup>3</sup>/<sub>4</sub>-inch-thick and 7<sup>3</sup>/<sub>4</sub>-inch-thick units, with one layer of 1/2-inch-thick gypsum wallboard attached as noted in Section 2.4, are recognized for fire-resistive ratings of up to 4 hours.

### 2.11 Special Inspection:

Special inspection is required as noted in Sections 1701.5.1 and 1701.5.4 of the code at the time of placing of reinforcing

steel and pouring of concrete. The inspector is required to inspect pouring and consolidation of concrete to ensure proper filling of voids at each level, since the forms remain permanently in place.

Taking of test specimens for stem wall foundation construction as noted in Figure 5 is not necessary.

When approved by the building official, special inspection is not necessary for installation of single-story, maximum 8-foot-high walls housing Group R, Division 3 or Group U, Division 1 Occupancies, provided the following conditions are met:

1. Maximum height of individual concrete pour is 48 inches.
2. Installation is by trained installers approved by the manufacturer.
3. Half the allowable design stresses are used for the design of the walls.

### 2.12 Identification:

Each package bears a label noting the product name, address of the manufacturer, flame-spread and smoke-density ratings and the name and logo of the quality control agency, Underwriters Laboratories Inc.

## 3.0 EVIDENCE SUBMITTED

Calculations and structural details; reports of tests in accordance with applicable portions of the ICBO ES Acceptance Criteria for Foam Plastic Insulation (AC12), dated June 1998, and the ICBO ES Acceptance Criteria for Concrete and Concrete Masonry Wall Systems (AC15), dated June 1987; reports of fire tests in accordance with UBC Standards 7-1 and 26-3; and a quality control manual.

## 4.0 FINDINGS

**That the ConForm's<sup>®</sup> SmartBlock<sup>™</sup> units described in this report comply with the 1997 Uniform Building Code<sup>™</sup>, subject to the following conditions:**

- 4.1 They are manufactured, identified and installed in accordance with the manufacturer's instructions and this report.
- 4.2 Walls using the SF series forms are limited to two-story or maximum one basement and one-story structures with a maximum unsupported wall height of 10 feet.
- 4.3 Walls using the forms are considered combustible construction.
- 4.4 Plans and calculations are submitted for building department approval for each structure, except that calculations need not be submitted when using the VWF series walls as foundations for stud bearing walls as noted in Table 18-I-C of the code.
- 4.5 The forms are separated from the building interior with minimum 1/2-inch-thick regular gypsum wallboard installed as set forth in this report.
- 4.6 Special inspection is provided in accordance with Section 2.11 of this report.
- 4.7 The units are manufactured in Santa Ana, California, under a quality control program with inspections by Underwriters Laboratories Inc. (NER-QA403).

**This report is subjected to re-examination in two years.**

## SI CONVERSIONS FOR TEXT

0.02 inch = 0.51 mm	$\frac{3}{8}$ inch = 10 mm	$\frac{1}{2}$ inch = 12.7 mm	$1\frac{1}{2}$ inches = 38 mm
$1\frac{3}{4}$ inches = 44.5 mm	2 inches = 51 mm	$2\frac{1}{8}$ inches = 54 mm	$3\frac{3}{4}$ inches = 95 mm
$5\frac{3}{4}$ inches = 146 mm	$6\frac{1}{4}$ inches = 159 mm	$6\frac{1}{2}$ inches = 165 mm	$7\frac{1}{2}$ inches = 191 mm
$7\frac{3}{4}$ inches = 197 mm	10 inches = 254 mm	12 inches = 305 mm	20 inches = 508 mm
24 inches = 610 mm	40 inches = 1016 mm	48 inches = 1219 mm	—
2,000 psi = 13.8 MPa	40,000 psi = 276 MPa	60,000 psi = 413 MPa	—
4 feet = 1219 mm	8 feet = 2438 mm	10 feet = 3048 mm	20 feet = 6096 mm
50 psf = 2394 Pa	—	—	—
1.5 lbs./ft. <sup>3</sup> = 24 kg/m <sup>3</sup>	2.0 lbs./ft. <sup>3</sup> = 32 kg/m <sup>3</sup>	—	—
100 mph = 161 km/h	—	—	—
1,500 lbs. per ft. = 21 891 N/m	4,800 lbs. per ft. = 70 051 N/m	—	—

TABLE 1—SF 10 WALLS WITH REINFORCEMENT AT EDGE OF WALL<sup>1,2,3,4</sup>

VERTICAL REINFORCING STEEL <sup>5,6</sup>	ALLOWABLE MOMENT (ft.-lbs./ft.)	ALLOWABLE SHEAR (lbs./ft.)
No. 4 at 10" o.c.	3,194	3,250
No. 5 at 10" o.c.	6,625	3,207
No. 6 at 10" o.c.	7,341	2,822

For **SI**: 1 inch = 25.4 mm, 1 (ft.-lb.)/ft. = 1.355818 N·m/m, 1 lb./ft. = 14.5939 N/m.

<sup>1</sup>Minimum compressive strength of concrete is 2,000 psi.

<sup>2</sup>Horizontal reinforcement is No. 4 at 10 inches on center or No. 6 at 20 inches on center.

<sup>3</sup>Walls to be anchored to all floors and roofs as specified in Section 1611 of the code. Walls shall be interconnected at corners by embedding and lapping the reinforcement as specified in Section 1912 of the code.

<sup>4</sup>When used as basement walls, the basement floor must be poured and the first floor in place prior to backfilling, or adequate temporary shoring must be installed.

<sup>5</sup>Minimum yield strength of No. 4 bar is 40,000 psi and Nos. 5 and 6 bars is 60,000 psi.

<sup>6</sup>Reinforcing steel must be placed on the tension side of the wall, and the outer surface of the steel is covered by  $1\frac{1}{2}$ -inch-thick (38 mm) concrete. If wall bears load from both sides, reinforcing steel must be in the center of wall and allowable values in Table 2 apply.

TABLE 2—SF 10 WALLS WITH REINFORCEMENT AT CENTER OF WALL<sup>1,2,3,4</sup>

VERTICAL REINFORCING STEEL <sup>5</sup>	ALLOWABLE MOMENT (ft.-lbs./ft.)	ALLOWABLE SHEAR (lbs./ft.)
No. 4 at 10" o.c.	2,114	2,223
No. 5 at 10" o.c.	4,219	2,223

For **SI**: 1 inch = 25.4 mm, 1 (ft.-lb.)/ft. = 1.355818 N·m/m, 1 lb./ft. = 14.5939 N/m.

<sup>1</sup>Minimum compressive strength of concrete is 2,000 psi.

<sup>2</sup>Horizontal reinforcement is No. 4 at 10 inches on center or No. 6 at 20 inches on center.

<sup>3</sup>Walls to be anchored to all floors and roofs as specified in Section 1611 of the code. Walls shall be interconnected at corners by embedding and lapping the reinforcement as specified in Section 1912 of the code.

<sup>4</sup>When used as basement walls, the basement floor must be poured and the first floor in place prior to backfilling, or adequate temporary shoring must be installed.

<sup>5</sup>Minimum yield strength of No. 4 bar is 40,000 psi and Nos. 5 and 6 bars is 60,000 psi.

TABLE 3—10VWF8 AND 12VWF8 BASEMENT WALL—WALL RESTRAINED AT TOP AND BOTTOM<sup>1,2,3,4,5,6,7</sup>

WALL HEIGHT (Feet)	EQUIVALENT FLUID PRESSURE (lbs./ft. <sup>2</sup> /ft.)											
	30	35	40	45	50	55	60	65	70	75	80	85
6	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.
7	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 12" o.c.	No. 4 at 12" o.c.	No. 4 at 12" o.c.	No. 4 at 12" o.c.
8	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 12" o.c.	No. 4 at 12" o.c.	No. 4 at 12" o.c.	No. 4 at 12" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.
9	No. 4 at 12" o.c.	No. 4 at 12" o.c.	No. 4 at 12" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.
10	No. 4 at 12" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 6 at 12" o.c.	No. 6 at 12" o.c.	No. 6 at 12" o.c.
11	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 6 at 12" o.c.	No. 6 at 12" o.c.	No. 7 at 12" o.c.	No. 7 at 12" o.c.	No. 5 at 6" o.c.	N/A	N/A
12	No. 6 at 18" o.c.	No. 6 at 12" o.c.	No. 6 at 12" o.c.	No. 6 at 12" o.c.	No. 7 at 12" o.c.	No. 7 at 12" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	N/A	N/A	N/A	N/A

For **SI**: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf/ft. = 47.8803 Pa/m.

<sup>1</sup>Minimum compressive strength of concrete is 2,000 psi.

<sup>2</sup>Minimum yield strength of No. 4 bar is 40,000 psi and Nos. 5, 6 and 7 bars is 60,000 psi.

<sup>3</sup>Reinforcing steel must be placed on the tension side of the wall, and the outer surface of the steel is covered by  $1\frac{1}{2}$ -inch-thick concrete.

<sup>4</sup>Horizontal reinforcement is No. 4 at 10 inches on center or No. 5 at 12 inches on center.

<sup>5</sup>Walls to be anchored to all floors and roofs as specified in Section 1611 of the code. Walls shall be interconnected at corners by embedding and lapping the reinforcement as specified in Section 1912 of the code.

<sup>6</sup>The basement floor must be poured and the first floor in place prior to backfilling, or adequate temporary shoring must be installed.

<sup>7</sup>Calculations are based on maximum two floors above the basement.

N/A = Not available.

TABLE 4—10VWF8 AND 12VWF8 RETAINING WALL—WALL UNRESTRAINED AT TOP<sup>1,2,3,4</sup>

WALL HEIGHT (feet)	EQUIVALENT FLUID PRESSURE (lbs./ft. <sup>2</sup> /ft.)											
	30	35	40	45	50	55	60	65	70	75	80	85
6	No. 4 at 18" o.c.	No. 4 at 18" o.c.	No. 4 at 12" o.c.	No. 4 at 12" o.c.	No. 4 at 12" o.c.	No. 4 at 12" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.
7	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 6 at 12" o.c.	No. 6 at 12" o.c.
8	No. 5 at 18" o.c.	No. 5 at 18" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 6 at 12" o.c.	No. 6 at 12" o.c.	No. 7 at 12" o.c.	No. 7 at 12" o.c.	No. 7 at 12" o.c.	No. 7 at 12" o.c.	No. 7 at 6" o.c.
9	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 6 at 12" o.c.	No. 6 at 12" o.c.	No. 7 at 12" o.c.	No. 7 at 12" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	No. 6 at 6" o.c.	No. 5 at 4" o.c.	N/A	N/A
10	No. 6 at 12" o.c.	No. 7 at 12" o.c.	No. 7 at 12" o.c.	No. 5 at 6" o.c.	No. 6 at 6" o.c.	No. 6 at 6" o.c.	No. 5 at 4" o.c.	N/A	N/A	N/A	N/A	N/A
11	No. 7 at 12" o.c.	No. 5 at 6" o.c.	No. 6 at 6" o.c.	No. 5 at 4" o.c.	No. 5 at 4" o.c.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	No. 6 at 6" o.c.	No. 5 at 4" o.c.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

For **SI**: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf/ft. = 47.8803 Pa/m.

<sup>1</sup>Minimum compressive strength of concrete is 2,000 psi.

<sup>2</sup>Minimum yield strength of No. 4 bar is 40,000 psi and Nos. 5, 6 and 7 bars is 60,000 psi.

<sup>3</sup>Reinforcing steel placed near the edge of wall side facing the soil such that the outer surface of the steel is covered by 1<sup>1</sup>/<sub>2</sub>-inch-thick concrete.

<sup>4</sup>Horizontal reinforcement is No. 4 at 10 inches on center or No. 5 at 12 inches on center.

N/A = Not available.

TABLE 5—10VWF6 AND 12VWF6 BASEMENT WALL—WALL RESTRAINED AT TOP AND BOTTOM<sup>1,2,3,4,5,6,7</sup>

BASEMENT WALL HEIGHT (feet)	EQUIVALENT FLUID PRESSURE (lbs./ft. <sup>2</sup> /ft.)											
	30	35	40	45	50	55	60	65	70	75	80	85
6	No. 4 at 17.25" o.c.	No. 4 at 17.25" o.c.	No. 4 at 17.25" o.c.	No. 4 at 17.25" o.c.	No. 4 at 17.25" o.c.	No. 4 at 17.25" o.c.	No. 4 at 17.25" o.c.	No. 4 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.
7	No. 4 at 17.25" o.c.	No. 4 at 17.25" o.c.	No. 4 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.
8	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.
9	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 6 at 12" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	N/A	N/A
10	No. 5 at 17.25" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	N/A	N/A	N/A	N/A	N/A
11	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	No. 5 at 6" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

For **SI**: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf/ft. = 47.8803 Pa/m.

<sup>1</sup>Minimum compressive strength of concrete is 2,000 psi.

<sup>2</sup>Minimum yield strength of No. 4 bar is 40,000 psi and Nos. 5, 6 and 7 bars is 60,000 psi.

<sup>3</sup>Reinforcing steel must be placed on the tension side of the wall, and the outer surface of the steel is covered by 1<sup>1</sup>/<sub>2</sub>-inch-thick (38 mm) concrete.

<sup>4</sup>Horizontal reinforcement is No. 4 at 10 inches on center or No. 5 at 12 inches on center.

<sup>5</sup>Walls to be anchored to all floors and roofs as specified in Section 1611 of the code. Walls shall be interconnected at corners by embedding and lapping the reinforcement as specified in Section 1912 of the code.

<sup>6</sup>The basement floor must be poured and the first floor in place prior to backfilling, or adequate temporary shoring must be installed.

<sup>7</sup>Calculations are based on maximum two floors above basement.

N/A = Not available.

**TABLE 6—10VWF6 AND 12VWF6 RETAINING WALL—WALL UNRESTRAINED AT TOP<sup>1,2,3,4</sup>**

WALL HEIGHT (feet)	EQUIVALENT FLUID PRESSURE (lbs./ft. <sup>2</sup> /ft.)											
	30	35	40	45	50	55	60	65	70	75	80	85
6	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No.5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 17.25" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 6 at 12" o.c.	No. 6 at 12" o.c.
7	No. 5 at 17.25" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 6 at 12" o.c.	No. 6 at 12" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.
8	No. 5 at 12" o.c.	No. 5 at 12" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	N/A	N/A	N/A	N/A	N/A	N/A
9	No. 5 at 6" o.c.	No. 5 at 6" o.c.	No. 5 at 6" o.c.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

For **SI**: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf/ft. = 47.8803 Pa/m.

<sup>1</sup>Minimum compressive strength of concrete is 2,000 psi.

<sup>2</sup>Minimum yield strength of No. 4 bar is 40,000 psi and Nos. 5 and 6 bars is 60,000 psi.

<sup>3</sup>Reinforcing steel placed near the edge of wall side facing the soil such that the outer surface of the steel is covered by 1<sup>1</sup>/<sub>2</sub>-inch-thick concrete.

<sup>4</sup>Horizontal reinforcement is No. 4 at 10 inches on center or No. 5 at 12 inches on center.

N/A = Not available.

**TABLE 7—SF10 BASEMENT WALL—WALL RESTRAINED AT TOP AND BOTTOM<sup>1,2,3,4,5,6</sup>**

WALL HEIGHT (feet)	EQUIVALENT FLUID PRESSURE (lbs./ft. <sup>2</sup> /ft.)											
	30	35	40	45	50	55	60	65	70	75	80	85
6	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No.4 at 10" o.c.	No.4 at 10" o.c.
7	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No.5 at 10" o.c.
8	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No.5 at 10" o.c.	No.5 at 10" o.c.
9	No. 4 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	N/A	N/A	N/A
10	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	N/A	N/A	N/A	N/A	N/A	N/A

For **SI**: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf/ft. = 47.8803 Pa/m.

<sup>1</sup>Minimum compressive strength of concrete is 2,000 psi.

<sup>2</sup>Minimum yield strength of No. 4 bar is 40,000 psi and No. 5 bar is 60,000 psi.

<sup>3</sup>Reinforcing steel must be placed on the tension side of the wall, and the outer surface of the steel is covered by 1<sup>1</sup>/<sub>2</sub>-inch-thick (38 mm) concrete.

<sup>4</sup>Horizontal reinforcement is No. 4 at 10 inches on center.

<sup>5</sup>Walls to be anchored to all floors and roofs as specified in Section 1611 of the code. Walls shall be interconnected at corners by embedding and lapping the reinforcement as specified in Section 1912 of the code.

<sup>6</sup>The basement floor must be poured and the first floor in place prior to backfilling, or adequate temporary shoring must be installed.

N/A = Not available.

**TABLE 8—SF10 RETAINING WALL—WALL UNRESTRAINED AT TOP<sup>1,2,3,4</sup>**

WALL HEIGHT (feet)	EQUIVALENT FLUID PRESSURE (lbs./ft. <sup>2</sup> /ft.)											
	30	35	40	45	50	55	60	65	70	75	80	85
6	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 4 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.
7	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No.5 at 10" o.c.	N/A	N/A	N/A	N/A
8	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 5 at 10" o.c.	No. 6 at 10" o.c.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	No. 5 at 10" o.c.	No. 6 at 10" o.c.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

For **SI**: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf/ft. = 47.8803 Pa/m.

<sup>1</sup>Minimum compressive strength of concrete is 2,000 psi.

<sup>2</sup>Minimum yield strength of No. 4 bar is 40,000 psi and Nos. 5 and 6 bars is 60,000 psi.

<sup>3</sup>Reinforcing steel placed near the edge of wall side facing the soil such that the outer surface of the steel is covered by 1<sup>1</sup>/<sub>2</sub>-inch-thick concrete.

<sup>4</sup>Horizontal reinforcement is No. 4 at 10 inches on center.

N/A = Not available.

STANDARD FORM SF 101040

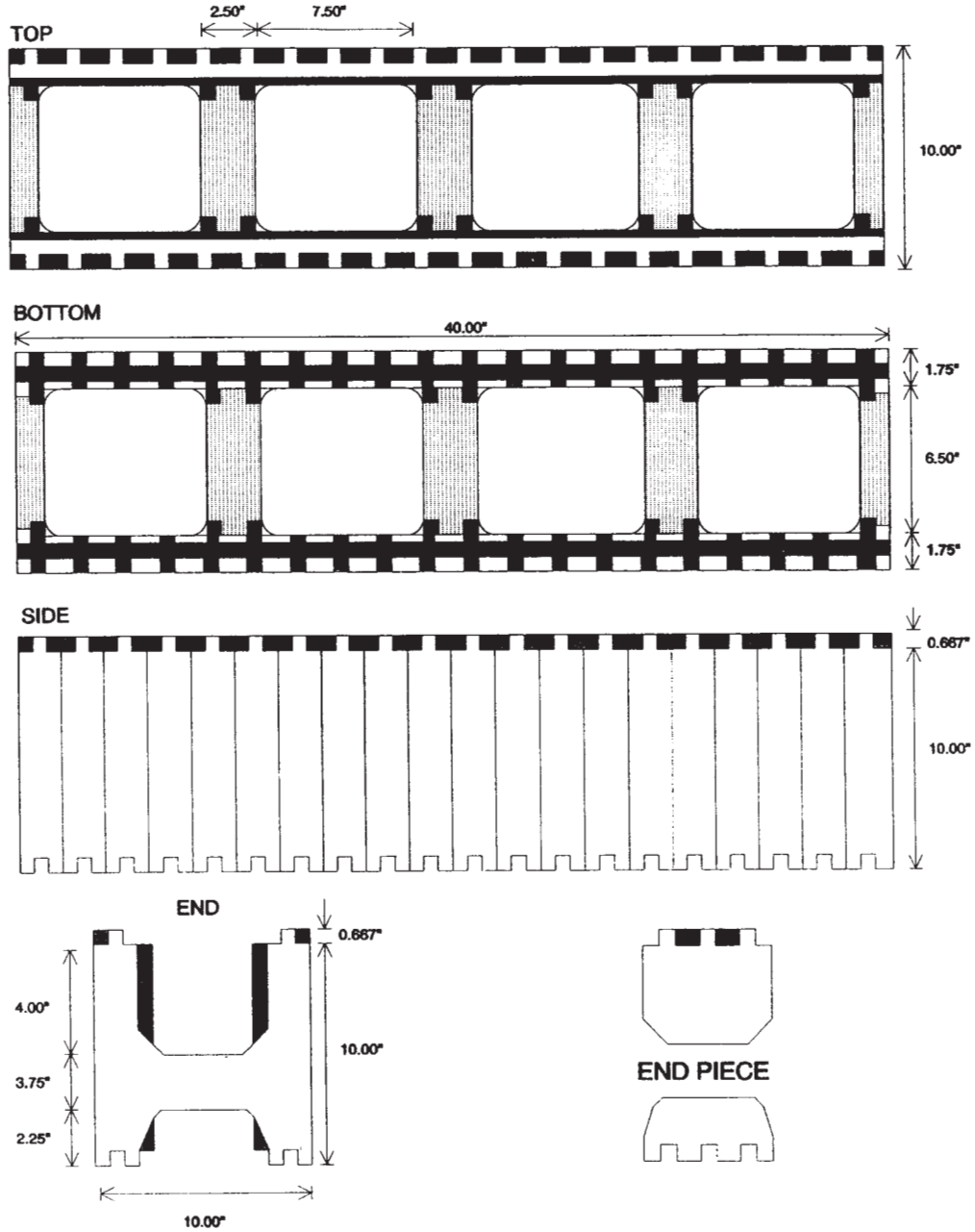


FIGURE 1—STANDARD FORM SF SERIES  
 For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

# VARIABLE WIDTH FORM VWF 21040

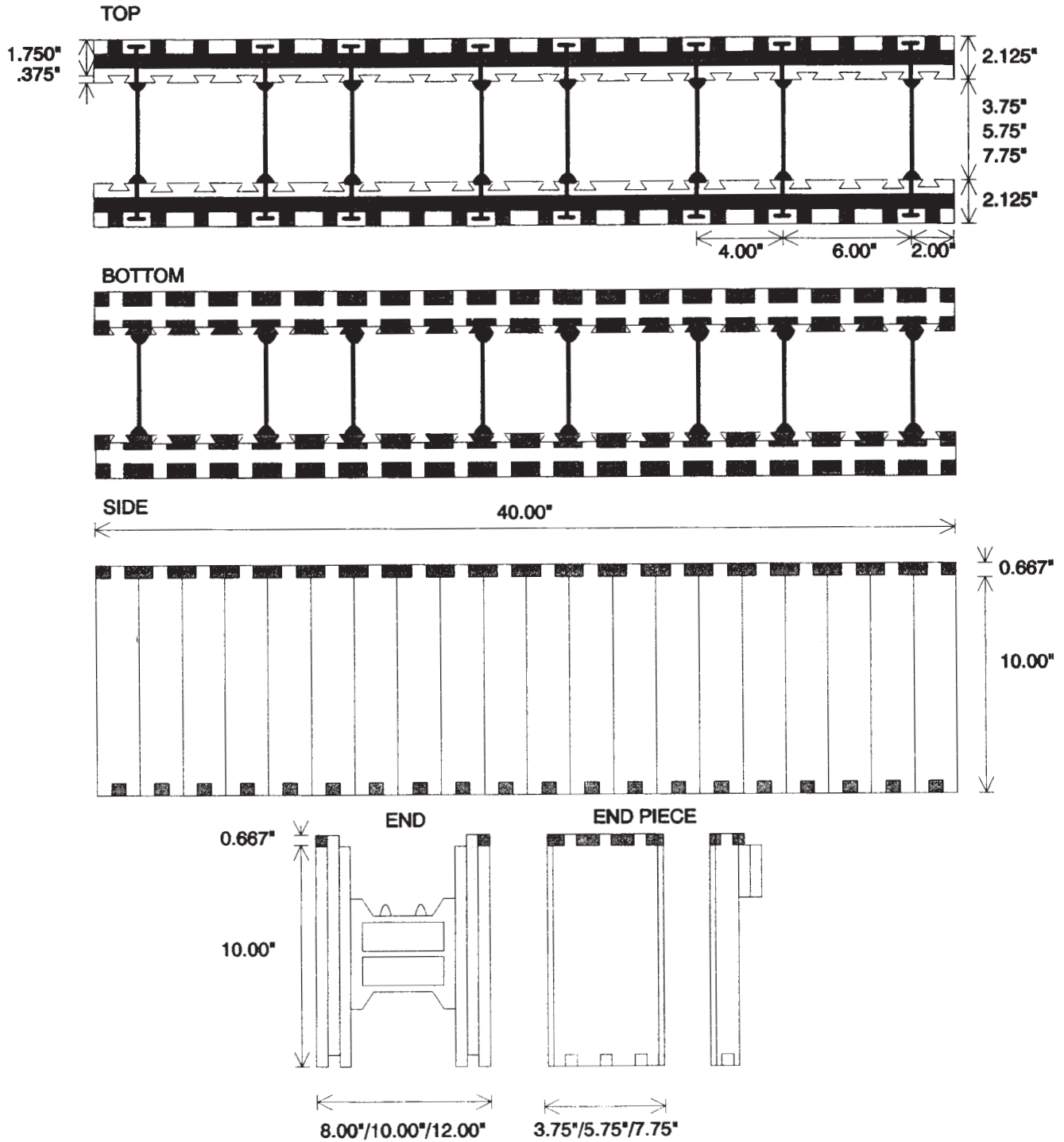


FIGURE 2—VARIABLE WIDTH 10VWF SERIES

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

### VARIABLE WIDTH FORM VWF 21240

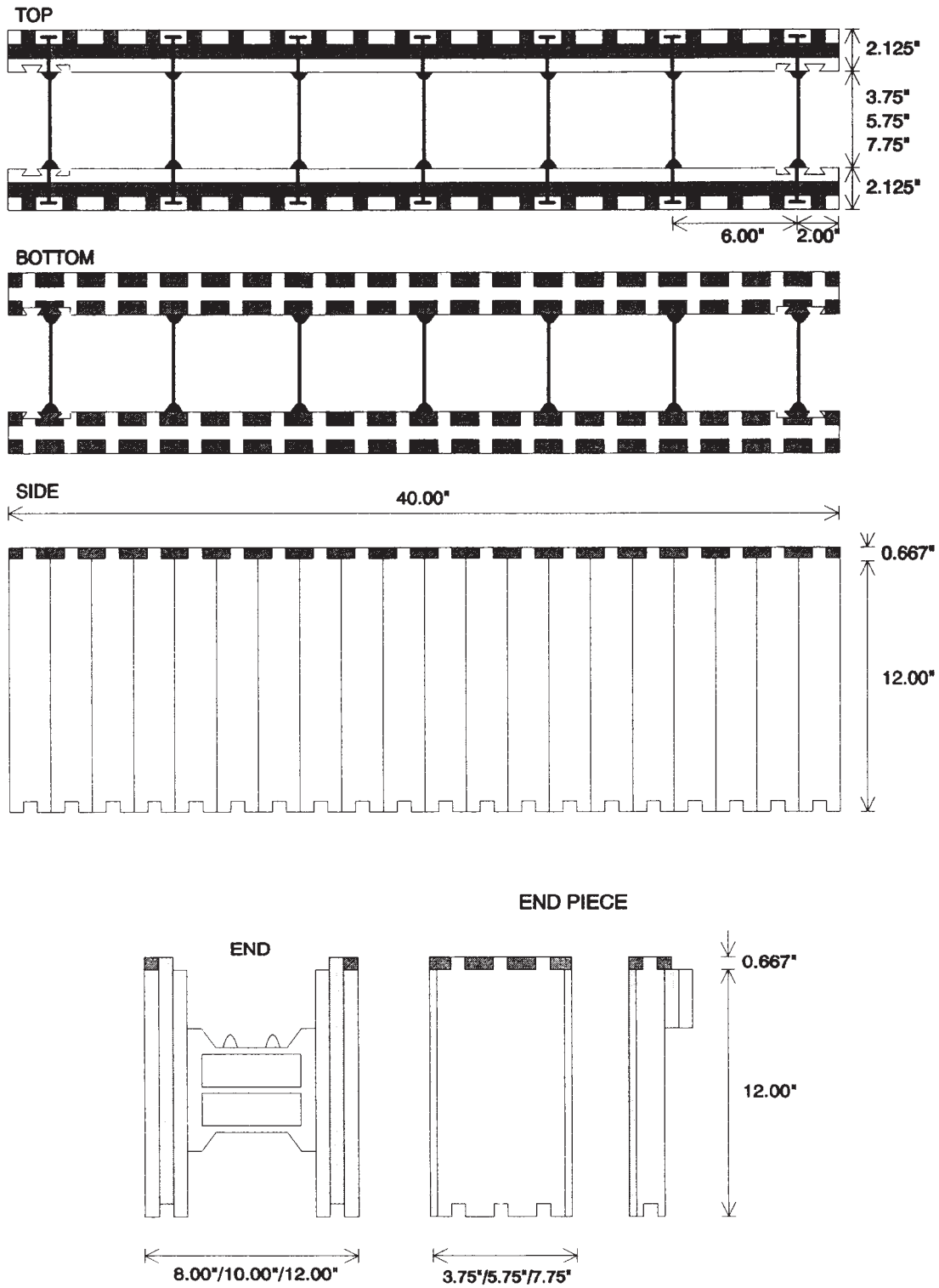
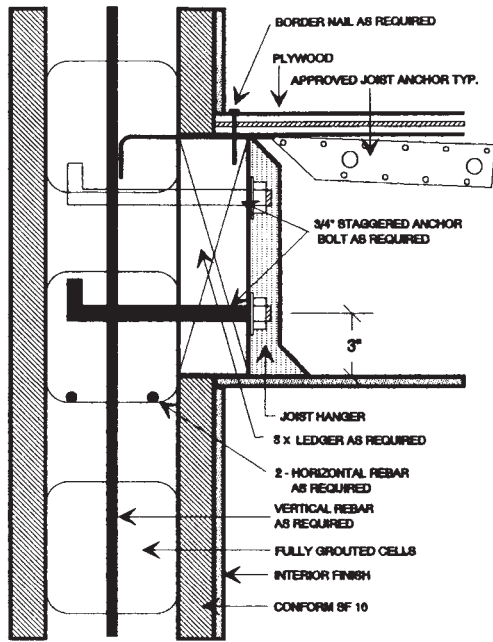


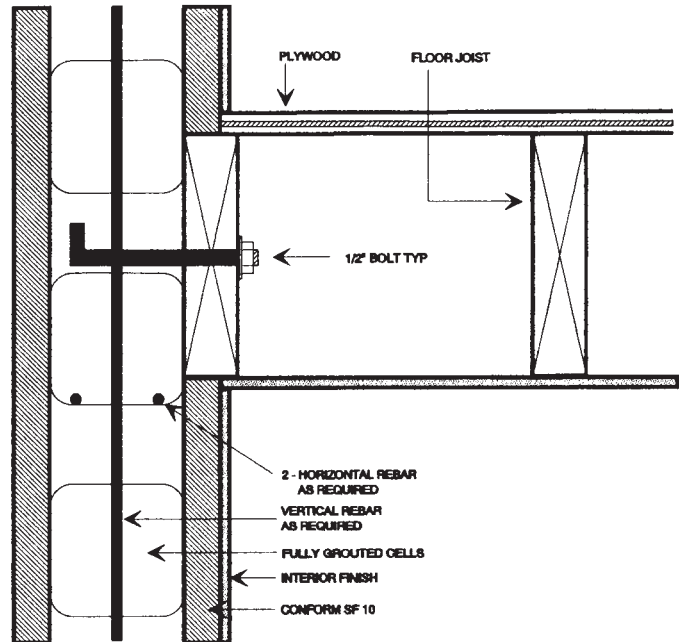
FIGURE 3—VARIABLE WIDTH 12VWF SERIES

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

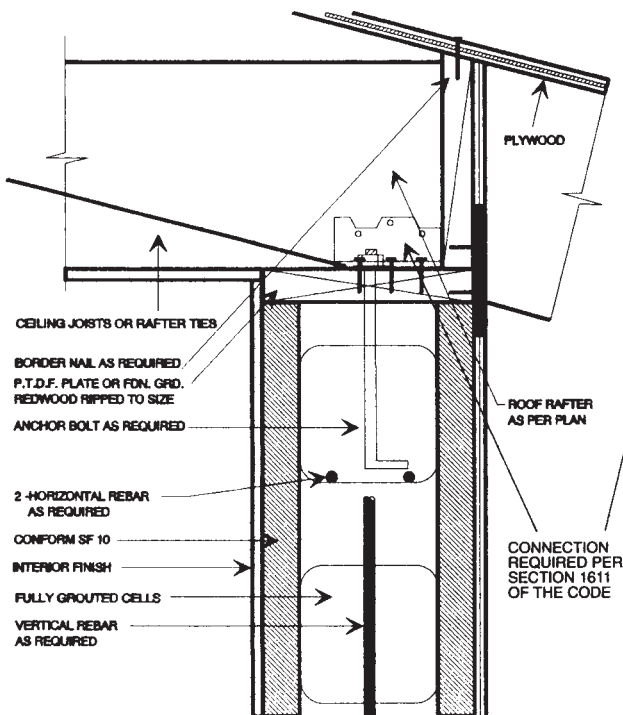




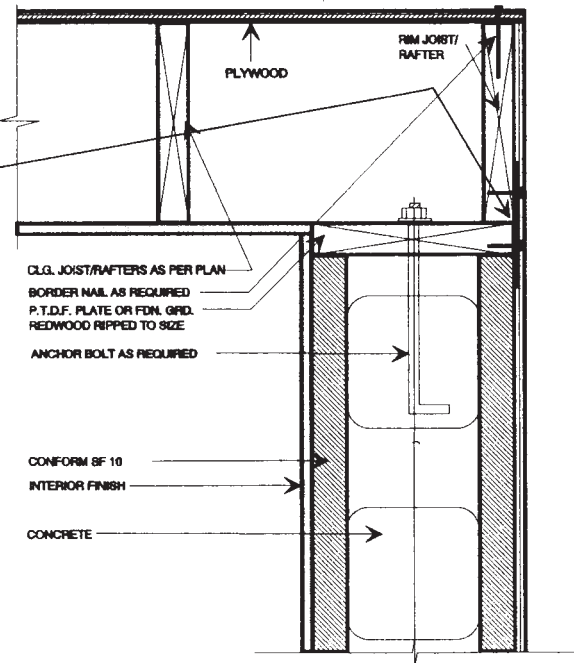
TYPICAL FLOOR FRAMING DETAIL  
JOISTS PERPENDICULAR TO WALL



TYPICAL FLOOR FRAMING DETAIL  
JOISTS PARALLEL TO WALL



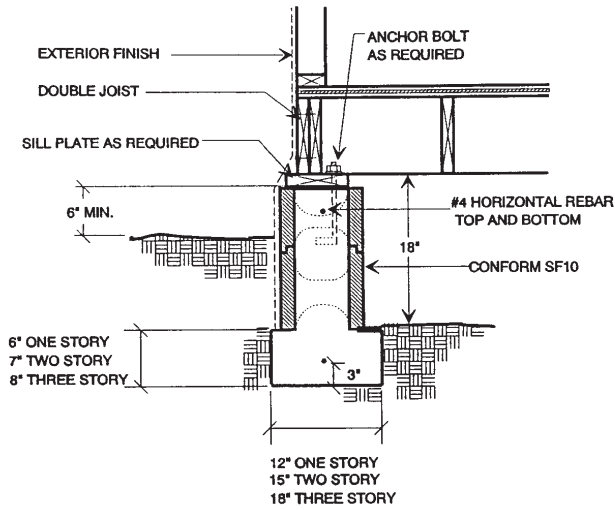
TYPICAL ROOF DETAIL  
RAFTERS PERPENDICULAR TO WALL



TYPICAL ROOF DETAIL  
RAFTERS PARALLEL TO WALL

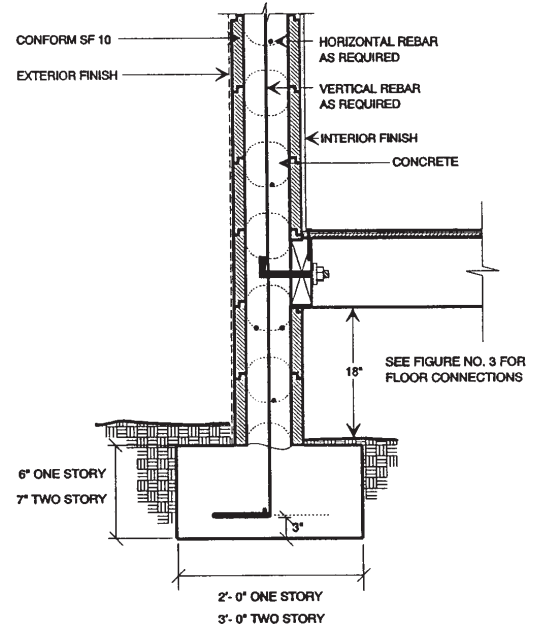
FIGURE 4—CONNECTIONS TO ROOFS AND FLOORS

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.



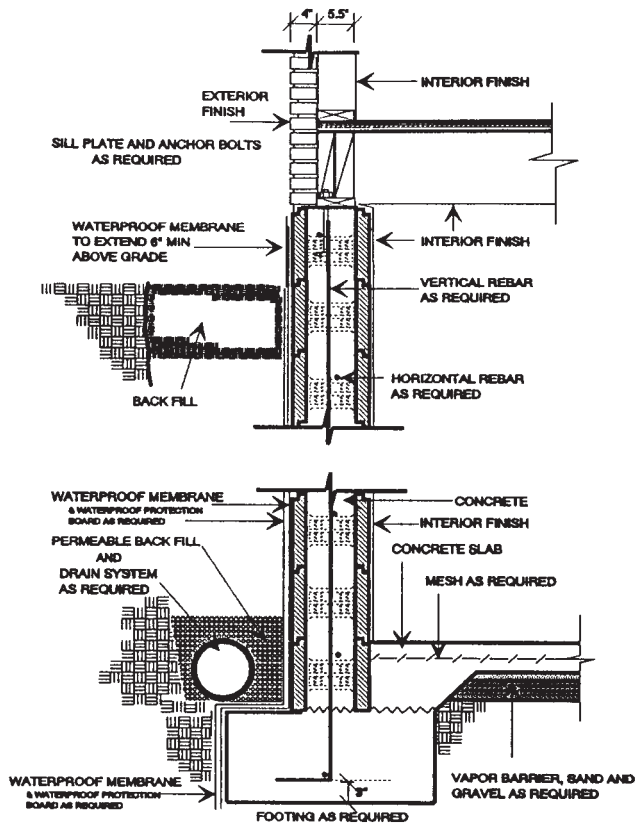
**FIGURE 5—SF SERIES FOUNDATION WALL (STUD WALL CONSTRUCTION)**

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.



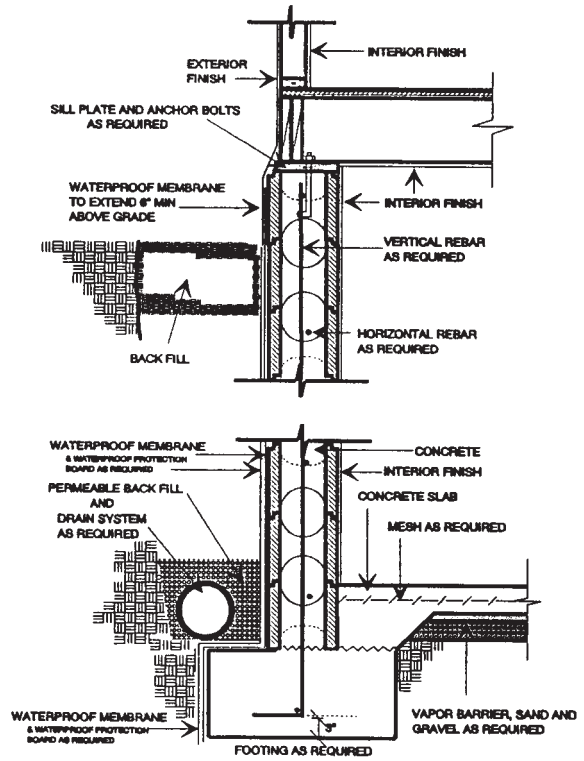
**FIGURE 6—SF SERIES FOUNDATION WALL (CONCRETE WALL CONSTRUCTION)**

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.



**FIGURE 7—VWF SERIES BASEMENT WALL**

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.



**FIGURE 8—SF SERIES BASEMENT WALL**

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.