DrJ CERTIFICATION

Technical Evaluation Report™

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Report Number 1905-01

GCT Insulated Concrete Panel Design Properties and Limit States Loads for Use as Floors, Walls, and Roofs Within the Building System in Canada

Gulf Concrete Technology (GCT)

Product:
PSM Series Panels and PSG Series Panels

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Additional Listees:

CSI Designations:

DIVISION: 03 00 00 - CONCRETE
Section: 03 11 00 - Concrete Forming
Section: 03 11 19 - Insulating Concrete Forming
Section: 03 21 00 - Reinforcement Bars
Section: 03 31 16 - Lightweight Structural Concrete
Section: 03 37 00 - Specialty Placed Concrete
DIVISION: 07 00 00 - THERMAL AND MOISTURE PROTECTION
Section: 07 21 00 - Thermal Insulation

1 Innovative Products Evaluated[1]

1.1 PSM Series Panels and PSG Series Panels

2 Applicable Codes and Standards[2]

2.1 *Codes*

2.1.1 *NBC—10, 15, 20: National Building Code of Canada*

2.1.2 *NECB—17, 20: National Energy Code of Canada for Buildings*

2.1.3 *O Reg. 332/12: Ontario Building Code (OBC)*[3]

2.2 *Standards and Referenced Documents*

2.2.1 *ANSI/ASHRAE/IES 90.1: Energy Standard for Buildings Except Low-Rise Residential Buildings*

2.2.2 *ASTM C387: Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar*

2.2.3 *ASTM E72: Standard Test Methods of Conducting Strength Tests of Panels for Building Construction*

2.2.4 *ASTM E90: Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements*

2.2.5 *CSA A23.1: Concrete Materials and Methods of Concrete Construction*

2.2.6 *CSA A23.3: Design of Concrete Structures*

2.2.7 *CAN/ULC-S102: Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies*

2.2.8 *CAN/ULC-S701: Standard for Thermal Insulation, Polystyrene, Boards, and Pipe Covering*

3 Performance Evaluation

3.1 Testing and related engineering evaluations are defined as intellectual property and/or trade secrets.[4]

3.2 GCT floor, wall, and roof insulated concrete panels are composite assemblies used in bearing and non-bearing concrete wall applications and in reinforced concrete floor and roof assemblies.

3.2.1 The assemblies are used in both fire-rated and non-fire-rated construction.

3.3 GCT insulated concrete panels were tested in accordance with ASTM E72 transverse and compressive loading techniques. Wall and roof/floor sections were tested to determine:

3.3.1 Bending stiffness and strength for bending about each axis (strong and weak)

3.3.2 Shear stiffness and strength for bending about each axis

3.3.3 Bearing reaction strength for bending about each axis

3.3.4 Compressive stiffness and strength about the strong axis

3.3.5 Compressive stiffness and strength about the strong axis with window and door openings

3.3.6 Compressive bearing and shear capacity about the strong axis

3.3.7 Compressive bearing and shear capacity about the strong axis with window and door openings

3.4 GCT insulated concrete panels were tested in accordance with ASTM E90 to determine their Sound Transmission Class (STC).

3.5 Engineering evaluations are conducted within DrJ's ANAB accredited ICS code scope, which are also its areas of professional engineering competence.[5]

3.6 Any regulation specific issues not addressed in this section are outside the scope of this report.

4 Product Description and Materials

4.1 The innovative products evaluated in this report is shown in **Figure 1** through **Figure 6**.

4.2 GCT insulated concrete panels are prefabricated lightweight structural elements consisting of an Expanded Polystyrene (EPS) core sandwiched between two layers of galvanized steel welded wire mesh.

4.2.1 A steel wire connector is pierced completely through the EPS core and welded to each of the outer layers of galvanized steel welded wire mesh.

4.2.2 Where needed, deformed steel reinforcement bars are used.

4.2.3 In the field, a high-strength mortar achieving 27.6 MPa (4,000 psi) at 28 days is sprayed onto each side of the panels at the jobsite to create monolithic wall, wall/slab, and wall/roof concrete elements.

4.2.4 Application equipment designed specifically for the application of mortar mixes is highly recommended.

4.3 GCT wall panels designated PSM consist of a single layer of wire mesh on each side of an EPS core varying from 41 mm (1.6") up to 254 mm (10") in thickness. The typical section configuration is shown in **Figure 1**.

4.3.1 A minimum of 19 mm (0.75") of mortar cover is required over the outer face of the wire mesh on each side, resulting in an average of 36 mm (1.4") thick mortar cover on each side of the panel.

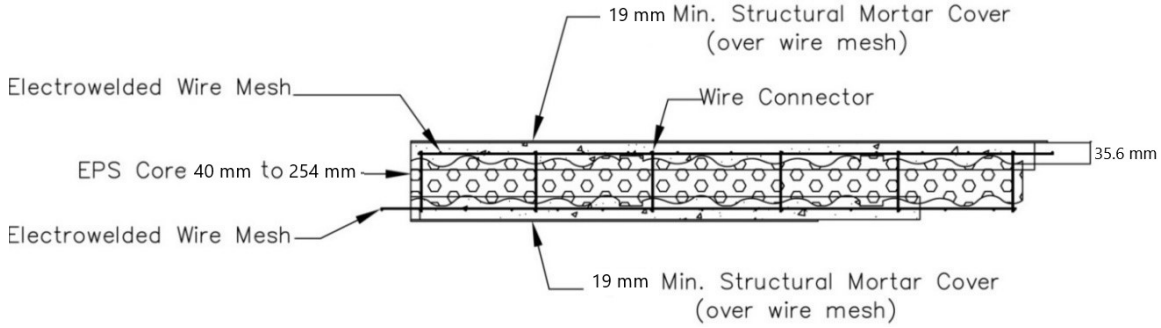


Figure 1. PSM Wall Section

4.4 GCT floor slab or roof panels designated PSM Slab, consists of an EPS core varying from 76 mm (3") up to 254 mm (10") in thickness. The typical section configuration is shown in **Figure 2**.

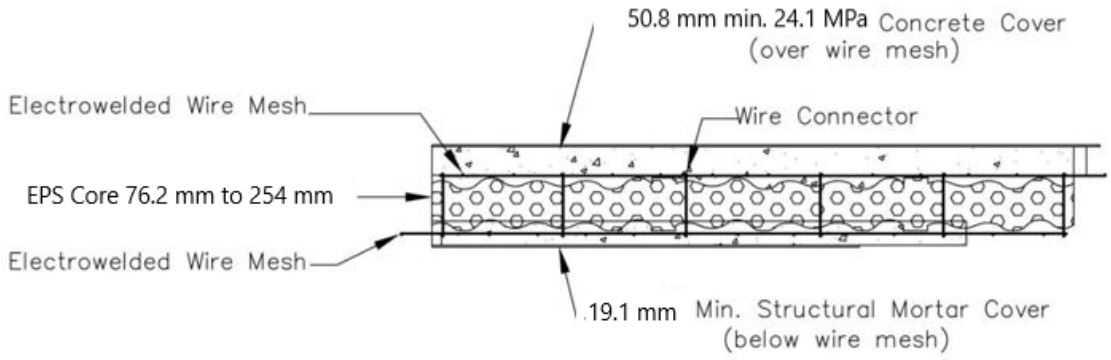


Figure 2. PSM Slab Section

4.4.1 Working as floor slabs or a roof system, the upper side is poured with a concrete layer (25 MPa [3,500 psi]) and will be 61 mm (2.4") thick with at least 51 mm (2") over the wire mesh.

4.4.2 The lower side of the section requires a minimum of 19 mm (0.75") of mortar cover under the outer face of the wire mesh for a total average depth of 36 mm (1.4").

4.5 GCT floor slab or roof panels designated PSG2, consist of EPS cores with voids to form two (2) concrete joists for every 1.2 m (4') of width. A typical section configuration is shown in **Figure 3**.

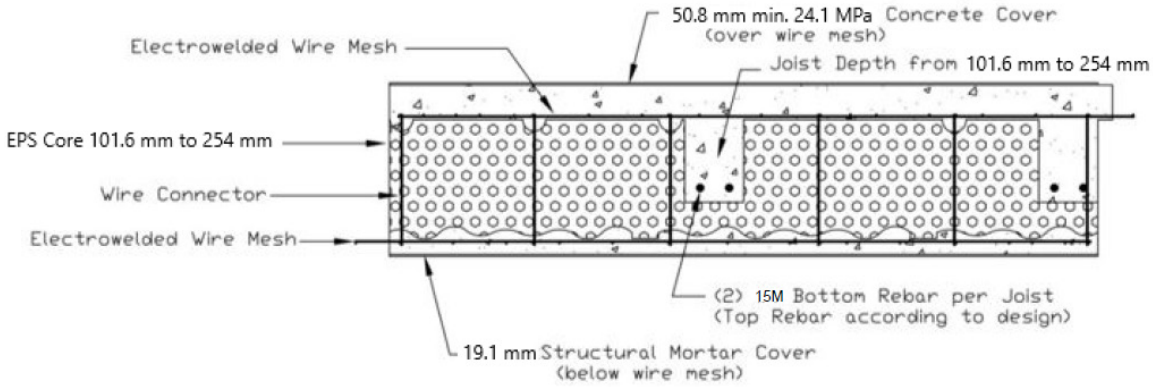


Figure 3. PSG2 Slab Section

4.5.1 According to the structural requirements, the joist depth will vary from 102 mm (4") to 254 (10").

4.5.2 The upper side is poured with a concrete layer (25 MPa [3,500 psi]) and will be 61 mm (2.4") thick with at least 51 mm (2") over the wire mesh.

4.5.3 The lower side of the section requires a minimum of 19 mm (0.75") of mortar cover under the outer face of the wire mesh for a total average depth of 36 mm (1.4").

4.5.4 In addition, a minimum (2) 15M (#4 Imperial) rebar are placed on the tension (lower) side of each concrete joist.

4.5.5 When required by the building design, rebar is placed in the top concrete layer.

4.6 GCT floor slab or roof panels designated PSG3 consist of EPS cores with voids to form three (3) concrete joists for every 1.2 m (4') of width. A typical section configuration is shown in **Figure 4**.

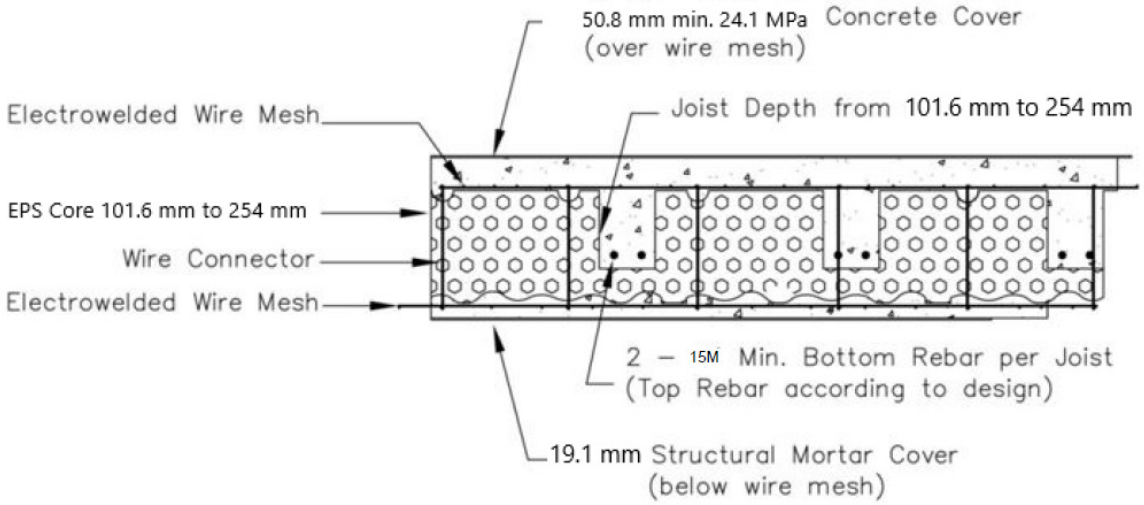


Figure 4. PSG3 Slab Section

4.6.1 The joist depth will vary from 102 mm (4") to 254 mm (10"), according to the requirements.

4.6.2 The upper side is poured with a concrete layer (25 MPa [3,500 psi]) and will be 61 mm (2.4") thick with at least 51 mm (2") over the wire mesh.

4.6.3 The lower side of the section requires a minimum of 19 mm (0.75") of mortar cover under the outer face of the wire mesh for a total average depth of 36 mm (1.4").

4.6.4 In addition, a minimum (2) 15M (#4 Imperial) rebar are placed on the tension (lower) side of each concrete joist.

4.6.5 When required by the building design, rebar is placed in the top concrete layer.

4.7 GCT floor and roof panels designated PSG6 consist of EPS cores with voids to form six (6) concrete joists for every 1.2 m (4') of width. A typical section configuration is shown in **Figure 5**.

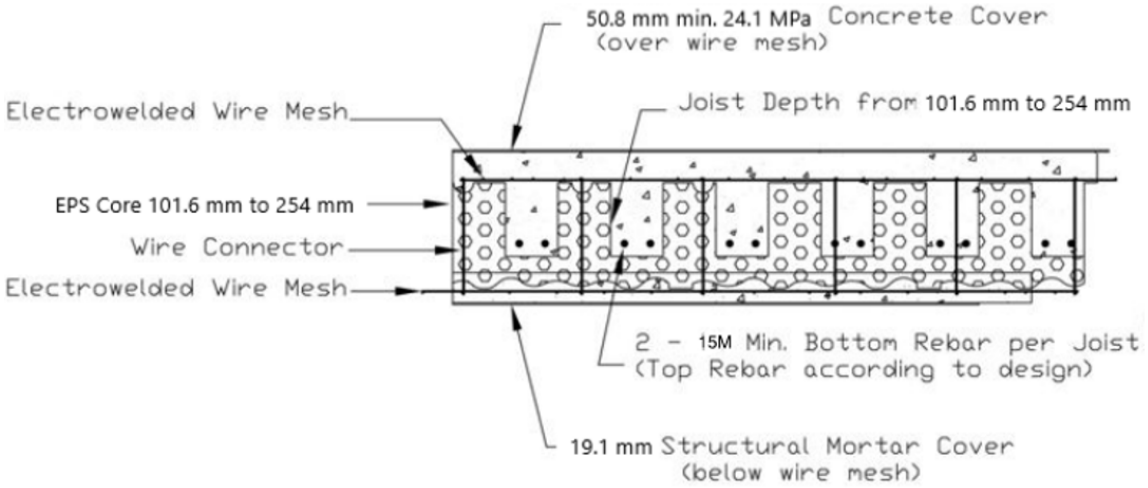


Figure 5. PSG6 Slab Section

4.7.1 According to the requirements, the joist depth will vary from 102 mm (4") to 254 mm (10").

4.7.2 The upper side is poured with a concrete layer (25 MPa [3,500 psi]) and will be 61 mm (2.4") thick with at least 51 mm (2") over the wire mesh.

4.7.3 The lower side of the section requires a minimum of 19 mm (0.75") of mortar cover under the outer face of the wire mesh for a total average depth of 36 mm (1.4").

4.7.4 In addition, a minimum two (2) 15M (#4 Imperial) rebar are placed on the tension (lower) side of each concrete joist.

4.7.5 When required by the building design, rebar is placed in the top concrete layer.

4.8 GCT panels consisting of an EPS core and galvanized wire mesh are prefabricated and delivered to the jobsite where they are installed. The high-strength mortar and concrete are then applied at the jobsite (see **Figure 6**).

Figure 6. Photos of GCT Insulated Concrete Panels

4.9 GCT insulated concrete wall, floor, and roof panels have the thicknesses and self-weights given in **Table 1**, **Table 2**, and **Table 3**.

Table 1. GCT Insulated Concrete Wall Panel Thickness and Self-Weight

GCT Panel Type	Wire-to-Wire Panel Thickness (mm)	Finish Panel Thickness (mm)	Self-Weight (kPa)
PSM60	81	124	1.7
PSM80	102	144	1.7
PSM100	119	163	1.7
PSM120	140	183	1.7
PSM140	159	202	1.7
PSM160	178	221	1.7
PSM190	213	257	1.7
PSM240	265	308	1.7
SI: 25.4 mm = 1 in, 1 MPa = 145 psi			

Table 2. GCT Wire Mesh Accessories Specifications[3]

Wire Mesh Type	Width[1] (mm)	Height[2] (mm)	Weight per Unit (N)	Length (m)	Area (m^2/Unit)
RG2 Flat Mesh	381	-	6.7	1.2	0.47
RG1 Corner Mesh	178	178	6.2	1.2	0.43
RGU U35/40 Mesh	60	178	7.3	1.2	0.51
RGU U75 Mesh	105	178	8.1	1.2	0.56
RGU U80 Mesh	110	178	8.1	1.2	0.57
RGU U100 Mesh	130	178	8.5	1.2	0.59
RGU U120 Mesh	150	178	8.9	1.2	0.62
RGU U140 Mesh	170	178	9.2	1.2	0.64
RGU U160 Mesh	190	178	9.6	1.2	0.67
RGU U190 Mesh	220	178	10.1	1.2	0.70
RGU U240 Mesh	270	178	10.9	1.2	0.76
Splice Mesh	25	-	1.3	0.3	0.01

SI: 25.4 mm = 1 in, 1 N = 0.225 lb

1. Mesh width is measured along thickness of panel.
2. Mesh height is measured along panel length.
3. For more information on how the wire mesh accessories are used, see the manufacturer Technical Manual and Installation Instructions.

Table 3. GCT Insulated Concrete Floor and Roof Panel Thickness and Self Weight

GCT Panel Type	Wire-to-Wire Panel Thickness (mm)	Finish Panel Thickness (mm)	Self-Weight (kPa)
PSM80-Slab	102	175	2.4
PSM100-Slab	119	194	2.4
PSM120-Slab	140	215	2.4
PSM140-Slab	159	234	2.4
PSM160-Slab	178	253	2.4
PSM190-Slab	213	288	2.4
PSM240-Slab	265	343	2.4
PSG2-100	152	222	2.4
PSG2-140	193	263	2.6
PSG2-160	212	282	2.7
PSG2-200	253	323	2.9
PSG2-240	292	362	3.1
PSG3-100	152	222	2.7
PSG3-140	193	263	2.9
PSG3-160	212	282	3.0
PSG3-200	253	323	3.3
PSG3-240	292	362	3.5
PSG6-100	152	222	3.3
PSG6-140	193	263	3.8
PSG6-160	212	282	4.0
PSG6-200	253	323	4.5
PSG6-240	292	362	5.1
PSG6-100R	292	362	3.3
PSG6-140R	292	362	3.8
PSG6-160R	292	362	4.0
PSG6-200R	292	362	4.5
SI: 25.4 mm = 1 in, 1 MPa = 145 psi			

4.10 *Material*

4.10.1 *EPS Core:*

4.10.1.1 The EPS foam core is made up of Type I EPS foam boards conforming to CAN/ULC-S701.

4.10.1.2 The EPS core is molded into proprietary shapes, which vary depending on the intended application (i.e., wall, floor, or roof application).

4.10.1.3 The EPS core thickness varies depending on the application, as described in **Section 4.2** through **Section 4.9**.

4.10.1.4 The EPS core has the following characteristics:

4.10.1.4.1 Minimum Density: 14.4 kg/m3

4.10.1.4.2 Flame Spread Index:[6] 250

4.10.1.4.3 Smoke Developed Index:[7] 490

4.10.2 *Steel Welded Wire Mesh:*

4.10.2.1 The galvanized steel welded wire mesh is made from steel with minimum fracture of 655 MPa (95 ksi), and complies with CSA A23.3 Clause 4.1.3.

4.10.2.2 Longitudinal or principal direction wires are 3 mm (11-gauge) in thickness and have an equivalent spacing of 76 mm (3.0") o.c.

4.10.2.3 Transverse or secondary direction wires are 2 mm (12.5-gauge) in thickness and have a uniform spacing of 66 mm (2.6") o.c.

4.10.2.4 The front and back wire mesh layers are tied together along the longitudinal direction in six (6) rows with 3 mm (11-gauge) wire.

4.10.3 *Other Reinforcement:*

4.10.3.1 Where required, deformed steel reinforcement bars are used, which have a minimum yield stress of 413.7 MPa (60 ksi) and comply with CSA A23.3 Clause 4.1.3.

4.10.4 *Mortar Application:*

4.10.4.1 For application on the GCT insulated concrete panels, Carmelo Structural Mortar Mix 4000 PSI is recommended because it has a compressive strength of 27.6 MPa (4,000 psi).

4.10.4.1.1 Other structural mortar mixes may be used, if they provide strength and stiffness that are at least equivalent to the Carmelo Structural Mortar Mix as described in **Section 4.10.4.4.1.3**.

4.10.4.2 Carmelo Structural Mortar Mix is a single component Portland cement-based plaster containing additives to enhance its bonding strength.

4.10.4.3 The mortar contains micro-spheres with pozzolanic action to make it less permeable, in addition to making it easy to place and finish.

4.10.4.4 Low-pressure mortar application equipment is highly recommended for speed, quality, and consistency.

4.10.4.4.1 The mortar used must have the following characteristics:

4.10.4.4.1.1 Complies with ASTM C387

4.10.4.4.1.2 Complies with freeze-thaw requirements for F-2 exposure, per CSA A23.1 Article 4.1.1.3

4.10.4.4.1.3 Minimum compressive strength of 27.6 MPa (4,000 psi) at 28 days according to ASTM C387

4.10.4.4.1.4 Maximum aggregate size: 5 mm

4.10.4.4.1.5 Aggregate must conform to CSA A23.1 Table 10

4.10.5 *Concrete:*

4.10.5.1 The placed concrete must be a normal weight complying with NBC Division B Subsection 4.3.3 and Article 9.3.1.1 and have the following characteristics:

4.10.5.1.1 Compressive strength: 25 MPa (3,500 psi) minimum at 28 days

4.10.5.1.2 Slump: minimum 51 mm (2")

4.10.5.1.3 Aggregate size: 12.7 ($^1/_2$") maximum

4.11 *Material Properties*

4.11.1 GCT insulated concrete wall and floor panels have the material properties given in **Table 4** and **Table 5**.

Table 4. Material Properties for GCT Insulated Concrete Wall Panels

Panel Type	Gross Section Bending Stiffness, EI [kN-mm²/mm of Panel Width]	Cracked Section Bending Stiffness, EI [kN-mm²/mm of Panel Width]	Cracking Moment, M_{cr} [kN-m/m of Panel Width]	Nominal Flexural Strength, M_n [kN-m/m of Panel Width]	Nominal Shear Strength, V_n (kN/Q) [kN/m of Panel Width]	Axial Stiffness, EA [kN/m of Panel Width]	Nominal Compressive Strength, P_n [kN/m of Panel Width]
PSM60	639,925	52,700	2.2	6.8	60.3	953,071	557.0
PSM80	912,834	75,285	2.7	8.1	60.3	953,071	557.0
PSM100	1,119,868	93,165	3.1	8.9	60.3	953,071	557.0
PSM120	1,449,241	119,515	3.6	10.1	60.3	953,071	557.0
PSM140	1,995,059	164,686	4.5	11.8	60.3	953,071	557.0
PSM160	2,456,181	202,329	5.8	13.0	60.3	953,071	557.0
PSM190	3,171,391	262,557	6.2	14.8	60.3	953,071	557.0
PSM240	4,733,560	390,542	7.6	18.0	60.3	953,071	535.8

SI: 25.4 mm = 1 in, 1 kN/m = 737.6 lb/ft, 1 kN/m² = 20.9 psf

Table 5. Material Properties for GCT Insulated Concrete Floor and Roof Panels

Panel Type	Gross Section Bending Stiffness, EI [kN-mm²/mm of Panel Width]	Cracked Section Bending Stiffness, EI [kN-mm²/mm of Panel Width]	Cracking Moment, M_{cr} [kN-m/m of Panel Width]	Nominal Flexural Strength, M_n [kN-m/m of Panel Width]	Nominal Shear Strength, V_n (kN/Q) [kN/m of Panel Width]
PSM80-Slab	2,578,520	150,570	5.6	10.0	82.3
PSM100-Slab	3,058,463	178,802	6.2	10.9	82.3
PSM120-Slab	3,783,084	225,856	7.1	12.1	82.3
PSM140-Slab	4,940,594	301,141	8.5	13.8	82.3
PSM160-Slab	5,900,481	357,605	10.2	15.0	82.3
PSM190-Slab	7,387,365	451,711	11.1	16.8	82.3
PSM240-Slab	10,746,969	649,335	14.7	20.2	82.3
PSG2-100	5,881,660	1,166,921	10.7	34.4	49.8
PSG2-140	9,627,101	1,919,774	15.1	43.8	54.7
PSG2-160	11,885,658	2,371,485	16.9	48.5	60.4
PSG2-200	17,146,215	3,425,479	20.5	57.9	71.9
PSG2-240	25,145,272	5,025,290	28.9	69.6	86.2
PSG3-100	7,265,026	1,449,241	12.0	44.7	54.5
PSG3-140	12,167,978	2,427,949	17.8	57.5	69.0
PSG3-160	15,132,334	3,020,820	19.6	63.9	76.2
PSG3-200	22,096,220	4,413,598	26.7	76.7	90.7
PSG3-240	32,767,903	6,549,816	35.6	92.8	108.7
PSG6-100	10,850,486	2,164,451	15.6	73.3	88.3
PSG6-140	18,840,133	3,764,262	24.5	96.4	111.8
PSG6-160	23,733,674	4,742,970	27.6	108.0	123.5
PSG6-200	35,346,423	7,057,992	35.6	131.2	146.9
PSG6-240	53,349,007	10,662,273	49.0	160.1	176.2
PSG6-100R	15,066,460	3,011,410	20.0	81.6	88.3
PSG6-140R	22,039,756	4,404,187	24.5	102.4	111.8
PSG6-160R	26,359,247	5,260,557	28.9	112.7	123.5
PSG6-200R	36,729,789	7,340,311	33.4	133.5	146.9

SI: 25.4 mm = 1 in, 1 kN/m = 737.6 lb/ft, 1 kN/m² = 20.9 psf

4.11.2 An effective bending stiffness for calculating deflections of GCT insulated concrete panels can be determined following procedures in CSA A23.3 Article 9.8.2.3.

4.11.3 Additional long-term deflection resulting from creep and shrinkage can be determined by multiplying the immediate deflection due to sustained loads by the factor λΔ (see CSA 23.3 Clause 9.8.2.5):

$$\lambda_{\Delta} = \frac{\xi}{1 + 50\rho'}$$

where:

ξ = Time dependent factor for sustained loads = 2.0 (for 5 years or more)

ρ' = Reinforcement ratio for the compression steel

4.11.4 GCT insulated concrete panels may be cambered to reduce the immediate deflection due to dead load and the long-term deflection due to sustained loads.

5 Applications

5.1 GCT insulated concrete panels have the allowable axial service load capacity, using the controlling design condition of compressive strength or buckling, as shown in **Table 6**.

Table 6. Factored Axial Load (kN/m) for Various Wall Heights[1,2]

GCT Panel Type	Self-Weight (kPa)	Wall Height, m (ft)						
		2.4 (8)	3 (10)	3.7 (12)	4.3 (14)	4.9 (16)	5.5 (18)	6.1 (20)
PSM60	1.7	295	185	130	95	75	60	45
PSM80	1.7	395	270	190	140	105	85	70
PSM100	1.7	395	340	235	175	135	105	85
PSM120	1.7	395	395	310	225	175	135	110
PSM140	1.7	395	395	395	315	240	190	155
PSM160	1.7	395	395	395	390	300	235	190
PSM190	1.7	395	395	395	395	390	310	250
PSM240	1.7	395	395	395	395	395	395	385
Values limited by buckling.								
Values limited by compressive strength.								

SI: 25.4 mm = 1 in, 1 MPa = 145 psi

1. All loads applied to the wall are considered as live load.
2. The capacities in this table are for pure compression only. Bending moments due to eccentric loads are not considered. See interaction diagrams for combined flexure and axial loads.

5.2 GCT insulated concrete wall panels have the allowable transverse service (i.e., wind, soil, pressure etc.) load capacities listed in **Table 7**. The load capacities shown are limited by the controlling design condition of shear strength, bearing strength, bending strength, or deflection at L/240 for walls with brittle finishes.

Table 7. Factored Transverse Load for GCT Insulated Concrete Wall Panels (kPa), for a Wall Deflection Limit of L/240[1,2,3]

GCT Panel Type	Self-Weight (kPa)	Wall Height, m (ft)										
		1.8 (6)	2.4 (8)	3 (10)	3.7 (12)	4.3 (14)	4.9 (16)	5.5 (18)	6.1 (20)	7.3 (24)	8.5 (28)	9.7 (32)
PSM60	1.7	12.5	6.5	3.9	2.6	1.8	1.4	1.0	0.8	0.6	0.3	0.3
PSM80	1.7	15.3	8.4	5.1	3.4	2.4	2.1	1.6	1.2	0.8	0.6	0.3
PSM100	1.7	15.3	10.0	6.0	3.9	2.8	2.1	1.6	1.2	0.8	0.6	0.3
PSM120	1.7	15.3	11.6	7.3	4.8	3.4	2.5	1.9	1.5	1.0	0.7	0.5
PSM140	1.7	15.3	13.5	8.6	6.0	4.3	3.2	2.4	1.9	1.3	0.9	0.6
PSM160	1.7	15.3	14.9	9.6	6.6	4.9	3.7	2.8	2.2	1.5	1.0	0.8
PSM190	1.7	15.3	15.3	10.8	7.5	5.5	4.2	3.3	2.7	1.8	1.3	0.9
PSM240	1.7	15.3	15.3	13.3	9.2	6.8	5.2	4.1	3.3	2.3	1.7	1.3

Values limited by flexural capacity.

Valued limited by deflection limit.

SI: 25.4 mm = 1 in, 1 MPa = 145 psi

1. Factored loads in this table are limited to 15.3 kPa. If greater resistance capacity is needed, please contact GCT for professional engineering assistance.
2. The deflection limit is L/240 for walls with brittle finishes. Other deflection limits can be provided upon request.
3. All loads applied to the wall are considered as live load.
4. Assumes that the panel is oriented with the strong axis in the vertical direction.

5.3 GCT insulated concrete floor and roof panels have the allowable service live load (i.e., bedroom, office, snow load, etc.) capacities listed in **Table 8**. The load capacities shown are limited by the controlling design condition of shear strength, bearing strength, bending strength, or deflection (minimum code requirement for the floor) at L/360 for live load (LL) and L/240 for total load (TL).

Table 8. Factored Live Load for GCT Insulated Concrete Floor Panels

GCT Panel Type	Self-Weight (kPa)	Factored Floor/ Roof Live Load (kPa) for 1 kPa of DL & Floor or Roof Deflection Limits of L/360 for LL & L/240 for TL[1,2]										
		Floor or Roof Span, m (ft)										
		1.8 (6)	2.4 (8)	3 (10)	3.7 (12)	4.3 (14)	4.9 (16)	5.5 (18)	6.1 (20)	7.3 (24)	8.5 (28)	9.7 (32)
PSM80-Slab	2.4	15.3	11.5	7.3	5.1	3.7	--	--	--	--	--	--
PSM100-Slab	2.4	15.3	12.5	8.0	5.5	4.1	--	--	--	--	--	--
PSM120-Slab	2.4	15.3	13.8	8.9	6.1	4.5	3.5	--	--	--	--	--
PSM140-Slab	2.4	15.3	15.3	10.1	7.0	5.1	3.9	--	--	--	--	--
PSM160-Slab	2.4	15.3	15.3	11.0	7.6	5.6	4.3	3.4	--	--	--	--
PSM190-Slab	2.4	15.3	15.3	12.3	8.5	6.3	4.8	3.8	3.1	--	--	--
PSM240-Slab	2.4	15.3	15.3	14.8	10.3	7.5	5.8	4.6	3.7	--	--	--
PSG2-100	2.4	15.3	15.3	15.3	15.3	12.8	9.1	6.5	4.8	--	--	--
PSG2-140	2.6	15.3	15.3	15.3	15.3	15.3	12.5	9.9	7.7	4.6	--	--
PSG2-160	2.7	15.3	15.3	15.3	15.3	15.3	13.8	10.9	8.9	5.6	--	--
PSG2-200	2.9	15.3	15.3	15.3	15.3	15.3	15.3	13.1	10.6	7.3	5.0	--
PSG2-240	3.1	15.3	15.3	15.3	15.3	15.3	15.3	15.3	12.7	8.8	6.5	--
PSG3-100	2.7	15.3	15.3	15.3	15.3	15.3	10.9	7.9	5.9	--	--	--
PSG3-140	2.9	15.3	15.3	15.3	15.3	15.3	15.3	12.6	9.5	5.6	--	--
PSG3-160	3.0	15.3	15.3	15.3	15.3	15.3	15.3	14.4	11.5	6.9	--	--
PSG3-200	3.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	14.0	9.7	6.3	--
PSG3-240	3.5	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	11.8	8.6	6.2
PSG6-100	3.3	15.3	15.3	15.3	15.3	15.3	15.3	11.3	8.4	--	--	--
PSG6-140	3.8	15.3	15.3	15.3	15.3	15.3	15.3	15.3	13.9	8.3	--	--
PSG6-160	4.0	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	10.3	6.6	--
PSG6-200	4.5	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	14.8	9.6	--
PSG6-240	5.1	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	14.0	9.5
PSG6-100R	3.3	15.3	15.3	15.3	15.3	15.3	15.3	15.2	11.4	6.8	--	--
PSG6-140R	3.8	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	9.7	6.2	--
PSG6-160R	4.0	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	11.4	7.3	--
PSG6-200R	4.5	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	9.9	--

Values limited by flexural capacity.

Values limited by deflection limit.

Values limited by shear capacity.

SI: 25.4 mm = 1 in, 1 MPa = 145 psi

1. Factored loads in this table are limited to 15.3 kPa. If greater resistance capacity is needed, please contact GCT for professional engineering assistance.
2. The deflection limit is based on the controlling case of L/240 for the dead load plus live load combination and L/360 for the live load combination per CSA A23.3 Table 9.3. Other deflection limits can be provided upon request.
3. Tabulated allowable live loads are in addition to 1 kPa of dead load and the self-weight of the panels.

5.4 GCT insulated concrete roof panels have the allowable service live load (i.e., snow load) capacities listed in **Table 9**. The load capacities shown are limited by the controlling design condition of shear strength, bearing strength, bending strength, or deflection (minimum code requirement for the roof) at L/240 for LL and L/180 for TL.

Table 9. Factored Live Load for GCT Insulated Concrete Roof Panels

GCT Panel Type	Self-Weight (kPa)	Factored Live Load (kPa) for 1 kPa of DL & Roof Deflection Limits of L/240 for LL & L/180 for TL[1,2]										
		Roof Span, m (ft)										
		1.8 (6)	2.4 (8)	3 (10)	3.7 (12)	4.3 (14)	4.9 (16)	5.5 (18)	6.1 (20)	7.3 (24)	8.5 (28)	9.7 (32)
PSM80-Slab	2.4	15.3	11.5	7.3	5.1	3.7	--	--	--	--	--	--
PSM100-Slab	2.4	15.3	12.5	8.0	5.5	4.1	--	--	--	--	--	--
PSM120-Slab	2.4	15.3	13.8	8.9	6.1	4.5	3.5	--	--	--	--	--
PSM140-Slab	2.4	15.3	15.3	10.1	7.0	5.1	3.9	3.1	--	--	--	--
PSM160-Slab	2.4	15.3	15.3	11.0	7.6	5.6	4.3	3.4	--	--	--	--
PSM190-Slab	2.4	15.3	15.3	12.3	8.5	6.3	4.8	3.8	3.1	--	--	--
PSM240-Slab	2.4	15.3	15.3	14.8	10.3	7.5	5.8	4.6	3.7	--	--	--
PSG2-100	2.4	15.3	15.3	15.3	15.3	12.8	9.8	7.7	5.7	--	--	--
PSG2-140	2.6	15.3	15.3	15.3	15.3	15.3	12.5	9.9	8.0	5.4	--	--
PSG2-160	2.7	15.3	15.3	15.3	15.3	15.3	13.8	10.9	8.9	6.1	--	--
PSG2-200	2.9	15.3	15.3	15.3	15.3	15.3	15.3	13.1	10.6	7.3	5.4	--
PSG2-240	3.1	15.3	15.3	15.3	15.3	15.3	15.3	15.3	12.7	8.8	6.5	5.0
PSG3-100	2.7	15.3	15.3	15.3	15.3	15.3	12.7	9.4	6.9	--	--	--
PSG3-140	2.9	15.3	15.3	15.3	15.3	15.3	15.3	13.0	10.5	6.7	--	--
PSG3-160	3.0	15.3	15.3	15.3	15.3	15.3	15.3	14.4	11.7	8.1	5.2	--
PSG3-200	3.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	14.0	9.7	7.1	--
PSG3-240	3.5	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	11.8	8.6	6.6
PSG6-100	3.3	15.3	15.3	15.3	15.3	15.3	15.3	13.4	10.0	5.9	--	--
PSG6-140	3.8	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	9.9	6.3	--
PSG6-160	4.0	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	12.3	7.9	--
PSG6-200	4.5	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	11.5	7.7
PSG6-240	5.1	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	14.9	11.4
PSG6-100R	3.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	13.6	8.1	--	--
PSG6-140R	3.8	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	11.5	7.4	--
PSG6-160R	4.0	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	13.6	8.7	--
PSG6-200R	4.5	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	11.9	8.0
Values limited by flexural capacity.												
Values limited by deflection limit.												
Values limited by shear capacity.												

Table 9. Factored Live Load for GCT Insulated Concrete Roof Panels

GCT Panel Type	Self-Weight (kPa)	Factored Live Load (kPa) for 1 kPa of DL & Roof Deflection Limits of L/240 for LL & L/180 for TL[1,2]										
		Roof Span, m (ft)										
		1.8 (6)	2.4 (8)	3 (10)	3.7 (12)	4.3 (14)	4.9 (16)	5.5 (18)	6.1 (20)	7.3 (24)	8.5 (28)	9.7 (32)

SI: 25.4 mm = 1 in, 1 MPa = 145 psi

1. Factored loads in this table are limited to 15.3 kPa. If greater resistance capacity is needed, please contact GCT for professional engineering assistance.
2. The deflection limit is based on the controlling case of L/240 for the dead load plus live load combination and L/360 for the live load combination per CSA A23.3 Table 9.3. Other deflection limits can be provided upon request.
3. Tabulated allowable live loads are in addition to 1 kPa of dead load and the self-weight of the panels.

5.5 *Window and Door Headers*

5.5.1 GCT panel headers have the allowable vertical service load capacities listed in **Table 10**.

Table 10. Factored Uniform Load Capacity of GCT Panel Headers (kN/m)[1,2,3]

GCT Panel Type	Header Depth (mm)	Header Span, m (ft)										
		0.6 (2)	0.8 (2.5)	0.9 (3)	1.1 (3.5)	1.2 (4)	1.4 (4.5)	1.5 (5)	1.7 (5.5)	1.8 (6)	2.0 (6.5)	2.1 (7)
PSM	305	130	130	90	65	50	40	30	25	20	20	15
	457	195	195	165	120	95	75	60	50	40	35	30
	610	260	260	260	190	145	115	95	75	65	55	50
	762	325	325	325	275	210	165	135	110	95	80	70
	914	390	390	390	370	280	225	180	150	125	105	90

Values limited by shear at the support.

Values limited by flexural strength.

SI: 25.4 mm = 1 in, 1 MPa = 145 psi

1. In all cases, the minimum header depth shall be at least 12".
2. Assumes that all applied loads are live loads
3. The primary (strong) axis of the panels may be installed in either the vertical or horizontal orientation where the length of the header is 1.2 m (4 ft) or less. For headers greater than 1.2 m (4 ft) in length, panels shall be oriented with the primary axis in the horizontal orientation.

5.5.2 GCT beams have the allowable uniform service load capacities listed in **Table 11**. Beam details are shown in **Figure 7**.

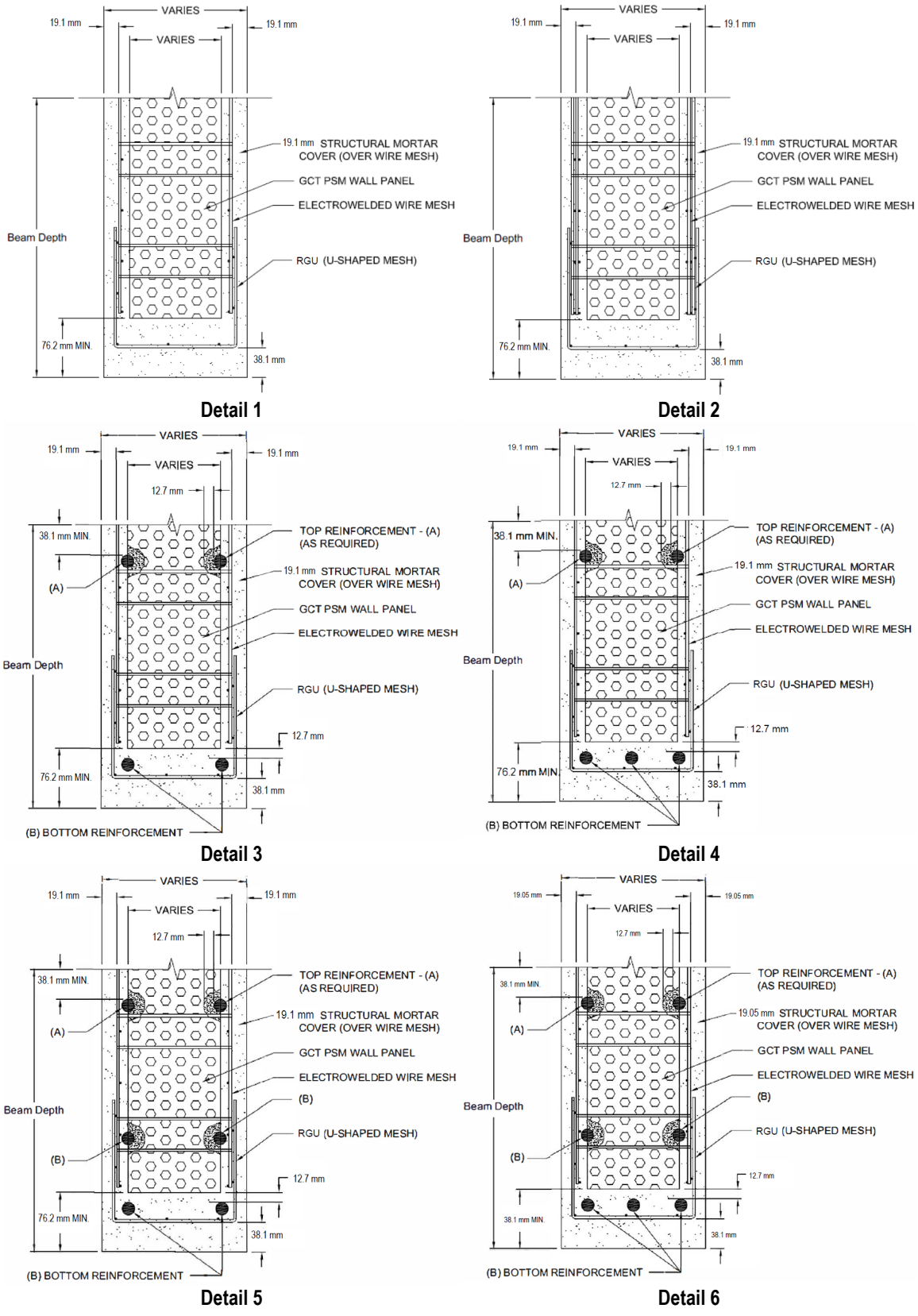


Figure 7. GCT Beam Details 1 through 6

Table 11. Uniform Factored Load Capacity (kN/m) of GCT Beams[1,2,3,4,5]

Beam Detail No.	Bottom Reinforcement	Top Reinforcement	Beam Depth (mm)	Beam Length, m (ft)						
				2.4 (8)	3.0 (10)	3.7 (12)	4.3 (14)	4.9 (16)	5.5 (18)	6.1 (20)
1	PSM Panel without additional reinforcement		305	6.4	4.1	2.9	2.1	1.6	1.3	1.0
			406	11.7	7.5	5.2	3.8	2.9	2.3	1.9
			508	19.1	12.2	8.5	6.2	4.8	3.8	3.1
			610	28.3	18.1	12.6	9.2	7.1	5.6	4.5
			762	45.4	29.1	20.2	14.8	11.4	9.0	7.3
			914	66.3	42.4	29.5	21.6	16.6	13.1	10.6
			1219	97.6	77.5	53.8	39.5	30.3	23.9	19.4
2	PSM Panel with two layers of wire mesh		305	11.6	7.4	5.1	3.8	2.9	2.3	1.9
			406	22.0	14.1	9.8	7.2	5.5	4.3	3.5
			508	35.7	22.9	15.9	11.7	8.9	7.1	5.7
			610	47.0	33.8	23.5	17.2	13.2	10.4	8.4
			762	59.6	47.7	37.9	27.9	21.3	16.9	13.7
			914	72.3	57.9	48.2	40.5	31.0	24.5	19.8
			1219	97.6	78.1	65.1	55.8	48.8	43.4	35.9
3	(2) 15M (#4 Imperial)	N/A	305	21.6	17.3	11.6	7.3	4.9	3.4	2.5
			406	30.1	24.1	20.1	15.1	10.9	7.6	5.6
			508	38.5	30.8	25.7	20.7	15.8	12.5	10.1
			610	47.0	37.6	31.3	26.5	20.3	16.1	13.0
			762	59.6	47.7	39.8	34.1	27.7	21.9	17.7
			914	72.3	57.9	48.2	41.3	35.8	28.3	22.9
			1219	97.6	78.1	65.1	55.8	48.8	42.5	34.4
4	(3) 15M (#4 Imperial)	(2) 15M (#4 Imperial)	305	21.6	17.3	14.4	10.5	7.0	4.9	3.6
		N/A	406	30.1	24.1	20.1	17.2	13.7	9.6	7.0
			508	38.5	30.8	25.7	22.0	19.3	16.8	12.8
			610	47.0	37.6	31.3	26.8	23.5	20.9	17.6
			762	59.6	47.7	39.8	34.1	29.8	26.5	23.6
			914	72.3	57.9	48.2	41.3	36.2	32.1	28.9
			1219	97.6	78.1	65.1	55.8	48.8	43.4	39.1
5	(4) 15M (#4 Imperial)	(2) 15M (#5 Imperial)	305	20.1	16.0	13.4	10.5	7.0	4.9	3.6
		(2) 15M (#4 Imperial)	406	28.5	22.8	19.0	16.3	14.3	11.2	8.2
		N/A	508	36.9	29.6	24.6	21.1	18.5	16.4	13.7
			610	45.4	36.3	30.3	25.9	22.7	20.2	18.2
			762	58.1	46.4	38.7	33.2	29.0	25.8	23.2
			914	70.7	56.6	47.2	40.4	35.4	31.4	28.3
			1219	96.1	76.9	64.0	54.9	48.0	42.7	38.4
6	(5) 15M (#4 Imperial)	(2) 20M (#6 Imperial)	305	20.1	16.0	13.4	11.5	8.3	5.8	4.2
		(2) 15M (#4 Imperial)	406	28.5	22.8	19.0	16.3	14.3	12.1	8.9
		(2) 15M (#4 Imperial)	508	36.9	29.6	24.6	21.1	18.5	16.4	14.8
		N/A	610	45.4	36.3	30.3	25.9	22.7	20.2	18.2
			762	58.1	46.4	38.7	33.2	29.0	25.8	23.2
			914	70.7	56.6	47.2	40.4	35.4	31.4	28.3
			1219	96.1	76.9	64.0	54.9	48.0	42.7	38.4

Table 11. Uniform Factored Load Capacity (kN/m) of GCT Beams[1,2,3,4,5]

Beam Detail No.	Bottom Reinforcement	Top Reinforcement	Beam Depth (mm)	Beam Length, m (ft)						
				2.4 (8)	3.0 (10)	3.7 (12)	4.3 (14)	4.9 (16)	5.5 (18)	6.1 (20)
Values limited by shear at the support.										
Values limited by flexural strength.										
Values limited by deflection.										

SI: 25.4 mm = 1 in, 1 kN/m = 737.6 lb/ft

1. Top and Bottom reinforcement shall have 38.1 mm (1.5 in) of concrete cover from the face of the bars to the exterior of the panel and 12.7 mm (0.5 in) of cover on the interior of the panel.
2. Deflection limit is L/360 for total load. The live load is assumed to be fifty percent (50%) of the total load.
3. Beams with rebar are assumed to be simply supported. Beams without rebar are assumed to have a fixed connection.
4. Design assumes that the panel is oriented with the strong axis in the horizontal direction.
5. The minimum beam depth shall be at least 305 mm (12 in) and shall have at least two longitudinal wires.

5.6 *Shear Walls*

5.6.1 The allowable racking shear (i.e., for lateral shear wall design) service load on GCT panel walls is limited to the capacities shown in **Table 12**.

Table 12. Maximum Factored Racking Shear for GCT Insulated Concrete Panels

GCT Panel Type	Wall Length m (ft)	Wall Height, m (ft)[1]					
		2.4 (8)		2.7 (9)		3.0 (10)	
		Racking Shear (kN/m)	Deflection at Maximum Allowable Shear Load (mm)	Racking Shear (kN/m)	Deflection at Maximum Allowable Shear Load (mm)	Racking Shear (kN/m)	Deflection at Maximum Allowable Shear Load (mm)
PSM	0.30 (1.0)	4.2	13.7	3.6	17.0	3.3	21.1
	0.46 (1.5)	5.5	6.9	5.0	8.6	4.4	10.7
	0.61 (2.0)	7.0	4.6	6.3	5.8	5.6	7.1
	0.76 (2.5)	8.5	3.6	7.6	4.6	6.8	5.6
	0.91 (3.0)	10.0	2.8	8.9	3.6	8.0	4.3
	1.22 (4.0)	12.9	2.0	11.5	2.5	10.4	3.3

SI: 25.4 mm = 1 in, 1 kN/m = 737.6 lb/ft

1. Interpolation between wall heights is permitted.

5.7 GCT Insulated concrete panels have the design interaction diagrams for out-of-plane bending, as shown in **Figure 8**.

5.7.1 The interaction diagrams shown in **Figure 8** are for 305 mm (1') of panel width and account for failure of the panels by concrete crushing. See **Table 6** for the maximum axial load capacities of GCT wall panels that include limits due to buckling.

5.7.2 The moment and axial loads in the interaction diagrams shown in **Figure 8** shall be compared to factored loads in accordance with the load combinations of CSA A23.3 Table C.1a.

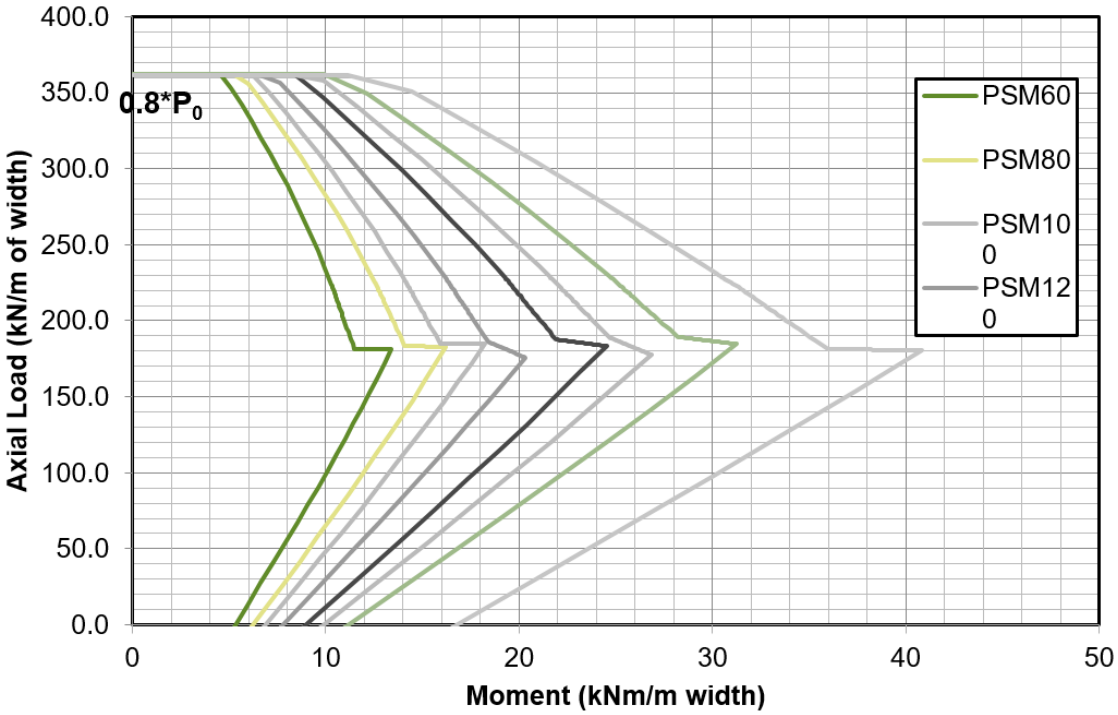


Figure 8. Interaction Diagrams for PSM Wall Panels

5.8 R-values and U-factors assigned to GCT panels, shown in **Table 13**.

Table 13. GCT Panel R-Values & U-Factors[1,2]

GCT Panel Type	R-Value	U-Factor	GCT Panel Type	R-Value	U-Factor	GCT Panel Type	R-Value	U-Factor	GCT Panel Type	R-Value	U-Factor
PSM or PSM-Slab	°F × h × ft²/Btu (°K×m²/W)	Btu/°F × h × ft² (W/°K×m²)	PSG	°F × h × ft²/Btu (°K×m²/W)	Btu/°F × h × ft² (W/°K×m²)	PSG	°F × h × ft²/Btu (°K×m²/W)	Btu/°F × h × ft² (W/°K×m²)	PSG	°F × h × ft²/Btu (°K×m²/W)	Btu/°F × h × ft² (W/°K×m²)
60	9 (1.6)	0.10 (0.63)	PSG2 100	20 (3.52)	0.05 (0.28)	PSG3 200	29 (5.1)	0.03 (0.20)	PSG6 100R	33 (5.8)	0.03 (0.17)
80	12 (2.1)	0.08 (0.47)	PSG2 140	24 (4.23)	0.04 (0.24)	PSG3 240	34 (6.0)	0.03 (0.17)	PSG6 140R	30 (5.3)	0.03 (0.19)
100	14 (2.5)	0.07 (0.41)	PSG2 160	27 (4.76)	0.04 (0.21)	PSG6 100	15 (2.6)	0.07 (0.38)	PSG6 160R	29 (5.1)	0.03 (0.20)
120	17 (3.0)	0.06 (0.33)	PSG2 200	31 (5.46)	0.03 (0.18)	PSG6 140	18 (3.2)	0.06 (0.32)	PSG6 200R	26 (4.6)	0.04 (0.22)
140	20 (3.5)	0.05 (0.28)	PSG2 240	36 (6.34)	0.03 (0.16)	PSG6 160	19 (3.3)	0.05 (0.30)	–	–	–
160	23 (4.1)	0.04 (0.25)	PSG3 100	18 (3.17)	0.05 (0.32)	PSG6 180	21 (3.7)	0.05 (0.27)	–	–	–
190	27 (4.8)	0.04 (0.21)	PSG3 140	23 (4.05)	0.04 (0.25)	PSG6 200	22 (3.9)	0.05 (0.26)	–	–	–
240	34 (6.0)	0.03 (0.17)	PSG3 160	25 (4.40)	0.04 (0.23)	PSG6 240	25 (4.4)	0.04 (0.23)	–	–	–

1. Table values are calculated based on the sum of the R-values of the component parts of the GCT panels and include analysis of the conductance of the ties running through the EPS core.
2. The R-values are calculated based on ANSI/ASHRAE/IES 90.1.

5.9 *Seismic Design*

5.9.1 Structures shall be designed for seismic forces in accordance with NBC Division B Subsection 4.1.8.

5.9.1.1 Seismic design for GCT floor, wall, and roof insulated concrete panels shall not be required in buildings exempt from seismic design in accordance with NBC Division B Subsection 4.1.8.

5.9.2 **Table 14** provides Seismic Design Coefficients (SDC) that conform to the requirements in NBC Division B Subsection 4.1.8 and Table 4.1.8.9 for design of shear walls in buildings that require seismic design in accordance with ASCE 7 (i.e., all seismic design categories).

5.9.2.1 The ductility response modification factor and, R_d, over strength-related force modification factor, R_o, indicated in **Table 14** shall be used to determine the base shear, element design forces, and design story drift in accordance with NBC Division B Subsection 4.1.8.

5.9.3 GCT wall panels used to resist shear forces shall have the following reinforcement provided:

5.9.3.1 GCT wall panels shall be anchored to the foundation/floor slab with a minimum of 457 mm (18") long 15M (#4 Imperial) rebar placed 305 mm (12") o.c., staggered, on each side of the panel, except on panel ends where 2 rebar shall be placed side-by-side (across from each other). The rebar shall be provided with 19 mm (3/4") cover on all sides and shall be placed inside of the wire mesh reinforcement.

5.9.3.2 GCT wall panels shall have angled wire mesh connecting the wall panels to the roof/floor panels. The wire mesh shall be embedded a minimum of 178 mm (7") into the structural mortar cover of each panel and shall be provided on both the top and bottom of the roof/floor panel.

5.9.3.3 The edges of all GCT wall panels shall be provided with U-shaped wire mesh with 152 mm (6") legs and a minimum of 76 mm (3") of structural mortar cover.

5.9.3.4 Where adjoining pieces of angled or U-shaped wire mesh reinforcement are spliced, the pieces shall overlap by a minimum of two wire spaces.

5.9.3.5 A 305 mm x 610 mm (1' x 2') piece of wire mesh installed at a 45° angle shall be provided at the corners of all openings on both sides of the GCT wall panels.

Table 14. Seismic Design Coefficients of GCT PSM Shear Wall Panels[1,2]

Seismic Force-Resisting System	GCT Panel Type	Ductility Factor, Rd[3]	Overstrength Force Modification Factor, R_o	Structural System Limitations & Building Height Limit,[4] m (ft)				
				$I_E F_a S_a(0.2)$				$I_E F_a S_a(1.0)$
				< 0.2	≥ 0.2 to < 0.35	≥ 0.35 to ≤ 0.75	> 0.75	>0.3
Special Reinforced Concrete Shear Walls	PSM	1.5	1.3	NL	NL	40 (130)	30 (100)	30 (100)

SI: 25.4 mm = 1 in

1. Work this table with additional system restrictions in Article 4.1.8.10 of NBC Division B.
2. For combinations of different types of SFRS acting in the same direction in the same storey, R_dR_o shall be taken as the lowest value of R_dR_o corresponding to these systems. See NBC Division B, Article 4.1.8.9.
3. Response modification coefficient, R_d, for use throughout NBC.
4. NL = Not Limited. Heights are maximum height limits above grade, as defined in NBC Division B Table 4.1.8.9.

5.10 *Foam Plastic Insulation*

5.10.1 The EPS core that is integral to GCT panels shall meet the requirements of NBC Division B Articles 3.1.5.15 and 9.10.17.10, as appropriate for this application.

5.10.2 *Thermal Barrier:*

5.10.2.1 An independent thermal barrier in accordance with NBC Division B Articles 3.1.5.15 (OBC Article 3.1.5.12A) and 9.10.17.10 is not required because the EPS core is covered in all cases, by mortar, and is never exposed to the interior of the building.

5.11 *Sound Transmission Class (STC)*

5.11.1 GCT insulated concrete panels were tested in accordance with ASTM E90 to determine their sound transmission class in accordance with NBC Division B Articles 5.8.1.1 and 9.11.1.2.

5.11.1.1 GCT panels with a 191 mm (7.5 in) thick EPS core or greater have a STC rating of 39.

5.12 Where the application falls outside of the performance evaluation, conditions of use and/or installation requirements set forth herein, alternative techniques shall be permitted in accordance with accepted engineering practice and experience. This includes but is not limited to the following areas of engineering: mechanics or materials, structural, building science and fire science.

6 Installation

6.1 Installation shall comply with the manufacturer installation instructions, this report, the approved construction documents and the applicable building code.

6.2 In the event of a conflict between the manufacturer installation instructions this report and the applicable building code, the more restrictive shall govern.

6.3 Installation, support, and structural detailing required for connections will be provided by GCT for each project to assure a proper load path to the foundation.

6.3.1 Example details can be found in **Appendix B**. Miscellaneous Floor Slab, Foundation Wall, Floor, Wall, and Roof Construction Details

6.3.2 Details shall be evaluated by the building designer for applicability to a specific building.

6.3.3 Installation shall be performed in accordance with the manufacturer installation instructions.

6.4 Support for GCT panels (i.e., foundation walls, footings, etc.) must be level and free of dirt and loose material.

6.5 GCT panels shall be installed and aligned in accordance with the plans designed and submitted to the building official per **Section 6**.

6.6 The high-strength mortar complying with **Section 4.10.4** is applied to each face of the GCT wall panels and the underside of floor assemblies covering the welded wire mesh.

6.6.1 Mortar thickness is per the approved plans with a minimum cover of 25.4 mm (1") over the wire mesh.

6.6.2 The tolerance is minus 6.4 mm (1/4").

6.7 The high-strength mortar shall be applied using a low-velocity application process in accordance with the manufacturer installation instructions and this report.

7 Substantiating Data

7.1 Testing has been performed under the supervision of a professional engineer and/or under the requirements of ISO/IEC 17025 as follows:

7.1.1 Material property testing including flexure, shear, and compression (weak axis, strong axis, door, and window) in accordance with ASTM E72

7.1.2 Airborne sound transmission loss testing in accordance with ASTM E90

7.2 Investigation of Wind Projectile Resistance of Emmedue M2 Panels; The Wind Science and Engineering Research Center, Texas Tech University

7.3 Information contained herein is the result of testing and/or data analysis by sources that conform to the evaluation requirements of NBC Volume 1 Relationship of the NBC to Standards Development and Conformity Assessment and/or professional engineering regulations. DrJ relies upon accurate data to perform its ISO/IEC 17065 evaluations.

7.4 Where appropriate, DrJ's analysis is based on provisions that have been codified into law through provincial, territorial, or local adoption of codes and standards. The developers of these codes and standards are responsible for the reliability of published content. DrJ analysis may use code-adopted provisions as a control sample. A control sample versus a test sample establishes a product as being equivalent to that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.

7.5 The accuracy of the provisions provided herein may be reliant upon the published properties of raw materials, which are defined by the grade mark, grade stamp, mill certificate, Listings, certified reports, duly authenticated reports from approved agencies, and research reports prepared by approved agencies and/or approved sources provided by the suppliers of products, materials, designs, assemblies and/or methods of construction. These are presumed to be minimum properties and relied upon to be accurate. The reliability of DrJ's engineering practice, as contained in this report, may be dependent upon published design properties by others.

7.6 Testing and engineering analysis: The strength, rigidity and/or general performance of component parts and/or the integrated structure are determined by suitable tests that simulate the actual conditions of application that occur and/or by accepted engineering practice and experience.

7.7 Where additional condition of use and/or code compliance information is required, please search for PSM Series Panels and PSG Series Panels on the DrJ Certification website.

8 Findings

8.1 As delineated in **Section 3**, PSM Series Panels and PSG Series Panels have performance characteristics that were tested and/or meet pertinent standards and is suitable for use pursuant to its specified purpose.

8.2 When used and installed in accordance with this report and the manufacturer installation instructions, PSM Series Panels and PSG Series Panels shall be approved for the following applications:

8.2.1 Use in bearing and non-bearing concrete wall applications and in reinforced concrete floor and roof assemblies

8.3 Any application specific issues not addressed herein can be engineered by an RDP. Assistance with engineering is available from Gulf Concrete Technology.

8.4 These innovative products have been evaluated in the context of the codes listed in **Section 2** and are compliant with all known provincial, territorial, and local building codes. Where there are known variations in provincial, territorial, or local codes applicable to this report, they are listed here.

8.4.1 No known variations

8.5 NBC Volume 1 Relationship of the NBC to Standards Development and Conformity Assessment:

> **Certification**
>
> Certification is the confirmation by an independent organization that a product, service, or system meets a requirement…Certification bodies publish lists of certified products and companies…Several organizations, including the Canadian Construction Materials Centre (CCMC), offer such evaluation services.
>
> **Evaluation**
>
> An evaluation is a written opinion by an independent professional organization that a product will perform its intended function. An evaluation is very often done to determine the ability of an innovative product, for which no standards exist, to satisfy the intent of the Code requirement...

8.6 ISO/IEC 17065 accredited third-party certification bodies,[8] including but not limited to, Standards Council of Canada (SCC)[9] and ANSI National Accreditation Board (ANAB),[10] confirm that product certification bodies have the expertise to provide technical evaluation services within their scope of accreditation. All SCC and ANAB product certification bodies meet NBC requirements to offer evaluation services for alternative solutions.[11]

8.6.1 DrJ is an ISO/IEC 17065 ANAB-Accredited Product Certification Body – Accreditation #1131[12] and employs professional engineers.[13]

8.7 Through ANAB accreditation and the IAF Multilateral Agreements, this report can be used to obtain product approval in any jurisdiction or country that has IAF MLA Members & Signatories to meet the Purpose of the MLA – "*certified once, accepted everywhere*." IAF specifically says, "*Once an accreditation body is a signatory of the IAF MLA, it is required to recognise certificates and validation and verification statements issued by conformity assessment bodies accredited by all other signatories of the IAF MLA, with the appropriate scope*."[14]

8.8 Product certification organizations, accredited by the SCC and ANAB, are defined as equivalent evaluation services:

8.8.1 Canada-United States-Mexico Agreement (CUSMA), Article 11.6 Conformity Assessment confirms mutual recognition by stating, "*...each Party shall accord to conformity assessment bodies located in the territory of another Party treatment no less favorable than that it accords to conformity assessment bodies located in its own territory or in the territory of the other Party*."

8.8.2 The SCC National Conformity Assessment Principles states, "*SCC is a member of a number of international organizations developing voluntary conformity assessment agreements that help ensure the international acceptance of Canadian conformity assessment results. Signatories to these agreements (like SCC) recognize each other's accreditations as being equivalent to their own*."[15]

8.9 Building official approval of a licensed professional engineer is performed by verifying the professional engineer and/or their business entity are listed by the engineering regulators of the relevant jurisdiction.

9 Conditions of Use

9.1 Material properties shall not fall outside the boundaries defined in **Section 3**.

9.2 As defined in **Section 3**, where material and/or engineering mechanics properties are created for load resisting design purposes, the resistance to the applied load shall not exceed the ability of the defined properties to resist those loads using the principles of accepted engineering practice.

9.3 Except as noted in **Section 4.3**, the products listed in **Section 1.1** shall be used in accordance with this section.

9.4 GCT insulated concrete panels as described in this report are subject to the following conditions:

9.4.1 This report, when required by the authority having jurisdiction, shall be submitted at the time of permit application.

9.4.2 Design drawings and calculations shall follow the requirements of this report and be submitted to the building official for approval.

9.4.3 Where required by the statutes of the jurisdiction where the building is to be constructed, the design drawings shall be prepared by the Registered Design Professional (RDP) for the Building licensed in the jurisdiction.

9.5 Evaluation of waterproofing materials is outside the scope of this report.

9.5.1 The soil capacity of the building site must be consistent with the requirements of the applicable code.

9.5.1.1 For use in residential construction, the soil capacity of the site may be assumed to have the load-bearing capacities specified in NBC Division B Part 9 Table 9.4.4.1.

9.5.1.2 In this case, a separate geotechnical evaluation is not required.

9.6 The installation shall comply with this report, the manufacturer installation instructions and the applicable code.

9.7 GCT foundation panels must be designed, manufactured, identified, and installed in accordance with this report.

9.7.1 Each installation shall provide GCT with quality control specimens for testing to confirm fundamental design properties of the mortar and the panels.

9.7.2 Each installation shall provide verification that the GCT panels were installed in accordance with the GCT installation instructions and connection details.

9.8 GCT insulated concrete panels are limited to Combustible Construction applications as prescribed by NBC Division B Subsection 3.1.4.

9.9 GCT Insulated concrete panels shall not be used for garage floors, or other corrosive environments, without adequate protection in accordance with the NBC.

9.10 Design loads shall be determined in accordance with the building code adopted by the jurisdiction in which the project is to be constructed and/or by the designer (i.e., owner).

9.11 At a minimum, these innovative products shall be installed per **Section 6** of this report.

9.12 Where required by regulation and enforced by the building official, also known as the authority having jurisdiction (AHJ) in which the project is to be constructed:

9.12.1 Any calculations incorporated into the construction documents shall conform to accepted engineering practice, and, when prepared by an approved source, shall be approved when signed and sealed.

9.12.2 This report and the installation instructions shall be submitted at the time of permit application.

9.12.3 These innovative products have an internal quality control program and a third-party quality assurance program.

9.12.4 At a minimum, these innovative products shall be installed per **Section 6** of this report.

9.12.5 This report shall be reviewed for code compliance by the AHJ in concert with the duties and powers granted to the building official by the provincial regulations governing such duties and powers.

9.12.6 The application of these innovative products in the context of this report are dependent on the accuracy of the construction documents, implementation of installation instructions, inspections, and any other regulatory requirements that may apply.

9.13 Design loads shall be determined in accordance with the building code adopted by the jurisdiction in which the project is to be constructed and/or by the designer (i.e., owner).

9.14 The actual design, suitability, and use of this report, for any particular building, is the responsibility of the owner or the authorized agent of the owner.

10 Identification

10.1 The innovative products listed in **Section 1.1** are identified by a label on the board or packaging material bearing the manufacturer name, product name, report number, and other information to confirm code compliance.

10.2 Additional technical information can be found at www.structuralpanelsgct.com.

11 Review Schedule

11.1 This report is subject to periodic review and revision. For the most recent version, visit drjcertification.org.

11.2 For information on the status of this report, contact DrJ Certification.

12 Legislation that Authorizes New Product Approval in International Markets is Found in Appendix A

12.1 PSM Series Panels and PSG Series Panels have been tested by an ISO/IEC 17025 accredited laboratory and/or evaluated to be in conformance with accepted engineering practice to ensure durable, livable and safe construction.

12.2 This report is published by an ISO/IEC 17065 accredited certification body with the expertise to evaluate products, materials, designs, services, assemblies and/or methods of construction.

12.3 This report meets the legislative intent and definition of a duly authenticated report, which shall be accepted by the AHJ, unless there are specific reasons why the alternative shall not be approved as provided for in writing.

Appendix A

1 Legislation that Authorizes New Product Approval in Canada

1.1 The Competition Act is a Canadian federal law governing competition law in Canada. The Act contains both criminal and civil provisions aimed at preventing anti-competitive practices in the marketplace. The Act is enforced and administered by the Competition Bureau, whose regulations encourage the approval of NBC referenced and alternative products, materials, designs, services, assemblies and/or methods of construction that:

1.1.1 Advance Innovation,

1.1.2 Promote competition so all businesses have the opportunity to compete on price and quality in an open market on a level playing field unhampered by anticompetitive constraints, and

1.1.3 Benefit consumers through lower prices, better quality, and greater choice.

1.2 **Approved by International Jurisdictions**: The USMCA and GATT agreements provide for approval of innovative materials, products, designs, services, assemblies and/or methods of construction through the Technical Barriers to Trade (TBT) agreements and the International Accreditation Forum (IAF) Multilateral Recognition Arrangement (MLA), where these agreements proclaim the desire of both countries to have their markets open to innovation.

1.3 These agreements:

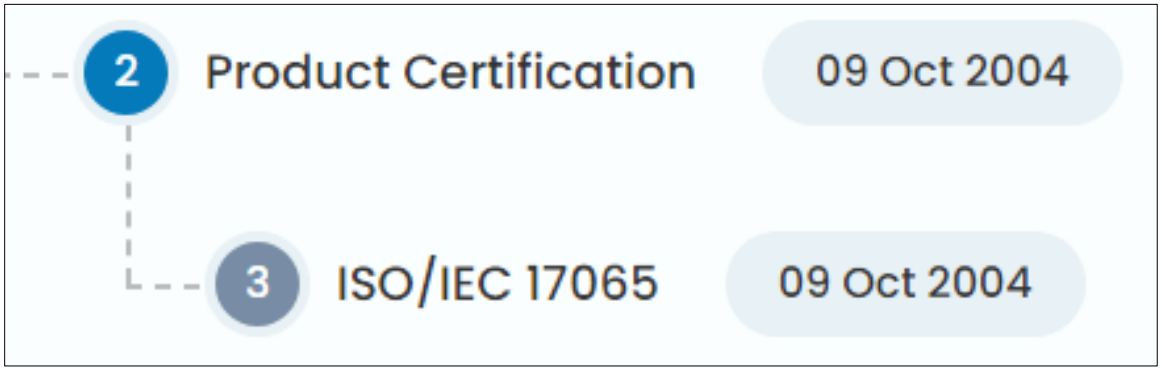
1.3.1 Permit participation of conformity assessment bodies located in the territories of other Members (defined as GATT Countries) under conditions no less favourable than those accorded to bodies located within their territory or the territory of any other country,

1.3.2 State that conformity assessment procedures (i.e., ISO/IEC 17020, 17025, 17065, etc.) are prepared, adopted, and applied so as to grant access for suppliers of like products originating in the territories of other Members under conditions no less favourable than those accorded to suppliers of like products of national origin or originating in any other country, in a comparable situation.

1.3.3 State that conformity assessment procedures are not prepared, adopted, or applied with a view to or with the effect of creating unnecessary obstacles to international trade. This means that conformity assessment procedures shall not be more strict or be applied more strictly than is necessary to give the importing Member adequate confidence that products conform to the applicable technical regulations or standards.

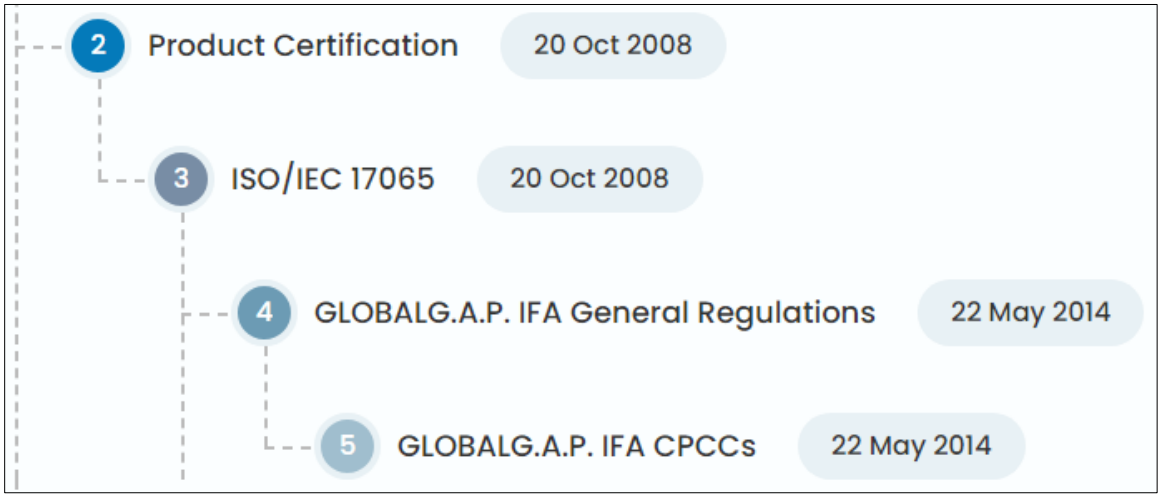
1.4 To this end, Canada operates an accreditation system as follows:

1.5 This includes ISO/IEC 17065 product certification as follows:

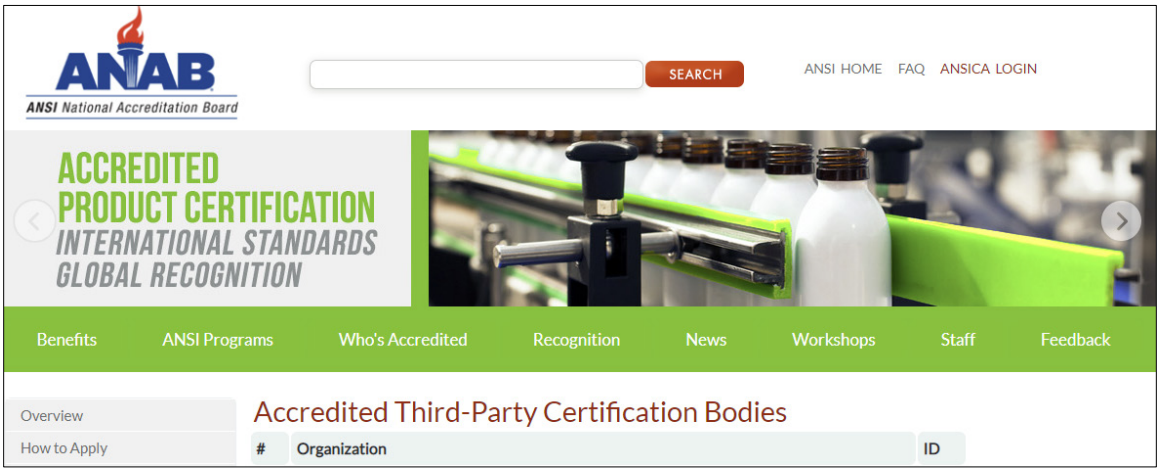


1.6 Similarly, the United States operates multiple accreditation processes with ANAB being the most prominent ISO/IEC 17065 product certification organization as follows:

1.7 This includes ISO/IEC 17065 product certification as follows:



1.8 The list of ANAB accredited ISO/IEC 17065 product certification organizations can be found at the following link: https://anabpd.ansi.org/Accreditation/product-certification/DirectoryListingAccredited?menuID=1&prgID=1



1.9 Approval is granted via International Agreement, where the purpose of the IAF MLA is to ensure mutual recognition of accredited certification and validation/verification statements between signatories. Subsequent acceptance of accredited certification and validation/verification statements is required so that one accreditation can be used for the timely approval of innovative materials, products, designs, services, assemblies and/or methods of construction. Accreditations granted by IAF MLA signatories are recognised worldwide based on their equivalent accreditation programs, therefore reducing costs and adding value to businesses and consumers.

1.10 Consequently, and as one example, these agreements permit product approval of innovative Australian and New Zealand products into US markets and vice-versa.

1.11 Finally, questions that often arises are, *"Why do these agreements exist?"* and *"Why is the ISO/IEC 17065 accredited third-party certification process so important?"*

1.11.1 The answer is that all countries desire to protect the intellectual property and trade secrets of their country's businesses.

1.11.2 In the US this protection is provided by 18 U.S. Code § 1831 Under Economic Espionage, where it states *"whoever, intending or knowing that the offense will benefit any foreign government, foreign instrumentality, or foreign agent, knowingly steals, or without authorization appropriates, takes, carries away, or conceals, or by fraud, artifice, or deception obtains a trade secret shall be fined not more than $5,000,000 or imprisoned not more than 15 years, or both."*

1.11.3 Any organization that commits any offense described shall be fined not more than the greater of $10,000,000 or three (3) times the value of the stolen trade secret to the organization, including expenses for research and design and other costs of reproducing the trade secret that the organization has thereby avoided.[16]

1.11.4 Protection of intellectual property and trade secrets reinforces the value of the IAF MLA, the GATT/TBT and the ISO/IEC 17065 product approval process.

1.11.5 The goal is to protect everyone's best interests while also facilitating economic freedom and opportunity by promoting free and fair competition in the marketplace.

Appendix B.
Miscellaneous Floor Slab, Foundation Wall, Floor, Wall, and Roof Construction Details

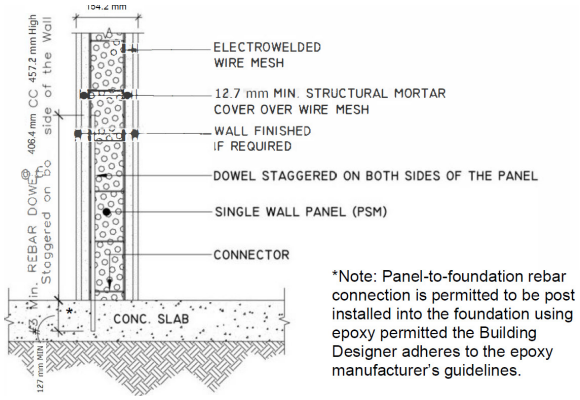


Figure B-9. Example of a GCT Panel Connection to Interior Slab on Grade

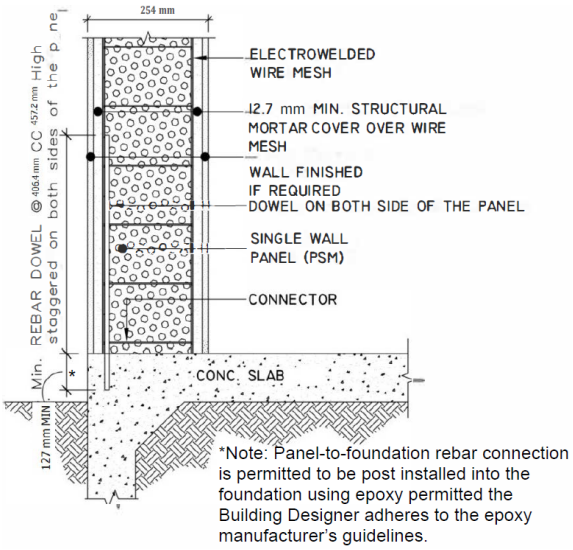


Figure B-10. Example of GCT Panel Connection at Exterior Turned Down Slab Footing

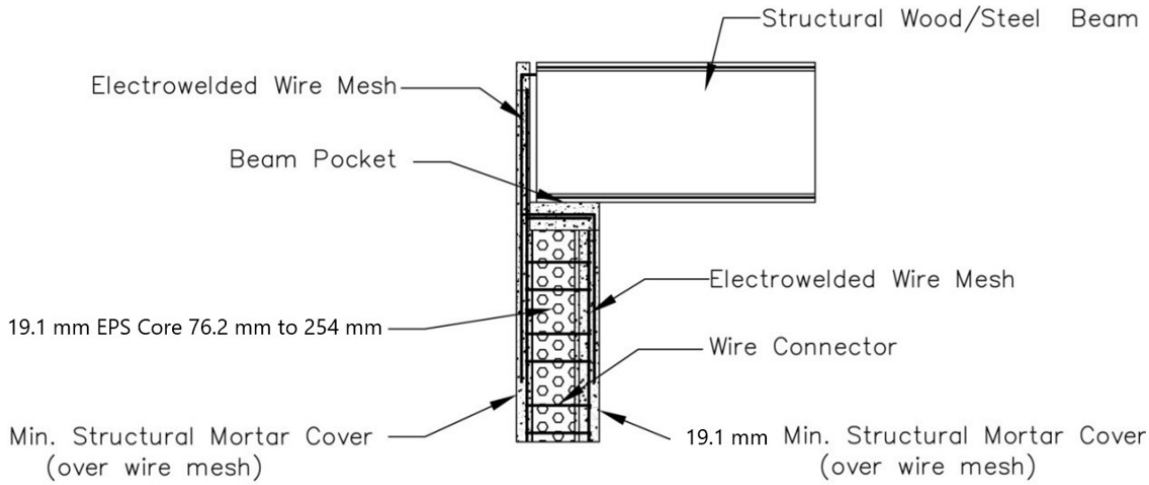


Figure B-11. PSM Wall Section with Beam Pocket

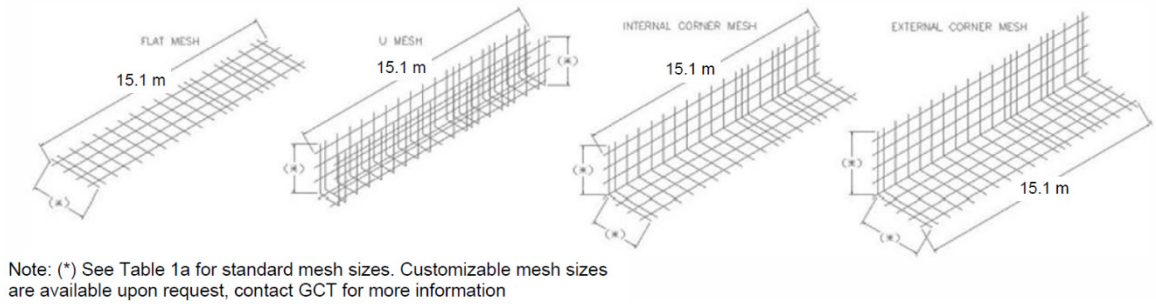


Figure B-12. Panel-to-Panel Connection/Joint

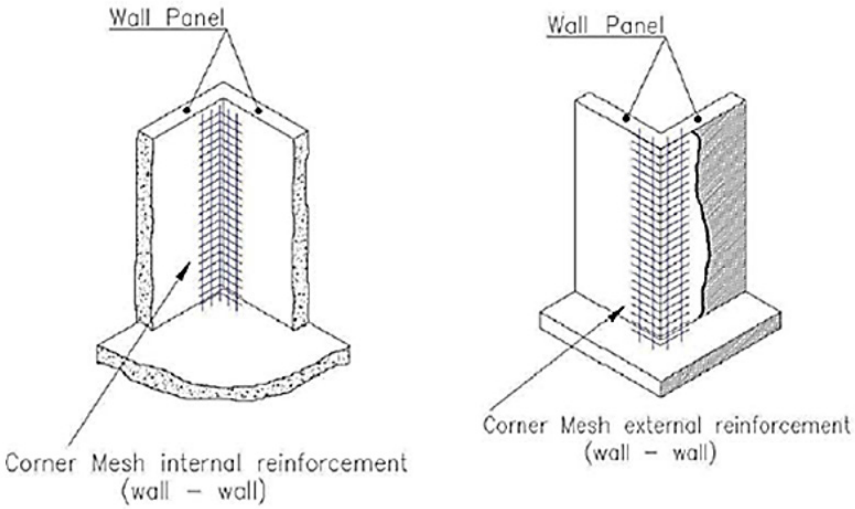
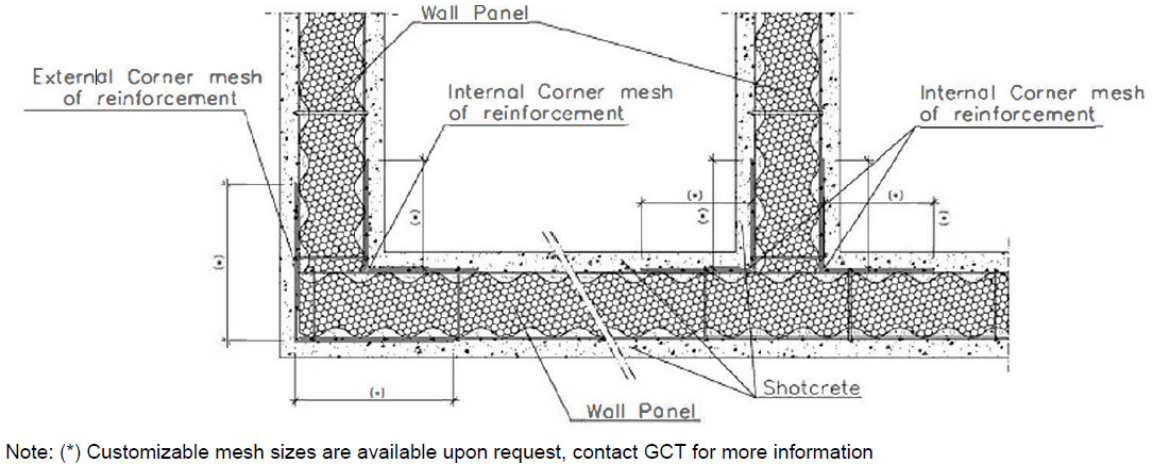


Figure B-13. Typical Types of Mesh Used for Reinforcement/Connection



Note: (*) Customizable mesh sizes are available upon request, contact GCT for more information

Figure B-14. Internal Corner Mesh Reinforcement

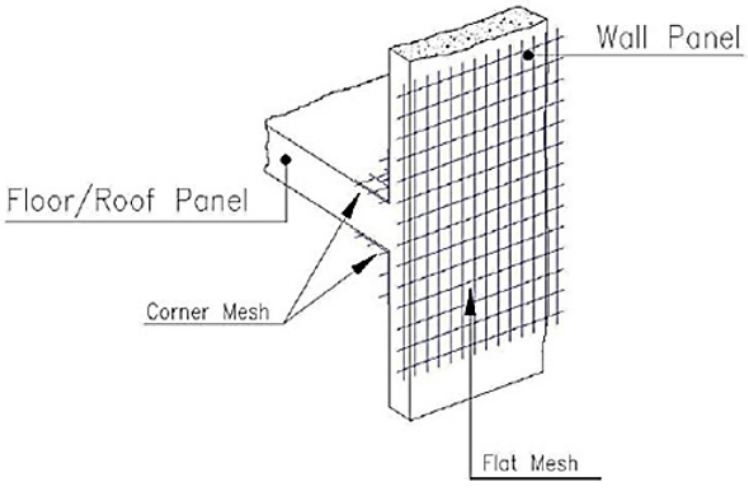


Figure B-15. Exterior Panel to Floor/Roof Panel Connection

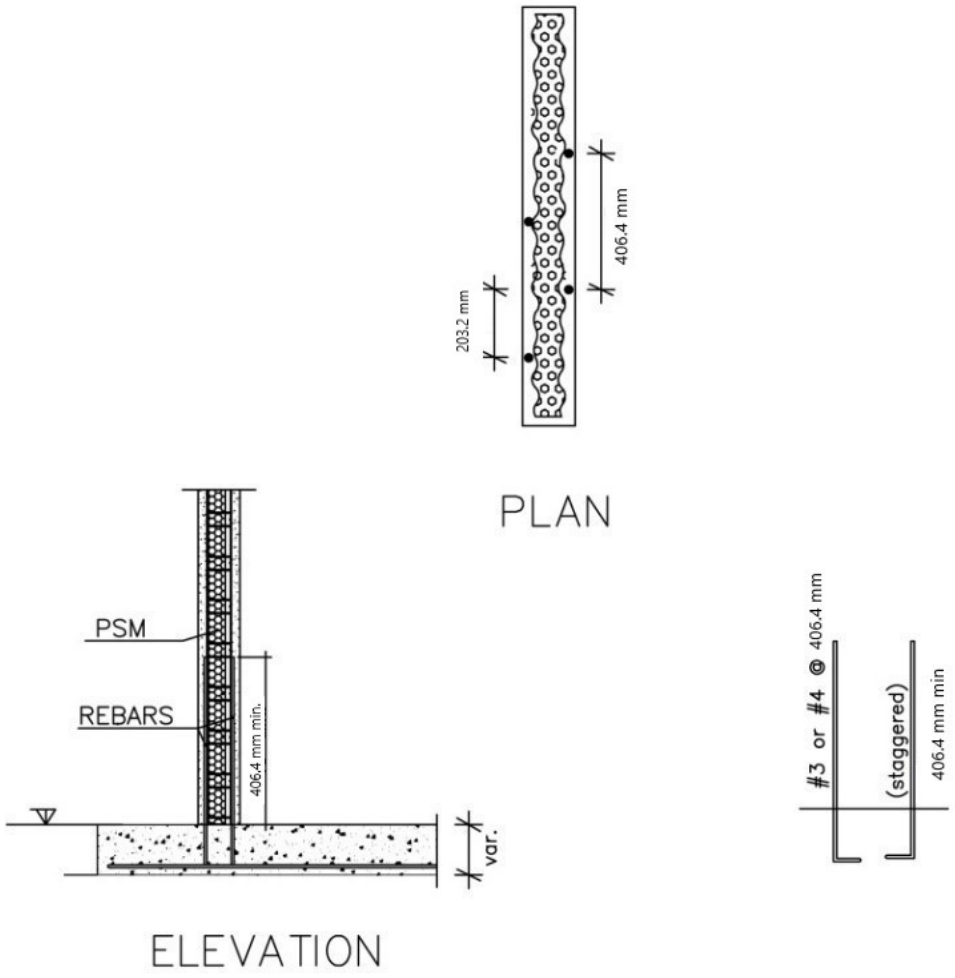


Figure B-16. Foundation Anchoring to PSM Wall

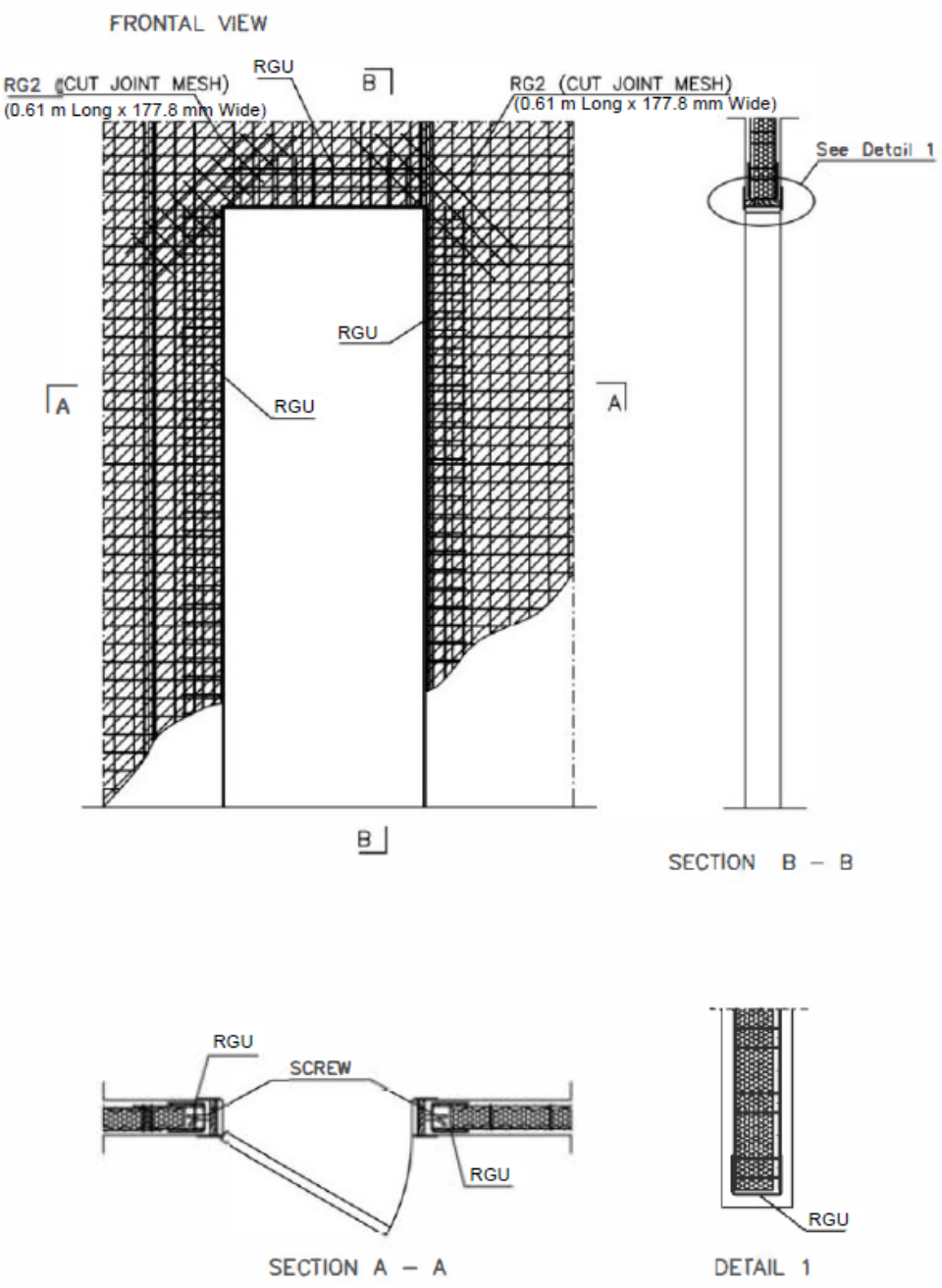


Figure B-17. Opening Reinforcement for a PSM Wall

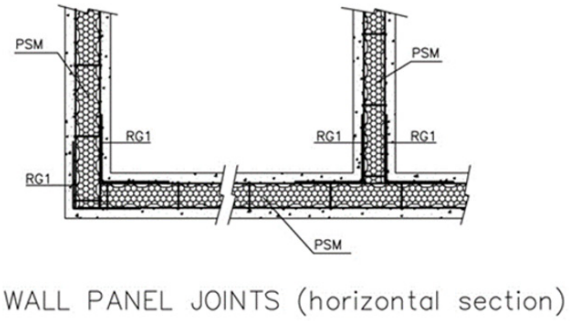


Figure B-18. Wall Single PSM Panel Connection

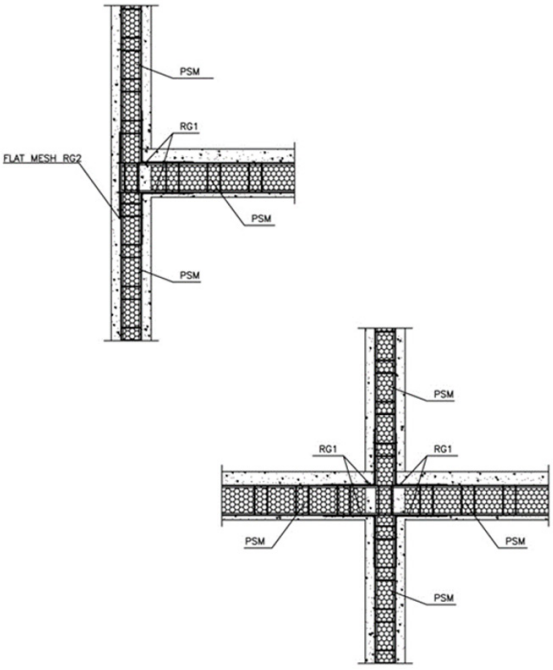


Figure B-19. PSM Slab to PSM Wall Connection - Plan View

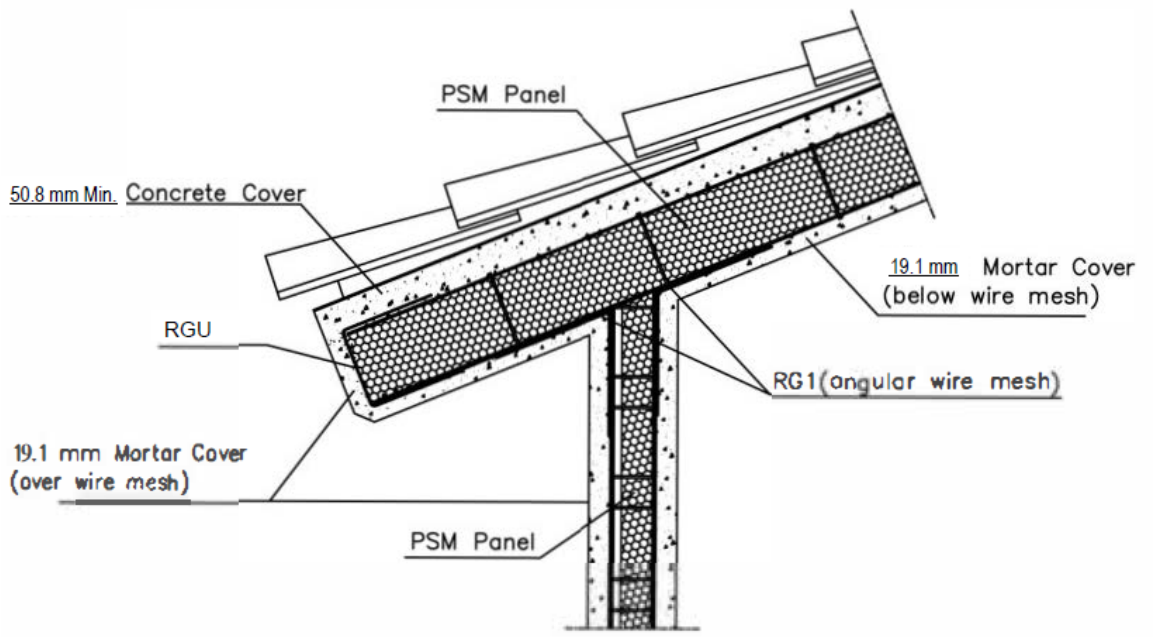
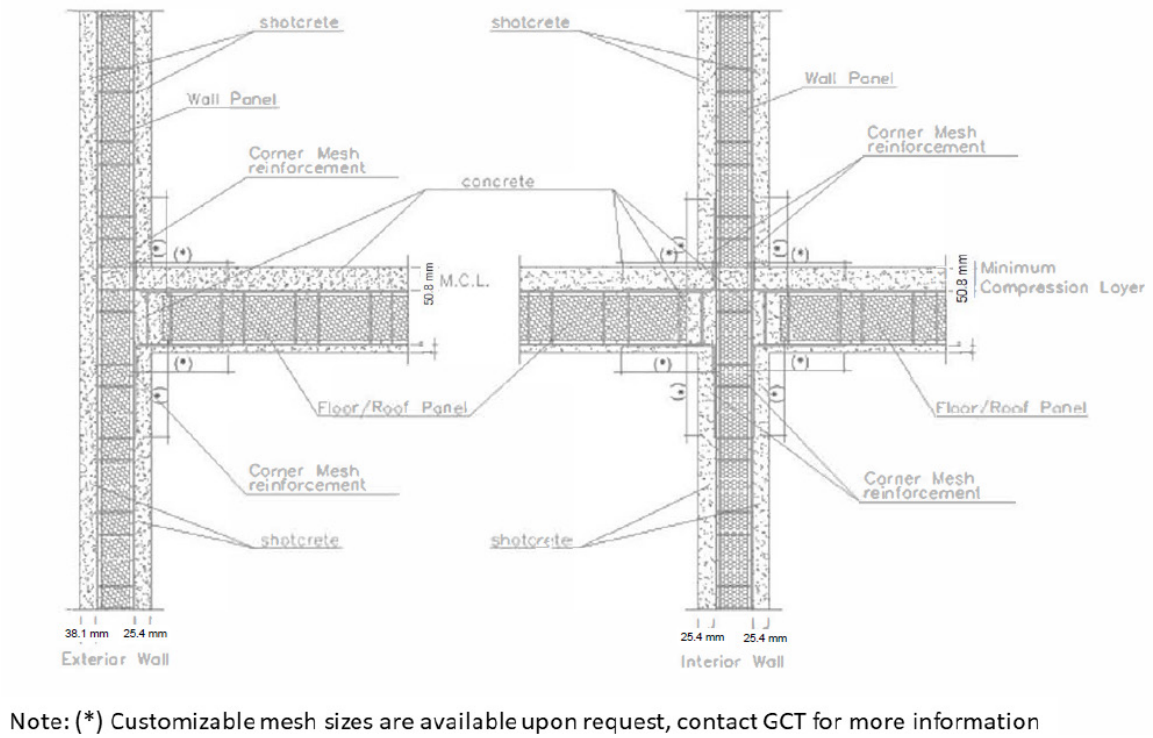


Figure B-20. PSM Wall to PSM Roof Connection



Note: (*) Customizable mesh sizes are available upon request, contact GCT for more information

Figure B-21. Wall Panel to Floor/Roof Panel Connection

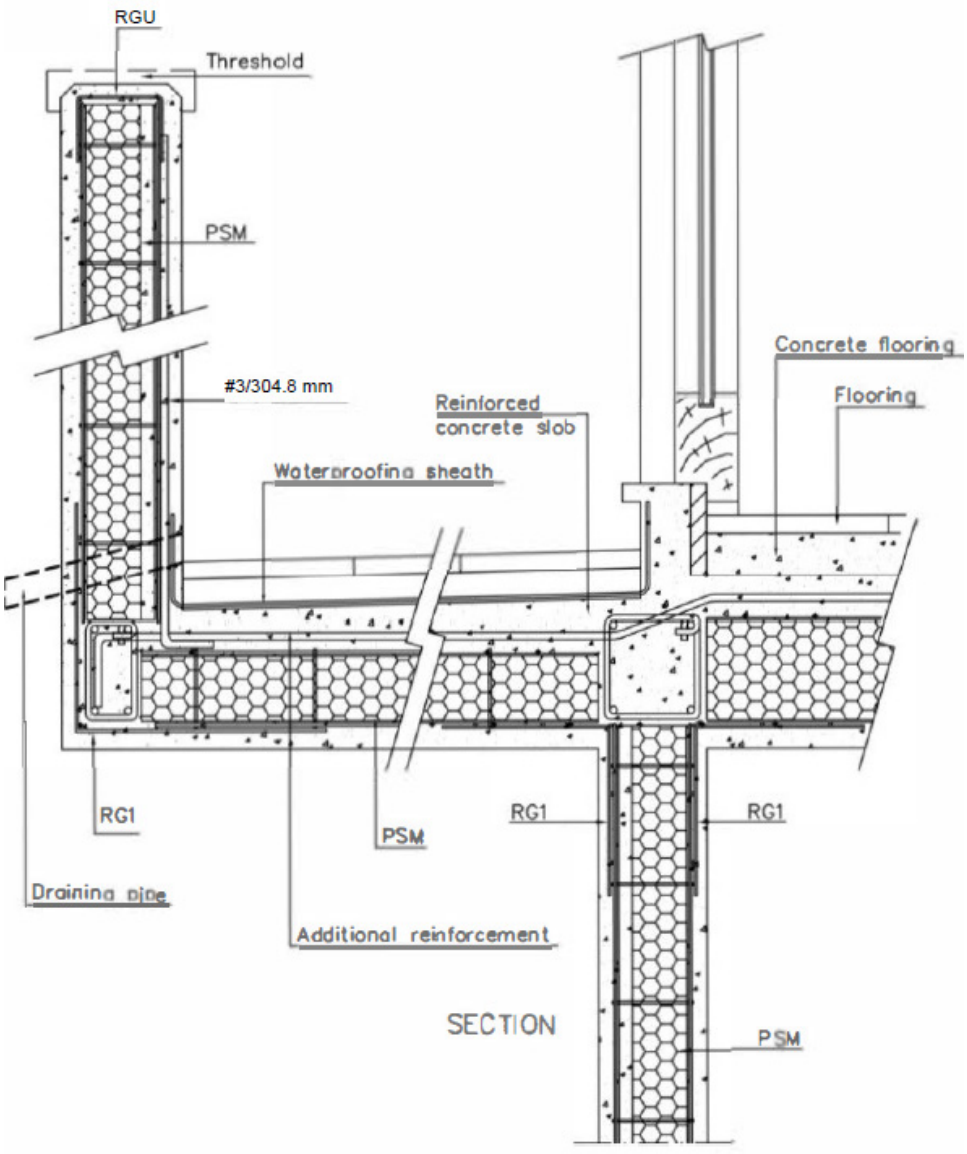


Figure B-22. Balcony Structural Details with PSM Wall

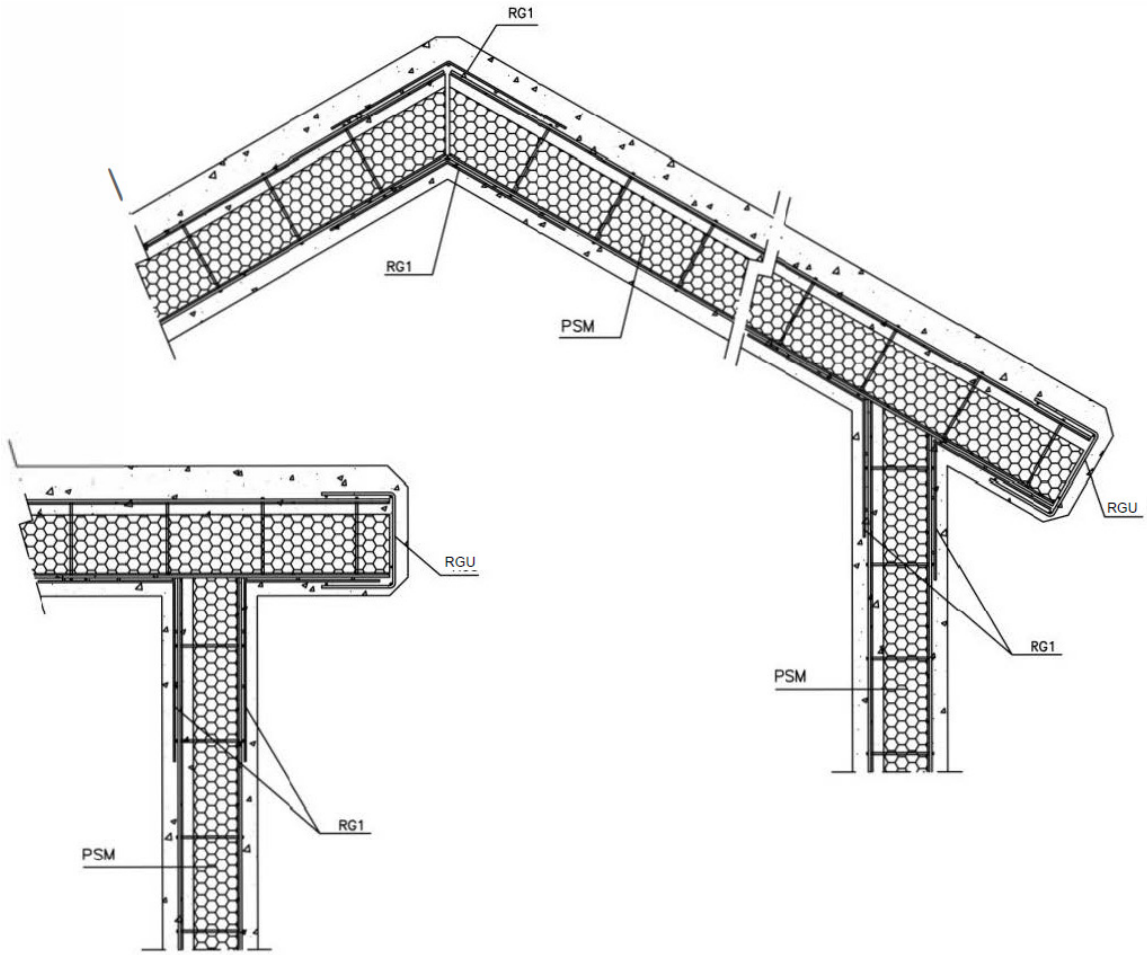


Figure B-23. PSM Roof Connection to PSM Wall

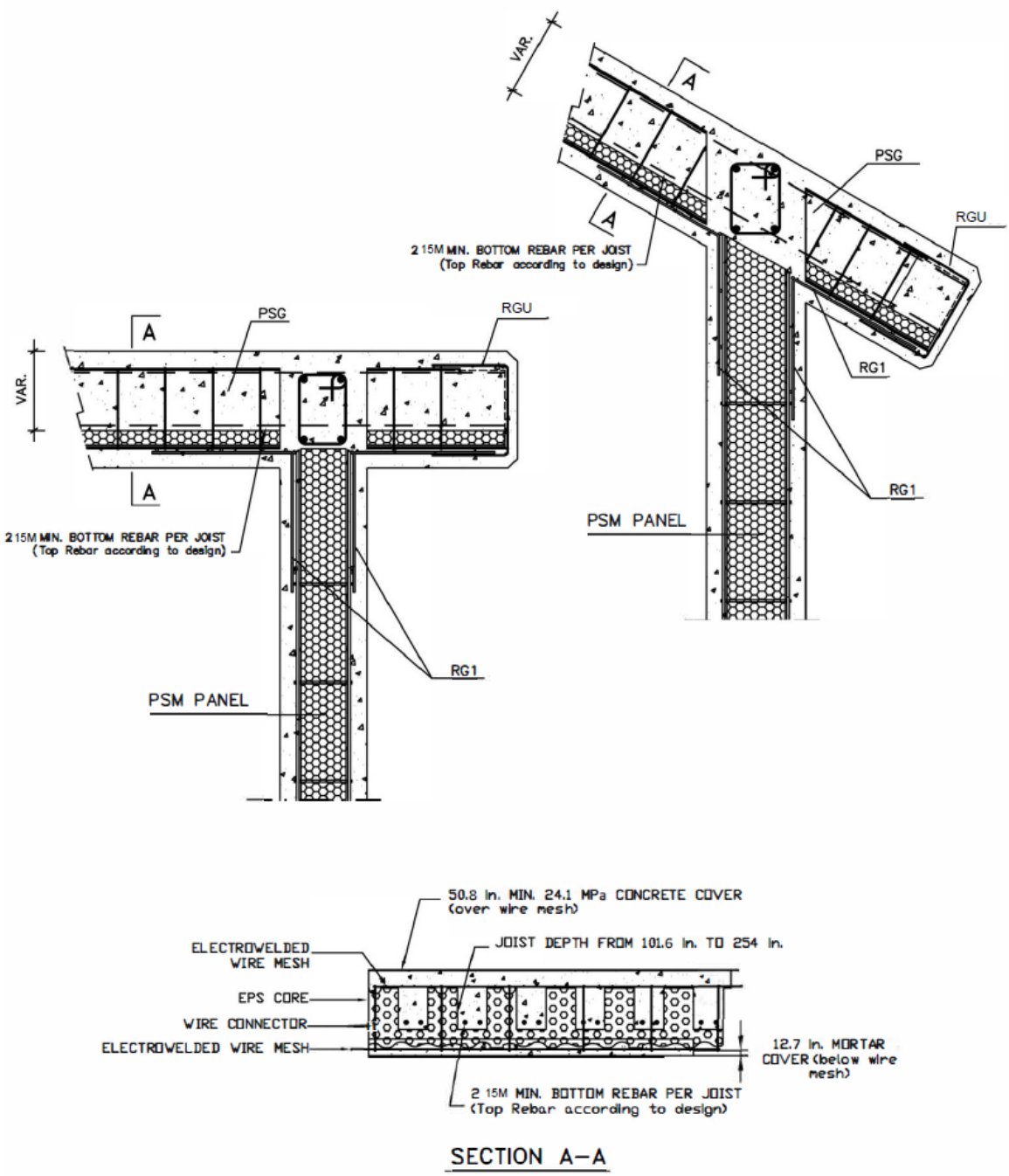


Figure B-24. PSM Roof Connection to PSM Wall

Notes

[1] For more information, visit drjcertification.org or call us at 608-310-6748.

[2] Unless otherwise noted, all references in this report are from the 2020 version of the NBC. This alternative solution is also approved for use with the 2010 and 2015 NBC and the standards referenced therein.

[3] References in this report to the National Building Code of Canada (NBC) apply to the Ontario Building Code (OBC), unless noted otherwise.

[4] 18 U.S. Code § 1831 - Economic espionage - Whoever, intending or knowing that the offense will benefit any foreign government, foreign instrumentality, or foreign agent, knowingly steals, or without authorization appropriates, takes, carries away, or conceals, or by fraud, artifice, or deception obtains a trade secret shall be fined not more than $5,000,000 or imprisoned not more than 15 years, or both. Any organization that commits any offense described shall be fined not more than the greater of $10,000,000 or 3 times the value of the stolen trade secret to the organization, including expenses for research and design and other costs of reproducing the trade secret that the organization has thereby avoided. https://www.law.cornell.edu/uscode/text/18/part-I/chapter-90.

[5] ANAB is part of the USMCA and IAF MLA, where the purpose of these agreements are to ensure mutual recognition of accredited certification and validation/verification statements between agreement signatories, and subsequent acceptance of ANAB accredited certification and validation/verification statements by professional engineers based upon having one universal approval process for the timely approval of innovative materials, products, designs, services, assemblies and/or methods of construction.

[6] When tested in accordance with CAN/ULC-S102, see NBC Division B Article 3.1.12.1.

[7] When tested in accordance with CAN/ULC-S102, see NBC Division B Article 3.1.12.1.

[8] https://anabpd.ansi.org/Accreditation/product-certification/DirectoryListingAccredited?menuID=1&prgID=1

[9] https://iaf.nu/en/member-details/?member_id=91

[10] https://iaf.nu/en/member-details/?member_id=14

[11] NBC Division A Clause A-1.2.1.1.(1)(b) provides information on code compliance via alternative solutions and defines alternative solutions as "...achiev[ing] at least the minimum level of performance required by Division B." NBC Division C Section 2.3 includes additional guidance for documentation of alternative solutions.

[12] https://anabpd.ansi.org/Accreditation/product-certification/AllDirectoryDetails?&prgID=1&OrgId=2125&statusID=4

[13] Through ANAB accreditation and the IAF MLA, DrJ certification can be used to obtain material, product, design, or method of construction approval in any jurisdiction or country that has IAF MLA Members & Signatories to meet the Purpose of the MLA – "*certified once, accepted everywhere*".

[14] https://iaf.nu/en/about-iaf-mla/#:~:text=required%20to%20recognise

[15] The National Conformity Assessment Principles states, "*Product regulations and standards may vary from country to country. If these are set arbitrarily, they could be deemed as protectionist. The World Trade Organization (WTO) Agreement on Technical Barriers to Trade (TBT Agreement) is intended to ensure that technical regulations, standards and conformity assessment procedures of member countries do not create unnecessary obstacles to trade. Under the TBT Agreement, members of the WTO agree to use international standards, including conformity assessment standards and guides, as a basis for their technical requirements.*"

[16] https://www.law.cornell.edu/uscode/text/18/part-I/chapter-90