ThermoWall®
panel system

REPORTE ICBO

LEGACY REPORT

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Legacy report on the 1997 Uniform Building Code™, the 2000 International Building Code® and the 2000 International Residential Code®

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LEGACY REPORT

DIVISION: 03—CONCRETE
Section: 03130—Permanent Forms

THERMOWALL® PANEL SYSTEM
TRILOGY MATERIALS, LTD.
5776 NORTH MESA
EL PASO, TEXAS 79912

1.0 SUBJECT

ThermoWall® Panel System.

2.0 DESCRIPTION

2.1 General:

Perform Wall Building System is comprised of individual panels, which form a permanent formwork for reinforced concrete beams, lintels, walls, foundations and retaining walls. Walls constructed as described in this report are permitted to be used in combustible or noncombustible construction.

2.2 Materials:

2.2.1 ThermoWall Panels: ThermoWall panels are manufactured from a mixture of polystyrene beads, portland cement, admixtures, and water. The panels have a density between 20 and 24 pcf (320 and 380 kg/m3), and a Class I (UBC) and Class A (IBC and IRC) flame-spread index and a smoke-density rating no greater than 450 when tested in accordance with UBC Standard 8-1 (ASTM E 84).

The panels are nominal 71/2, 15, or 30 inches (191, 361, or 762 mm) wide; 81/2, 10, 12 or 14 inches (216, 254, 305, or 356 mm) thick; and 10 feet (3048 mm) high, with available core diameters of either 6 inches (152.4 mm) or 8 inches (1203.2 mm).

When stacked in the final position, the panels form vertical and horizontal cavities where reinforcement and concrete are placed. See Figures 1, 2, and 3 for typical details of the panels.

2.2.2 Concrete: Normal-weight concrete with 3/4-inch (19 mm) maximum aggregate size must have a minimum compressive strength of 2,500 psi (17.2 MPa) at 28 days. Optimum slump is between 8 and 9 inches (203 and 229 mm).

2.2.3 Reinforcement: Deformed steel reinforcement bars must have a minimum yield stress of 40 ksi (275 MPa) andde consumo y descripción de cada planta.

must comply with Section 1903 of the 1997 Uniform Building Code™ (UBC), 1903.5 of the 2000 International Building Code® (IBC), or Section R404.4.6 and R611.6.2 of the 2000 International Residential Code® (IRC).

2.2.4 Other: When required by the building official, wood members in contact with concrete for plates or window and door framing must be preservative-treated with an approved wood preservative, and must be attached with galvanized steel fasteners in accordance with Section 2304.3 of the UBC, Section 2304.9.5 of the IBC, or Section R323.3 of the IRC. Wood members for plates or window and door framing must comply with Sections 2316 and 2317 of the UBC. Materials other than wood, such as vinyl, are permitted for window and door framing if approved by the building official.

2.3 Design:

2.3.1 General: The design of cast-in-place, reinforced concrete structural members formed by ThermoWall panels must conform to Chapters 16 and 19 of the UBC or IBC and the following:

1. Minimum horizontal reinforcement must be No. 4 deformed rebar spaced a maximum of 30 inches (762 mm) on center for structures located in Seismic Zones 0, 1, and 2 (IBC Seismic Design Categories A and B); and must be minimum No. 4 deformed rebar spaced a maximum of 15 inches (381 mm) on center for structures located in Seismic Zones 3 and 4 (IBC Design Categories C, D, E, and F).

2. Minimum vertical reinforcement must be No. 4 deformed rebar spaced a maximum of 30 inches (760 mm) on center for structures located in Seismic Zones 0, 1, and 2 (IBC Seismic Design Categories A and B), and for structures located in Exposure C areas having a UBC basic (fastest mile) wind speed of 70 mph (102 km/h) or an IBC basic (3-second gust) wind speed of 85 mph (123 km/h). Minimum vertical reinforcement must be No. 4 deformed rebar spaced a maximum of 15 inches (381 mm) on center for structures located in Seismic Zones 3 and 4, and for structures located in Exposure C areas having a basic wind speed greater than 70 mph (102 km/h) or an IBC basic (3-second gust) wind speed of 85 mph (123 km/h). The rebar size may need to increase and/or the rebar spacing may need to decrease, as a result of the structure being designed under Chapters 16 and 19 of the UBC or IBC.

3. Development and splices of reinforcement must be in accordance with Section 1912 of the UBC or Section 1901.2 of the IBC.

4. Calculations are based on the assumption that the Perform Wall panels form a solid-concrete wall having an equivalent thickness, beq, of 4.75 inches (121 mm) for walls with 6-inch-diameter (152 mm) cores, and 6.75 inches (171 mm) for walls with 8-inch-diameter (203 mm) cores.

5. The strength-reduction factor, N, is in accordance with Section 1909.3 of the UBC or Section 1901.2 of the IBC.

6. A shape-reduction factor, R, of 0.85, and the strength-reduction factor specified in Section 1909.3 of the UBC or Section 1901.2 of the IBC, must be used cumulatively in the design of structural concrete formed by the Perform Wall panels.

7. For members subject to shear and flexure only, the nominal shear strength provided by the concrete is determined as follows:

$V_c = 2\ b_{eq} d$
for **SI**:

$V_c = 0.166 N R\ b_{eq} d$

where:

b_{eq} = Width of an equivalent rectangular section equal to 4.75 inches (121 mm) for walls with 6-inchdiameter (152 mm) cores, and 6.75 inches (171 mm) for walls with 8-inch-diameter (203 mm) cores.
d = Distance from extreme concrete compression fiber to centroid of tension reinforcement in opposite half of member.
fNc = Specified compressive strength of concrete(psi).
N = Strength reduction factor equal to 0.85.
R = Shape-reduction factor equal to 0.85.

8. In-plane shear strength of shear walls is determined as follows:
fv = NR fcNLubeq
For SI: fv = NR fcNLubeq

where:

beq = Width of an equivalent rectangular section equal to 4.75 inches (121 mm) for walls with 6-inchdiameter (152 mm) cores, and 6.75 inches (171 mm) for walls with 8-inch-diameter (203 mm) cores.

fNc = Specified compressive strength of concrete (psi).
Lu = Total length of shear wall panel (inches).

9. The length of wall considered the effective length for concentrated vertical loads must not exceed the centerto center distance between loads or the width of the bearing plate plus four times the effective wall thickness [beq, equal to 4.75 inches (121 mm) for walls with 6-inchdiameter (152 mm) cores, and 6.3 inches (160 mm) for walls with 8-inch-diameter (203 mm) cores].

10. Roof and floors must be anchored and supported at the wall in accordance with Section 1633.2.8 of the UBC or Section 1604.8.2 of the IBC. Ledger bolts must have the minimum diameter and spacing specified on the building plans approved by the building official.The horizontal reinforcement at each roof and floor level-must be in accordance with the design, and be at least one No. 4 rebar.

11. Walls subject to axial loading or combined flexural and axial loading must be designed as compression members in accordance with Section 1910 of the UBC or Section 1901.2 of the IBC.

12. Anchorage to foundations must comply with Section 1915.8 of the UBC or Section 1901.2 of the IBC.

2.3.2 Alternate Design as SlenderWalls: Alternate design of concrete walls formed by the Perform Wall panels is permitted to be used to comply with Section 1914.8 of the UBC, provided the calculations are based on the assumption that the ThermoWall panel system is a solid-concrete wall having an equivalent thickness of 4.75 inches (121 mm) for walls with 6-inch-diameter (152 mm) cores, and 6.75 inches (171 mm) for walls with 8-inch-diameter (203 mm) cores, and provided the following are considered in the design:

1. The height-to-thickness ratio (h/beq) must not exceed 60.

2. In cases where the vertical service-load stress exceeds 0.04 fc, the height-to-thickness ratio (h/beq) must not exceed 30.

2.3.3 Design in Accordance with the IRC: Reinforced concrete walls and structural members constructed with the ThermoWall panels must be designed and constructed in accordance with Section R404.4 or Section R611 of the IRC.

2.3.4 Prescriptive Design—Method 1 (UBC Only): The following prescriptive design approach for all panel thicknesses for a two-story building specified in this section is permitted to be used in lieu of calculations required by Section 2.3.1 of this evaluation report:

1. ThermoWall® panels contain a minimum inner core diameter of 6 inches.

4. The maximumsuperimposed load applied vertically on the wall is 2,500 pounds per lineal foot (36 500 N/m) with a maximum applied load eccentricity of 51/2 inches (140 mm).

5. Maximum basic wind speed is 100 miles per hour (161 km/h) in Exposure C locations as defined in Chapter 16, Division II, of the UBC.

6. Vertical and horizontal wall reinforcements must be spaced in accordance with Table 1, and placement must comply with Section 1914.3 of the UBC.

7. Wall openings must be vertically and horizontally reinforced in accordance with Table 2.

8. Roof and floors must be anchored and supported at the wall in accordance with Section 1633.2.8 of the UBC.

9. Ledger bolts must have the minimum diameter and spacing specified on the building plans approved by the building official.

10. Allowable in-plane shear loads specified in Table 3 must be greater than or equal to design loads.

11. Anchorage to foundations must comply with Section 1915.8 of the UBC.

12. The horizontal reinforcement at each roof and floor level must consist of a minimum of one No. 5 bar.

2.3.5 Prescriptive Design—Method 2 (UBC Only): In lieu of calculations required by Section 2.3.1 of this report, the structural design of Perform walls 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 screengrid ICF wall system.

2.4 Installation: The ThermoWall panels must be supported on concrete footings complying with Chapter 18 of the UBC or the IBC, or Chapter 4 of the IRC. Vertical rebars, embedded in the footing, must extend into the panel wall system with sufficient lap splice complying with Section 1912 of the UBC or Section 1901.2 of the IBC. Panels are affixed to each other using an approved high-yield expansive foam adhesive, such as Convenience Products' Touch-n-Seal or Hilti's Filler Foam, or by using an approved mortar adhesive. The panels are pressed together until the adhesive is cured. Alternatively, clamps, which are removed after the adhesive has dried, can be used. If panels are stacked horizontally, whalers can be used and dry stacking is permitted. The panels may be laid horizontally or vertically provided the horizontal and vertical reinforcement is placed in accordance with the approved building plans. See Figure 3 for a typical panel layout schedule.

Horizontal reinforcement is permitted to rest directly on the ThermoWall panel units in the cells, and the vertical reinforcement must be placed in accordance with the design drawings before concrete is poured. Lap splices for the reinforcement must comply with Section 1912 of the UBC, or Section 1923 of the IBC, or Section R611.7.1 of the IRC. Concrete is to fill all voids of the wall panels. Field verification of a proper pour can be accomplished by pushing a 1/4-inchdiameter (6.4 mm) steel rod through the face shell of the panels to the concrete core.

Ledgers must be attached to the concrete core of the ThermoWall panels. The face shell of the form units can remain. Wood ledgers are attached by cutting 6-inch-diameter (152 mm) holes into the side of the panel at the location of the horizontal or vertical core at spacing required by design, before the placement of concrete. A dam must be used to hold a J-bolt centered in the hole. When concrete is poured into the wall system, the holes provided for the J-bolts form a solid concrete connection from the ledger board to the horizontal bond beam.

Wood plates must be anchored to the top of the wall. Anchor bolts used to connect the wood ledgers or plates to the concrete must be cast in place, with the bolts sized and spaced as required by design.

2.5 Interior Finish: The ThermoWall panel system is permitted to be exposed to the interior of the building since the ThermoWall panels satisfactorily pass diversified testing required by Section 2602.4 of the UBC, Section 2603.4 of the IBC, and Section R318.3 of the IRC. Additionally, The panels have a Class I (UBC) and Class A (IBC and IRC) flame-spread index and a smoke-density rating no greater than 450 when tested in accordance with UBC Standard 8-1 (ASTM E 84). When an interior finish is provided, such as gypsum wallboard or plaster, the attachment of the finish is in accordance with the manufacturer's installation instructions.

2.6 Exterior Finish:

2.6.1 Above Grade: Exterior walls can be left unfinished or can be finished with an approved wall-covering in accordance with the UBC, IBC, or IRC, or an ICC-ES evaluation report.

Negative wind pressure capacity of the exterior finish material is as recognized in the code for generic materials or in a current ICC-ES evaluation report for proprietary materials.

2.6.2 Below Grade: Wall surfaces must be dampproofed and, when required by the local building department, waterproofed in accordance with Appendix 18 of the UBC or Section 1806 of the IBC, or Section R406 of

the IRC. Dampproofing and waterproofing materials must be approved by Trilogy Materials, Ltd., and the building official.

2.7 Foundation Walls: The wall system is permitted to be used as stem walls supported on concrete footings complying with the UBC Table 18-I-C, IBC Table 1805.2, or IRC Section R404.

2.8 Retaining Walls: The wall system is permitted to be used as retaining walls with reinforcement designed in accordance with this report and accepted engineering principles.

2.9 Crawl Spaces: The ThermoWall panels in underfloor crawl spaces are permitted to be exposed to the crawl space, provided ventilation complies with Section 2306.7 of the UBC, or Section 2304.11.9 of the IBC, Section R408.1 of the IRC.

2.10 Fire-resistive Construction: Wall assemblies constructed from minimum 10-inch-thick (254 mm) Perform Wall panels have a four-hour fire-resistive rating for walls that are load-bearing or nonload-bearing. The ThermoWall panels having a width of 71/2, 15 or 30 inches (191, 381 or 762 mm) are bonded together with an approved polyurethane foam,such as Convenience Products' Touch-NSeal or Hilti's Filler Foam, and the cavity of the ThermoWall panels must be filled with normal-weight concrete using either carbonate or siliceous aggregate. The concrete must be reinforced with reinforcing bars in accordance with this report and the approved building plans.

2.11 Special Inspection: Except for foundation stem walls conforming to Table 18-I-C of the UBC or Table 1805.4.2 of the IBC, special inspection is required for placement of reinforcing steel and concrete, and concrete cylinder testing, as noted in Section 1701 of the UBC. For buildings regulated by the IBC, special inspections and verification of concrete construction are required in accordance with Section 1704.4 and Table 4.4 of the IBC. Special inspection is not required when regulation is by the IRC.

When the building official approves, special inspection is not required for construction regulated by the UBC when all of the following conditions are met:

1. Wall systems are a maximum of 8 feet (2438 mm) high and are limited to use in single-story construction of Group R, Division 3, or Group U, Division 1, Occupancies.

2. Maximum height of individual concrete lifts is 48 inches (1219 mm). Succeeding lifts must be placed in accordance with Section 1905.10.5 of the UBC.

3. Installation is by trained installers approved by Trilogy Materials, Ltd.

4. Compressive strength (f'c) of concrete used in design is one-half of that specified.

2.12 Identification: Each package bears a label specifying the Trilogy Materials, Ltd., name; and the name and address of one of the two manufacturers noted in Table 4.

Additionally, product labels include the evaluation report number (ER-5949), and the name and logo of the quality control agency (Underwriters Laboratories Inc.).

3.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Interim Criteria for Concrete and Concrete Masonry Wall Systems (AC15), dated January 2001; reports of tests in accordance with UBC Standards 26-3, 8-1 (ASTM E 84), and 7-1 (ASTM E 119); reports of water-penetration tests in accordance with ASTM E 331 and E 514; and quality control manuals.

4.0 FINDINGS

That the Trilogy Materials, Ltd., Perform Wall Building System described in this report comply with the 1997 Uniform Building Code™, the 2000 International Building Code® (IBC), and the 2000 International Residential Code® (IRC), subject to the following conditions:

4.1 Panels are manufactured, identified and installed in accordance with this report and the manufacturer's installation instructions.

4.2 When required by the building official, calculations showing compliance with the general design requirements of Chapter 19 of the UBC or IBC are submitted to the building official for approval, except calculations are not required when the building design is based upon Section 2.3.3 or 2.3.4 of this evaluation report.

4.3 When regulation is under the UBC or IBC special inspection is provided in accordance with Section 2.11 of this report.

4.4 When regulation is under the IRC, compliance with Section R324.4 of the IRC must be demonstrated.

4.5 The ThermoWall panels are manufactured at the addresses shown in Section 2.12 and Table 4 of this report, under a quality control program with inspections by Underwriters Laboratories Inc. (AA-668).

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

TABLE 1_ TRILOGY PERFORM WALL PANELS REINFORCING SCHEDULE FOR THE PRESCRIPTIVE DESIGN APPROACH SPECIFIED IN SECTION 2.3.4 OF THIS EVALUATION REPORT 1,2,3,4,5

WALL CONDITION	SEISMIC ZONES	REINFORCING	
		Horizontal	Vertical
Crawl space wall and above-grade wall	0, 1, 2	#3 ea. cell	#3 ea. cell
	3 and 4	#4 ea. cell	#4 ea. cell
Basement wall with height of backfill ?H" > 5' - 0"	All	#4 ea. cell	#4 ea. cell
Crawl space wall and above-grade wall ?H" > 5' - 0"	All	#4 ea. cell	#5 ea. cell

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 psf = 0.048 kN/m2, 1 plf = 14.6 N/m, 1 mph = 1.61 km/h, 1 pcf = 16 kg/m3, 1 psi = 0.0069 MPa, 1 ksi = 6.72 MPa.

1Maximum floor and roof joist spans shown in Figures 4 and 5 are based on total floor load = 55 psf and total roof load = 50 psf. Other loading combinations are allowed with a maximum total superimposed load on the wall equal to 2,500 plf.

2Maximum allowable wind pressure based on 100 mph, Exposure C.

3Equivalent fluid pressure of soil = 62.5 pcf.

4Concrete: fNc = 2,500 psi, minimum. All voids must be filled.

5Reinforcing steel: Fy = 60 ksi. All reinforcing must be centered in the cell and lapped as follows: #4-18 inches, #5-24 inches. Corner bars must be provided with 24-inch legs at every course at all corners and intersections.

TABLE 2—LINTEL REINFORCING SCHEDULE FOR THE PRESCRIPTIVE DESIGN APPROACH SPECIFIED IN SECTION 2.3.4 OF THIS EVALUATION REPORT 1,2

Max. gravity Load Per foot (plf)	OPENING LENGTH IN WALL								
	2'-0"	3'-0"	4'-0"	6'-0"	8'-0"	10'-0"	12'-0"	14'-0"	16'-0"
	Lintel Reinforcing Schedule								
100	# 4	# 4	# 4	# 4	# 4	# 4	2-#5 T&B	2-#5 T&B	2-#5 T&B
200	# 4	# 4	# 4	# 4	# 4	# 4	2-#5 T&B	2-#6 T&B	2-#6 T&B
400	# 4	# 4	# 4	# 4	# 4	# 5	2-#5 T&B	2-#7 T&B	2-#7 T&B
600	# 4	# 4	# 4	# 4	# 4				
800	# 4	# 4	# 4	# 4					
1,000	# 4	# 4	# 4	# 4					
1,200	# 4	# 4	# 4						
1,500	# 4	# 4	# 4						
2,000	# 4	# 4							
2,500	# 4								

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 plf = 14.6 N/m.
1Combinations below the heavy solid line require a minimum of two #3 stirrups every vertical cell, spaced at 4¾ inches on center over the entire
length of the lintel. Combinations above the heavy solid line require a minimum of one #3 stirrup every vertical cell over the entire length of the
lintel.
2Lintel reinforcing shall extend a minimum of 2'-0" past the edge of the opening.
3This reinforcement schedule is based on lintels having a depth such that the distance from the extreme compression fiber to the centroid of the
flexural reinforcement is a minimum of 30 inches.

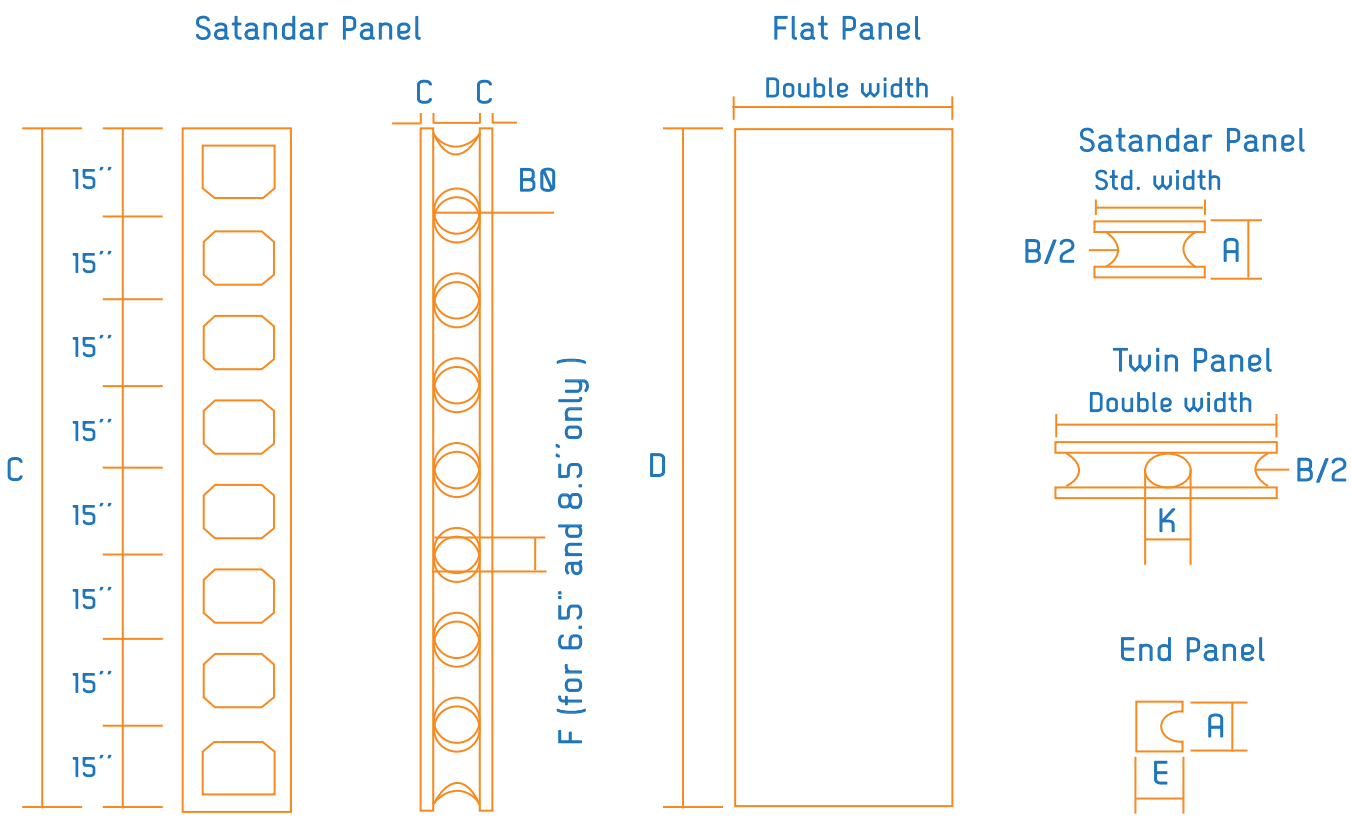
TABLE 3—ALLOWABLE IN-PLANE SHEAR CAPACITY OF TRILOGY PERFORM WALL PANELSSHEAR WALLS FOR THE PRESCRIPTIVE DESIGN APPROACH SPECIFIED IN SECTION 2.3.4 OF THIS EVALUATION REPORT1

WALL LENGTH "L"	ALLOWABLE IN-PLANE SHEAR CAPACITY (plf)
L < 4'-0"	0
4'-0" # L<6'-0"	400
6'-0" # L<8'-0"	600
L $ 8"-0"	800

For SI: 1 foot = 304.8 mm, 1 plf = 14.6 N/m.
1Walls must be reinforced with horizontal and vertical rebar in accordance with Table 1.

TABLE 4 — NAMES AND ADDRESSES OF MANUFACTURING PLANTS

NAME OF MANUFACTURER'S PLANT	ADDRESS OF MANUFACTURER'S PLANT
Materiales de construcción de Mexicali S.A de C.V.	Carr. A San Luis R.C. Km 7 Col. Parcelas Mexicali, B.C. Mexico
ThermoWall PS S.A de C.V.	Prolongacion Oliver Cromwell No. 2780 Parque Industrial Fernandez Cd. Juarez, Chihuahua C.P. 32360 Mexico



DIMENSIONS - ins (mm)							
A	B	C	D	Std. Width	Dbl. Width	E	F
6.5 (165)	3 ½ (89)	1 ½ (38)	105 (2667) OR 120 (3048)	15 (381)	30 (762)	N.A.	5 ¼ (133)
8.5 (216)	5 (127)	1 ¾ (44)					
10 (254)	6 (152)	2 (51)				7 ½ (191)	N.A.
12 (305)	6 (152)	3 (76)					
14 (358)	6 (152)	4 (102)					
12-8 (305)	8 (203)	2 (51)					
14-8 (358)	8 (203)	2 (51)					

VOLUME and WEIGHTS						
Thickness ins (mm)	Length* ins (mm)	Standar Panel cuft (dm^3)			End Panel	Weight Std. Panel lbs (kg) ± 10%
		Outside	Cavity	Net	Net	
6.5 (165)	120 (3048)	6.77 (192)	1.85 (52)	4.92 (139)	N.A.	125 (57)
8.5 (218)	120 (3048)	8.85 (251)	2.87 (81)	5.98 (169)		138 (63)
10 (254)	120 (3048)	10.42 (295)	3.58 (101)	6.84 (194)	4.23 (120)	158 (72)
12 (305)	120 (3048)	12.50 (354)	3.58 (101)	8.92 (253)	5.27 (149)	206 (93)
14 (358)	120 (3048)	14.58 (413)	3.58 (101)	11.01 (312)	6.31 (179)	254 (115)
12-8´ (305)	120 (3048)	12.50 (354)	5.75 (163)	6.75 (191)	4.49 (127)	156 (71)
14-8´´ (356)	120 (3048)	14.58 (413)	5.75 (163)	8.83 (250)	5.53 (157)	204 (93)

* Values in this table can be used in order to determine values for different panel length in order to fit customer needs.
**Panels with 8" cavity.

FLAT PANELS			
Thickness ins (mm)	Width ins (mm)	Length* ins (mm)	Weight Std. Panel lbs (kg) ± 10%
2 (51)	30 (762)	60 (1524) or 120 (3048)	96 (44)
4 (102)			192 (87)
5 (127)			241 (109)

FIGURE 1—CONFIGURATION AND DIMENSIONS OF PERFORM WALL PANELS

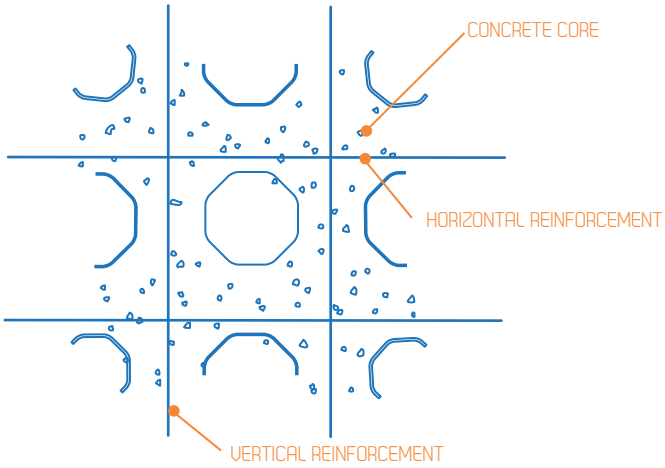
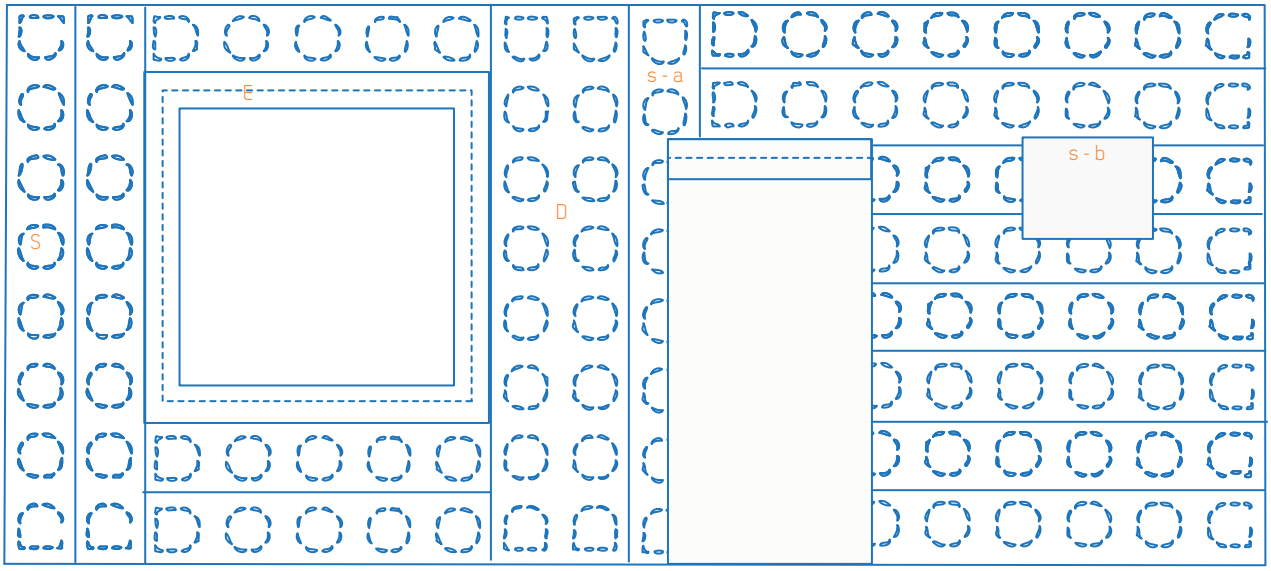


FIGURE 2 - PLACEMENT OF REINFORCEMENT WITHIN THE WALL



S Standar panel
E End panel
D Double panel
S-a Standard panel cut to fit
S-b Smaller openings cut out before concrete is poured

FIGURE 3 - EXAMPLE OF PERFORM WALL PANELS LAYOUT SCHEDULE

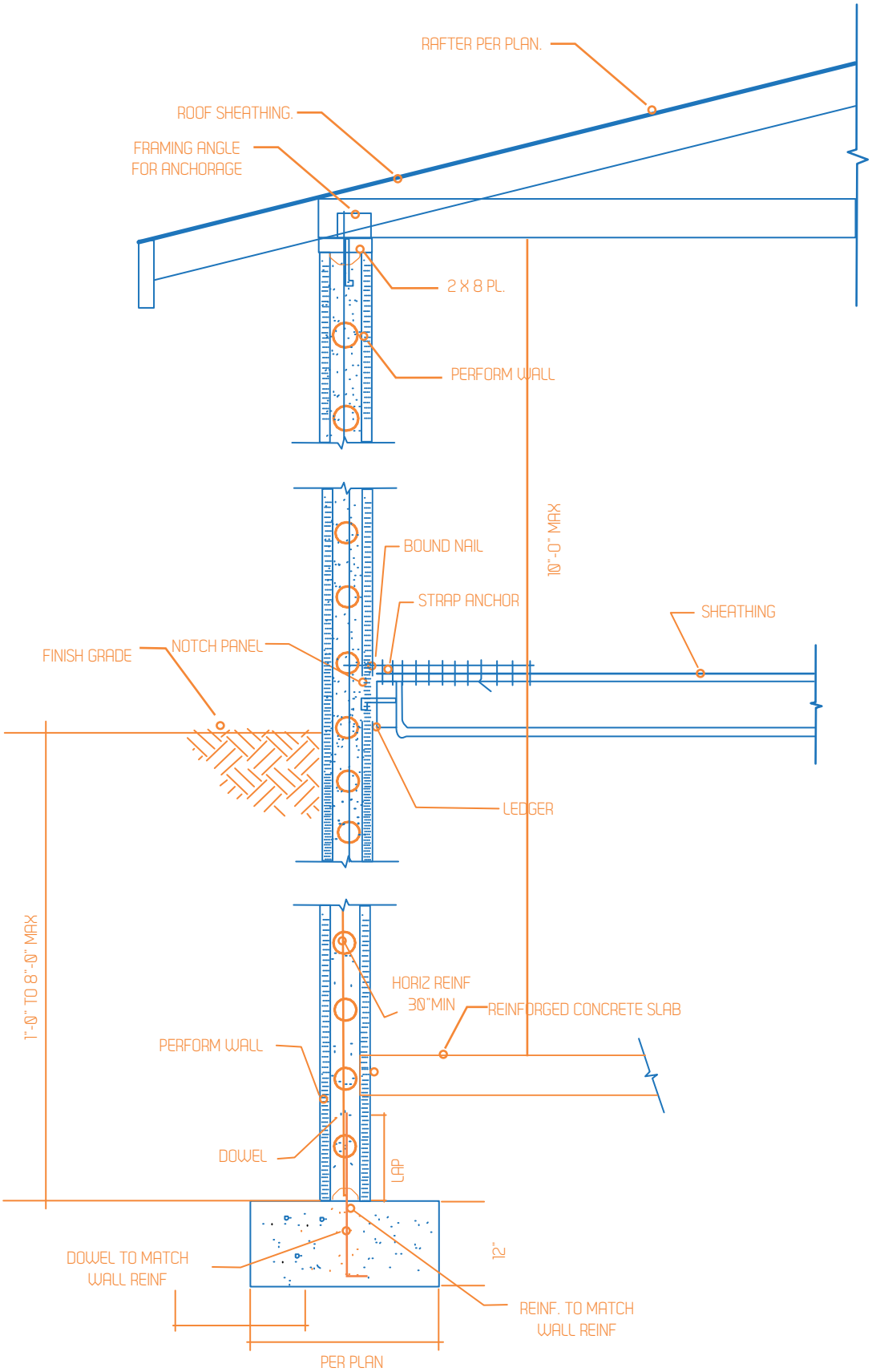


FIGURE 4—TWO-STORY HEIGHT LIMIT DETAIL WHEN USING THE PRESCRIPTIVE DESIGN APPROACH SPECIFIED IN SECTION 2.3.4 OF THIS EVALUATION REPORT

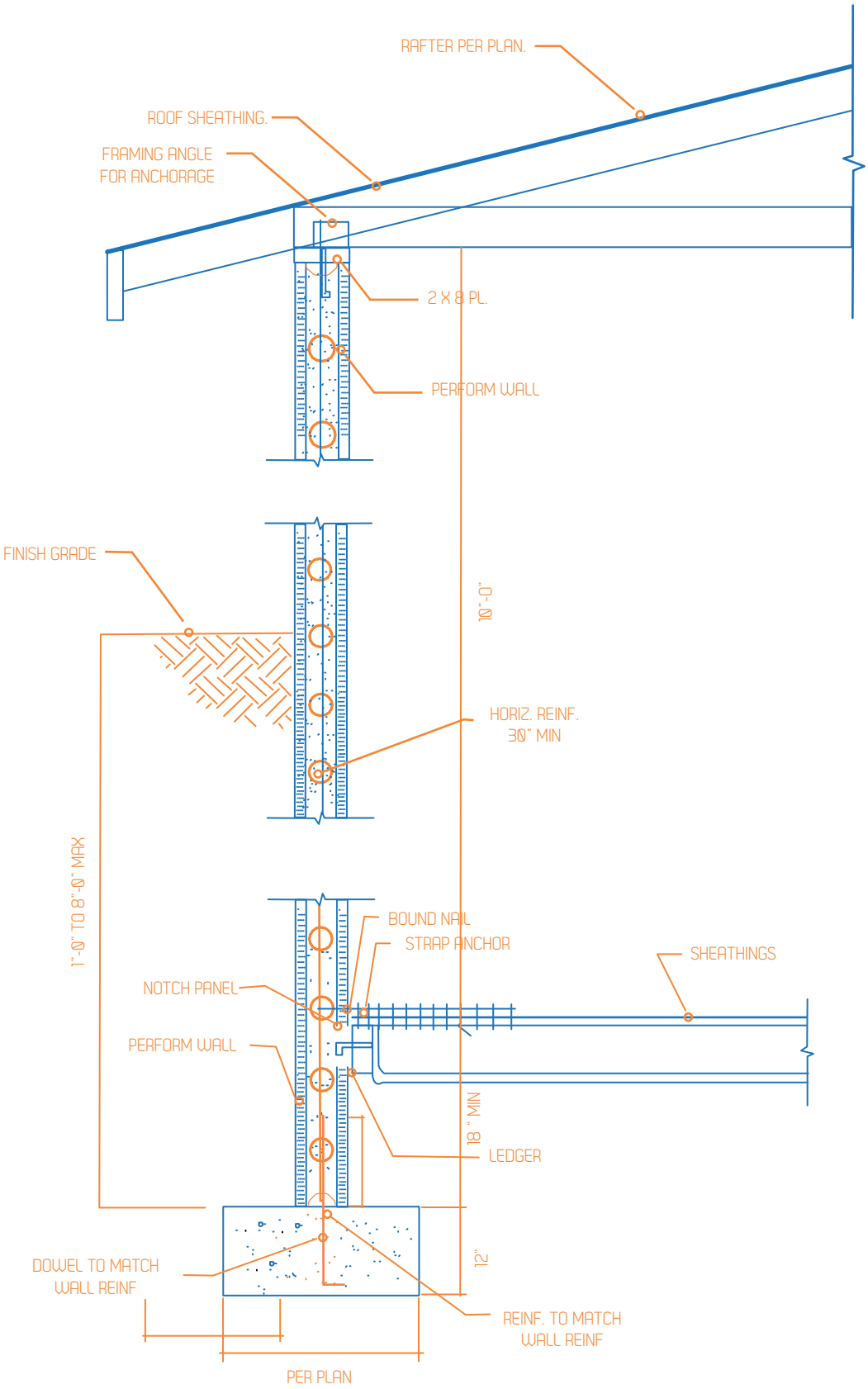


FIGURE 5—TWO-STORY HEIGHT LIMIT DETAIL WHEN USING THE PRESCRIPTIVE DESIGN APPROACH SPECIFIED IN SECTION 2.3.4 OF THIS EVALUATION REPORT