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PRODUCT: GREENSTONE ICE PANELS

REPORT HOLDER: Greenstone Building Products Ltd.

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CSI DIVISION: 07 00 00 Thermal and Moisture Protection

CSI SECTION: 07 21 00 Thermal Insulation
07 41 13 Metal Roof Panels
07 42 13 Metal Wall Panels

APPLICABLE CODES: 2018, 2015 International Building Code (IBC)
2018, 2015 International Residential Code (IRC)

EVALUATED: Foam Plastic, Surface Burning Characteristics
Thermal Insulation, Physical Performance
Structural Capacity
Fire-Resistance Ratings



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1.0 APPROVED FOR FOLLOWING:

APPROVED TYPES OF CONSTRUCTION:	VA, VB
APPROVED USE:	Exterior and Interior walls, floors and roof.
APPROVED INSTALLATIONS:	• Load Bearing and Non-load Bearing Exterior and Interior Walls • Load Bearing and Non-load Bearing Fire-Resistance Rated Walls • Roofs • Floors

2.0 PRODUCT USE AND DESCRIPTION:

2.1 General:

Greenstone ICE (Insulated Composite Envelope) panels are factory assembled, composite panels composed of light gauge galvanized steel members with molded Type II expanded polystyrene (EPS) thermal insulation to create a finished engineered composite panel. The light-frame steel members are on each ICE panel face, without cross bridging to create a finished thermally broken insulating composite panel. Panels are erected onsite, where additionally required components as prescribed in the 2018 / 2015 IBC or 2018 / 2015 IRC and as outlined in this report, are applied to create the finished wall, roof, or floor assembly.

Greenstone ICE panels comply for use in Types VA and VB construction as defined by the 2018 / 2015 IBC. Where Greenstone ICE panels are used for construction governed by the 2018 / 2015 IRC, Engineered Design in accordance with Section 3.1.1.3 is required.

Greenstone ICE panels are manufactured at up to 48 inches (1219 mm) widths and the following panel options as noted in Table 1:



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Table 1. Greenstone ICE Panel Configurations

Thickness		Stud Spacing		Steel Thickness		Height	
inches	mm	inches	mm	Gauge	mm	ft	mm
5.5	140	16	406	20	0.889	8	2438
						10	3048
						12	3658
				18	1.245	8	2438
						10	3048
						12	3658
				16	1.651	8	2438
						10	3048
						12	3658
7.5	191	16	406	20	0.889	8	2438
						10	3048
						12	3658
				18	1.245	8	2438
						10	3048
						12	3658
				16	1.651	8	2438
						10	3048
						12	3658
7.5	191	12	305	20	0.889	10	3048
				16	1.651	8	2438
						10	3048
9.25	235	12	305	20	0.889	12	3658
						8	2438
						10	3048
11.5	292	12	305	20	0.889	12	3658

Other Greenstone ICE panels are available upon request and are outside the scope of this report.

Examples of Greenstone ICE panel products and panel connection details can be found in Figure 2 of this report.

Details of panel panel connections are described in this report. Panel connections to the overall structural system are outside the scope of this report.



2.2 PRODUCT COMPONENTS

2.2.1 EPS Foam Plastic Thermal Insulation:

Greenstone ICE panels include expanded polystyrene (EPS) *foam plastic* thermal insulation molded at 5.5 to 11.5 inches (140-292 mm) thicknesses. The EPS *foam plastic* component has a flame spread index of 25 or less and a smoke developed index of 450 or less at a nominal density of 1.50 lbs/ft³ (24 kg/m³) when tested and evaluated following UL 723 and complies with 2018 / 2015 IBC Section 2603.3 and 2018 / 2015 IRC Section 316.3 for thicknesses noted when protected with a code prescribed thermal barrier as outlined in Section 4.2.2 of this report.

The EPS foam is listed by an *approved agency* and complies with Type II specifications per ASTM C578 for use as thermal insulation.

Greenstone ICE panel EPS foam plastic is labeled in accordance with 2018 / 2015 IBC 2603.2 and 2018 / 2015 IRC R316.2

2.2.2 Light Gauge Steel Framing:

Greenstone ICE panels incorporate galvanized light gauge steel studs of 2-1/2 in. x 1-3/16 in (64 mm x 30 mm) cross-section, running the length of the panel, of steel thicknesses in Table 1 spaced at 16 inches (405 mm) or 12 inches (305 mm) on center spacing. The studs are located on the surface of each ICE panel face. Greenstone ICE panel steel studs conform to ASTM A653/A653M minimum SS Grade 33 with minimum G90 galvanized coating.

2.2.3 Top Track:

Greenstone ICE wall panels top track (load-bearing channel (LBC)) are installed continuously along the top of wall panels along each panel face, with LBC terminating at intermediate steel stud locations. The LBC are not approved for installation where termination is over header locations or where the LBC terminates at a location between studs. The LBC are attached to the steel studs with self tapping screws described in Section 2.7 of this report. Greenstone ICE panel LBC steel is minimum 16 gauge (0.060 inches / 1.52 mm) thickness and conforms to ASTM A653/A653M minimum SS Grade 33 with minimum G90 galvanized coating.

LBC thicknesses increased for point loading considerations shall be supported by Engineering Design.

2.2.4 Bottom Track:

Greenstone ICE wall panels bottom track (split tracks) are installed continuously at the bottom of panels along each panel face, for connection of panels to the underlying substrate. The bottom tracks are attached to the steel studs with self-tapping screws described in Section 2.7 of this report. Greenstone ICE panel bottom track steel is minimum 18 gauge (0.048 inches / 1.22 mm) thickness and conforms to ASTM A653/A653M minimum SS Grade 33 with minimum G90 galvanized coating.

2.2.5 Interior Connection Plates:

Greenstone ICE wall panels are connected at female to female stud edges, along the interior panel face using connection plates of minimum 6 in. x 2 in. (152 mm x 51 mm) in size. Connection plates are located 24 in. (610 mm) from top of the wall with spacing at a maximum 3 times the Greenstone ICE panels stud spacing except where Greenstone ICE panels are used in fire-resistant rated construction, where installation shall follow Section 8.2 of this report. Connection plates are fastened to the Greenstone ICE panel studs with self-tapping screws described in Section 2.7 of this report. Greenstone ICE panel connection plate steel is a minimum of 18 gauge (0.048 inches / 1.22 mm)

thickness and conforms to ASTM A653/A653M minimum SS Grade 33 with minimum G90 galvanized coating.

2.2.6 Corner Connection Plates:

2.2.6.1 Exterior Connection Plates: Greenstone ICE wall panel corners are connected at exterior panel edges with connection plates of minimum 2 in. x 4 in. (51 mm x 102 mm) in plate size. Exterior connection plates are located 24 in. (610 mm) from top of wall, with spacing at maximum 3 times the Greenstone ICE panels stud spacing. Connection plates are fastened to the Greenstone ICE panel studs with self-tapping screws described in Section 2.7 of this report. Greenstone ICE panel exterior connection plate steel is minimum 18 gauge (0.048 inches / 1.22 mm) thickness and conforms to ASTM A653/A653M minimum SS Grade 33 with minimum G90 galvanized coating.

2.2.6.2 Interior Connection Plates: Greenstone ICE wall panel corners are connected at interior panel edge locations with 1 in. x 1 in. x 6 in. length (25 mm x 25 mm x 102 mm) in plate size. Interior connection plates are located 24 in. (610 mm) from top of wall, with spacing at maximum 3 times the Greenstone ICE panels stud spacing. Where Greenstone ICE panels are used as foundation walls, connection plates are required immediately above bottom track joint locations. Connection plates are fastened to the Greenstone ICE panel studs with self-tapping screws described in Section 2.7 of this report. Greenstone ICE panel interior connection plate steel is minimum 18 gauge (0.048 inches / 1.22 mm) thickness conforms to ASTM A653/A653M minimum SS Grade 33 with minimum G90 galvanized coating.

2.2.7 Self-tapping Screws

The following are Greenstone ICE panel and accessories connection details:

Panel to panel connection exterior: Connection of adjacent Greenstone ICE panels on the exterior face requires minimum #10 – 3/4 inch (19 mm) self-tapping screws fastened along the male stud leading edge into the underlying female stud. Fastener spacing is to match the stud spacing of the Greenstone ICE panels.

Top track (LBC) and bottom track (split track) to panel stud connections: Connection of top track and bottom tracks to Greenstone ICE panel studs require minimum #10 – 3/4 inch (19 mm) self-tapping screws at each location of light gauge steel stud and track junction for each panel face.

Connection plate for the interior panel to panel connection: Connection plates used at interior locations to secure adjacent panels are to include 6 #10 – 3/4 in. (19 mm) self-tapping screws, with 3 screws into each panel.

Exterior corner plate connections: Connection plates used at exterior corner locations to secure adjacent panels are to include 8 #10 – 3/4 in. (19 mm) length self-tapping screws.

Interior corner plate connections: Connection plates used at interior corner locations to secure adjacent panels are to include 6 #10 – 3/4 in. (19 mm) self-tapping screws with 3 screws into each panel.

See Figures 3 through 5 of this report for connection details described above.

2.2.8 Adhesive

Greenstone ICE panels include a thermosetting adhesive applied to the light gauge steel studs, top track and bottom track prior to molding to ensure bonding of the EPS to the steel members.

3.0 DESIGN:

Design loads to be resisted by Greenstone ICE panels shall be determined in accordance with the applicable building codes. Loads to be resisted by Greenstone ICE panels shall not exceed the allowable loads outlined in Tables 2 through 6 of this report. Loads in the tables may be applied to shorter panel spans or lengths/heights where supported by Engineering Design. Extrapolation of allowable loads is outside the scope of this report. Where combined load combinations are anticipated, the design shall consider the load combinations based on acceptable engineering practice.

When used as shear walls under construction governed by the 2018 / 2015 IBC, Greenstone ICE panels are limited to use in Seismic Design Categories A, B and C.

Greenstone ICE panels comply for use in Types VA and VB construction, as defined by the 2018 / 2015 IBC. Greenstone ICE panel structures require Engineered Design in accordance with R301.1.3 of the 2018 / 2015 IRC.

Greenstone ICE panels used in fire-resistance rated applications shall be constructed in accordance with Section 4.4 and 8.2 of this report with load limitations as outlined.

4.0 INSTALLATIONS:

4.1 General:

The installation of Greenstone ICE panels must comply with the manufacturer's published installation instructions, project specifications, this report, and the applicable code(s). Where conflicts exist, this report and the applicable building code shall govern.

Greenstone ICE panels are to be connected as outlined in Figure 2 of this report.

4.2 Interior:

4.2.1 General:

Greenstone ICE panels used as wall or roofs / ceilings are to be separated from the interior space in accordance with Section 4.2.2 and 4.2.3 of this report, as appropriate. Connection of interior decorum, furniture and cabinetry are approved where the necessary load resistance does not exceed allowable fastener capacities for connection to the light gauge steel elements as determined for the fastener type used, calculated in accordance with appropriate engineering methodology for connection to steel elements.

4.2.2 Occupied Space:

4.2.2.1 Use With a Code Prescribed Thermal Barrier.

2018 / 2015 IBC: Except as provided in Sections 2603.4.1 and 2603.9o of the 2018 / 2015 IBC, Greenstone ICE panels exposed to occupancies of the building interior shall be covered by a thermal barrier of minimum ½ inch (13 mm) thick gypsum board complying with ASTM C1396, or by a material complying with NFPA 275 compatible for use with the Type II EPS insulation at thicknesses of 5.5 inches (140 mm) or greater. Gypsum shall be mechanically connected to the Greenstone ICE panel light-frame steel elements in accordance with the applicable code. Taping and mudding of fastener heads and joints are optional where gypsum is used, except when Greenstone ICE panels are used in fire-resistance rated applications, where installation shall conform to Sections 4.4 and 8.2 of this report.



2018 / 2015 IRC: Unless allowed under Section R316.5 of the 2018 / 2015 IRC, Greenstone ICE panels exposed to occupancies of the building shall be protected by a thermal barrier of minimum of 1/2 inch (13 mm) gypsum wall board complying with ASTM C1396, 23/32 inch (18 mm) thick structural wood panel, or a material complying with NFPA 275 compatible for use with the Type II EPS insulation at thicknesses of 5.5 inches (140 mm) or greater. Where gypsum or structural wood panels are used, the thermal barrier shall be mechanically connected to the Greenstone ICE panel light-frame steel elements in accordance with the applicable code. Taping and mudding of fastener heads and joints are optional where gypsum is used, except when Greenstone ICE panels are used in fire-resistance rated applications, where installation shall conform to Sections 4.4 and 8.2 of this report.

4.2.2.2 Use Without a Code Prescribed Thermal Barrier.

No alternative thermal barriers are approved under this current report over Greenstone ICE panels.

4.2.3 Attic and Crawlspace:

4.2.3.1 Use With a Code Prescribed Ignition Barrier:

Greenstone ICE panels exposed in attics and crawlspaces shall be protected with a code prescribed ignition barrier as defined in the Section 2603.4.1.6 of the 2018 / 2015 IBC and Sections R316.5.3 and R316.5.4 of the 2018 / 2015 IRC. The ignition barrier is to cover all exposed foam.

4.2.3.2 Use Without a Code Prescribed Ignition Barrier:

No alternative ignition barriers are approved under this current report over Greenstone ICE panels.

4.3 Exterior:

4.3.1. Above Grade:

4.3.2 Wall Panels: Exterior walls requiring sheathing as a structural element in the Engineering Design, shall have sheathing type and installation done in accordance with the applicable code. Where used in fire-resistance rated construction, sheathing shall comply with Sections 4.4 and 8.2 of this report.

4.3.2.1 Weather Protection: Greenstone ICE panels used as exterior walls require installation with a code prescribed water resistive barrier, exterior cladding and flashings for providing weather protection in accordance with Section 1403.2 of the 2018 / 2015 IBC and water resistance in accordance with Section R703.1.1 of the 2018 / 2015 IRC. Water resistive barriers and exterior cladding materials shall comply with Section 1404 of the 2018 / 2015 IBC and R703 of the 2018 / 2015 IRC. Water resistive barriers and cladding components shall be installed in accordance with the applicable code and the manufacturer's installation instructions.

4.3.2.2 Vapor Retarders: Superform ICF EPS component is a Class II vapor retarder at thicknesses 5 inches (127 mm) or greater, so where a Class II vapor retarder is required, this can be omitted.

4.3.2.3 Termite Protection: Where Superform ICF are installed in areas defined as "very heavy" as indicated in Figure 2603.8 of the 2018 / 2015 IBC and Figure R301.2(6) of the 2018 / 2015 IRC, and where the EPS foam component is located within 6 in. (152 mm) above grade from exposed earth, construction is to follow Section 2603.8 of the 2018 / 2015 IBC and R318.4 of the 2018 / 2015 IRC. This construction requires all structural elements of walls, floors, ceilings, and



roofs to be of noncombustible materials or preservative-treated wood, unless an approved method of protecting the foam plastic from subterranean termite damage is provided to the authority having jurisdiction.

4.3.3 Roof Panels: Greenstone ICE panels require sheathing installation as a structural element in accordance with Section 2304.8.2 of the 2018 / 2015 IBC or R803 of the 2018 / 2015 IRC. Greenstone ICE panels are installed over the applied sheathing following for providing increased thermal resistance. Approved roof coverings to provide weather protection are required in accordance with Section 1503 of the 2018 / 2015 IBC and R903 of the 2018 / 2015 IRC. Roof underlayment and coverings are to comply with Section 1507 of the 2018 / 2015 IBC and R905 of the 2018 / 2015 IRC. Roof coverings for installation direct to the Greenstone ICE panels are to follow the roof covering manufacturer's installation instructions for connection to spaced Greenstone ICE panel light gauge steel elements.

Connection details for the roof covering to Greenstone ICE panels and Greenstone ICE panels to the underlying structure are to be done according to the Engineering Design and are outside the scope of this report.

Greenstone ICE panels are not approved for use in fire-classified roof assemblies.

4.3.2. Below Grade:

4.3.2.1 Walls: Use of Greenstone ICE panels as foundation walls require Engineering Design. Engineering Design is to consider construction process, backfill type, and height of wall below grade, connection of the Greenstone ICE panels for transmitting the lateral pressures to the underlying structure, dampproofing or waterproofing as outlined in Section 4.3.2.1.1 of this report, and methods for protection of the steel elements from potential corrosion effects of soil moisture in event of dampproofing or waterproofing material failure. Backfilling is not permitted until the basement floor and the first floor have been installed, or the Greenstone ICE panels are braced on the interior face.

4.3.2.1.1 Dampproofing or waterproofing: As required by site conditions, dampproofing or waterproofing shall be installed in accordance with 2018 / 2015 IBC Chapter 1805 or 2018 / 2015 IRC Section R406 as applicable. The dampproofing or waterproofing material must be compatible for use with EPS thermal insulation products.

4.3.2.1.2 Termite Protection: Where Greenstone ICE panels are used below grade in areas defined as "very heavy" termite infestation probability as indicated in Figure 2603.8 of the 2018 / 2015 IBC and Figure R301.2(6) of the 2018 / 2015 IRC, construction is to follow Section 2603.8 of the 2018 / 2015 IBC and R318.4 of the 2018 / 2015 IRC. This construction requires all structural elements to walls, floors, ceilings, and roofs to be of noncombustible materials or preservative-treated wood unless an approved method of protecting the foam plastic from subterranean termite damage is provided to the authority having jurisdiction

4.4. Fire-Resistance-Rated Construction:

Greenstone ICE panels are approved for use where load-bearing fire-resistance-rated construction is required for up to 1-hour, with the fire-resistance rating from the interior facing fire where protected on the interior surface with 2 layers of 5/8 in. (16 mm) Type X gypsum wall board, oriented horizontally, with joints taped and mudded where loading is reduced by 50% the allowable axial loading outlined in Table 5 of this report. Greenstone ICE panel construction shall be in accordance with Section 8.2 of this report (refer to Figure 2 and Table 7 of this report).

Greenstone ICE panels are approved for use in non-load-bearing fire-resistance-rated construction for up to 2-hours, with the fire-resistance rating from the interior facing fire when the assembly is constructed with 2 layers of 5/8 in. (16 mm) Type X gypsum wall board, oriented horizontally, with joints taped and mudded. Greenstone ICE panel construction shall be in accordance with Section 8.2 of this report (refer to Figure 3 and Table 8 of this report).

See Section 8.2 of this report for details of installation for use in fire-resistance-rated applications.

5.0 LIMITATIONS

- Installation of the Greenstone ICE panels is to match this report, the Engineering Design and site specifications.
- Inspection of panel joints to ensure proper connection and sealant application against the approved Engineering Design and site specifications.
- Greenstone ICE panels are required to be separated from interior space by an approved thermal barrier when installed in accordance with Section 4.2.2 of this report and the applicable code
- Greenstone ICE panels installed in in Attic and Crawlspcace applications require installation of an approved ignition barrier in accordance with Section 4.2.3 of this report and the applicable code.
- Greenstone ICE panels are required to be protected by a code-compliant water resistive barrier and exterior cladding or roof coverings when installed on the exterior of the building above grade. Refer to section 4.3 of this report for details.
- Greenstone ICE panels for use below grade require Engineering Design and shall be done in accordance with Engineering Design for Foundation Walls, and Section 4.3.2 of this report. A dampproofing or waterproofing barrier as appropriate is required. A dampproofing or waterproofing compatible for use over expanded polystyrene substrates is required.
- Greenstone ICE panels when used in fire-resistance-rated construction shall be installed in accordance with Section 4.4 and Section 8.2 of this report.
- Greenstone ICE panels used below grade in areas defined as “very heavy” termite infestation probability, require construction in accordance with IBC Section 2603.8 or IRC R318.4, as applicable.
- Greenstone ICE panels are manufactured in Brandon, Manitoba with inspections by QAI Laboratories.

6.0 SUPPORTING INFORMATION:

The following substantiating data has been evaluated for Greenstone ICE panels:

- Data for use as Type II thermal insulation in accordance with ASTM C578 *Standard Specification for Cellular, Expanded Polystyrene Thermal Insulation*.
- Data for determining surface burning characteristics determined in accordance with UL 723 *Standard for Test for Surface Burning Characteristics of Building Materials*.
- Data for strength testing of products per ASTM E72 *Standard Test Methods for Conducting strength Tests of Panels for Building Construction*.
- Data outlining details for use in load-bearing fire-resistance rated construction per ASTM E119 *Standard Test Methods for Fire Tests of Building Construction and Materials*.
- Calculations in accordance with American Iron and Steel Institute (AISI S100) *North American Specification for the Design of Cold-Formed Steel Structural Members*.

7.0 MARKING:

MANUFACTURED BY		Greenstone Building Products Ltd.	
PRODUCT		Structural Insulated Composite Envelope (ICE) Panel	
ASTM E84 RATING	FSI $\leq$ 25; SDI $\leq$ 450	CAN/ULC-S102.2 RATING	FSI $\leq$ 250; SDI $\geq$ 500
CAN/ULC-S101 & ASTM E119 RATING		1 hour Fire Resistance	
ASTM C578	Type II	CAN/ULC-S701	Type 2
GAUGE	☐ 16G ☐ 20G ☐ OTHER: _____		
STUD SPACING	☐ 160C ☐ OTHER: _____		
EPS DENSITY	☐ 1.5 lb ☐ 2 lb	Refer to QAI Evaluation Report: CERus - 1002	



Refer to QAI Evaluation
Report: CERus - 1002

PROJECT NUMBER: GSBP0000

Figure 1. Example of Greenstone ICE Panel Finished Product Label



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8.0 RESULTS / RATINGS:

8.1 Greenstone ICE Panel Allowable Load Capacities:

Table 2. Greenstone Building Products ICE Panels Transverse Loading Capacities 1.5 lbs/ft³ Density Panels:

Transverse Load Resistance Greenstone ICE Type II 1.5 lbs/ft ³ EPS Density Panels ^{1,2,3,4}								
PANEL THICKNESS inches	STUD SPACING Inches	STEEL GAUGE	PANEL HEIGHT ft	DEFLECTION LIMIT psf			DESIGN STRENGTH, R _a (psf)	NOMINAL STRENGTH R _n (psf)
				L/360	L/240	L/180		
5.5	16	20	8	50	72	89	150	188
			10	32	47	58	113	141
			12	23	33	43	83	104
		18	8	47	70	93	156	195
			10	29	46	61	92	115
			12	26	38	48	92	116
		16	8	59	83	105	172	215
			10	37	54	69	95	119
			12	28	41	54	98	123
7.5	12	20	10	64	94	123	194	243
		16	8	98	144	187	287	359
			10	76	109	137	202	252
			12	54	83	106	190	237
7.5	16	20	8	67	94	119	208	261
			10	47	71	95	142	177
			12	39	57	72	112	140
		18	8	70	100	128	169	212
			10	46	68	91	127	158
			12	39	58	76	108	135
		16	8	72	103	129	190	238
			10	51	76	98	128	160
			12	45	65	84	114	143
9.25	12	20	8	102	145	184	319	399
			10	74	108	138	226	283
			12	60	88	112	181	226
11.5	12	20	12	75	109	135	207	259

1. Transverse load capacity is determined based on minimum bearing of 3 inches at panel ends. Alternate bearing conditions for connection of panels for transferring loads to the underlying structure are outside the scope of this report and are to follow the approved Engineering Design and project specifications.
2. Transverse loads are determined for panels only and do not consider the contribution from sheathing materials.
3. Design Strength determined based on AISI S100 Load and Resistance Factor Design (LRFD) methodology with Resistance Factor $\Phi = 0.80$.
4. Design following Allowable Strength Design (ASD) is to be based on the nominal strength (R_n) noted, with applied Safety Factor $\Omega = 2$.



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Table 3. Greenstone Building Products ICE Panels Transverse Loading Capacities 2.0 lbs/ft³ Density Panels:

Transverse Load Resistance Greenstone ICE Type II 2.0 lbs/ft ³ EPS Density Panels ^{1,2,3,4}								
PANEL THICKNESS inches	STUD SPACING Inches	STEEL GAUGE	PANEL HEIGHT ft	DEFLECTION LIMIT psf			DESIGN STRENGTH, R _a (psf)	NOMINAL STRENGTH R _n (psf)
				L/360	L/240	L/180		
7.5	8	20	10	100	146	194	362	453
9.25	8	20	10	121	172	225	362	453

1. Transverse load capacity is determined based on minimum bearing of 3 inches at panel ends. Alternate bearing conditions for connection of panels for transferring loads to the underlying structure are outside the scope of this report and are to follow the approved Engineering Design and project specifications.
2. Transverse loads are determined for panels only and do not consider contribution from sheathing materials.
3. Design Strength determined based on AISI S100 Load and Resistance Factor Design (LRFD) methodology with Resistance Factor $\Phi = 0.80$.
4. Design following Allowable Strength Design (ASD) is to be based on the nominal strength (R_n) noted, with applied Safety Factor $\Omega = 2$.

Table 4. Greenstone Building Products ICE Panels Transverse Loading Capacities 2.5 lbs/ft³ Density Panels:

Transverse Load Resistance Greenstone ICE Type II 2.5 lbs/ft ³ EPS Density Panels ^{1,2,3,4}								
PANEL THICKNESS inches	STUD SPACING Inches	STEEL GAUGE	PANEL HEIGHT ft	DEFLECTION LIMIT psf			DESIGN STRENGTH, R _a (psf)	NOMINAL STRENGTH R _n (psf)
				L/360	L/240	L/180		
7.5	8	20	8	152	222	287	444	555
			10	115	168	218	426	532
7.5	12	20	10	91	128	165	275	344

1. Transverse load capacity is determined based on minimum bearing of 3 inches at panel ends. Alternate bearing conditions for connection of panels for transferring loads to the underlying structure are outside the scope of this report and are to follow the approved Engineering Design and project specifications.
2. Transverse loads are determined for panels only and do not consider contribution from sheathing materials.
3. Design Strength determined based on AISI S100 Load and Resistance Factor Design (LRFD) methodology with Resistance Factor $\Phi = 0.80$.
4. Design following Allowable Strength Design (ASD) is to be based on the nominal strength (R_n) noted, with applied Safety Factor $\Omega = 2$.



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Table 5. Greenstone Building Products ICE Panels Axial Loading Capacities:

Axial Load Resistance Greenstone ICE Type II 1.5 lbs/ft ³ Density Panels ^{1,2,3,4,5}						
PANEL THICKNESS inches	STUD SPACING Inches	STEEL GAUGE	MAXIMUM HEIGHT ft	LOAD @ COMPRESSION LIMIT $\Delta = 1/8$ inch lbs/ft	DESIGN STRENGTH, R_a (lbs/ft)	NOMINAL STRENGTH R_n (lbs/ft)
5.5	16	20	≤ 12	7,846	7,846	9,808
		18		10,315	10,315	12,894
		16		12,746	12,746	15,932
7.5	12	20	≤ 12	9,808	9,808	12,260
		18		12,894	12,894	16,118
		16		15,932	15,932	19,915
7.5	16	20	≤ 12	7,846	7,846	9,808
		18		10,315	10,315	12,894
		16		12,746	12,746	15,932

1. Axial load capacities are determined for uniformly distributed load over Greenstone ICE panels. For point loads, top track (LBC) or additional reinforcing may be added where supported by by Engineering Design and approved by the authority having jurisdiction.
2. Axial load capacities are determined for Greenstone ICE panels without sheathing, thermal barrier or ignition barrier.
3. Connection details including attachment of floor and roof panels, and connection of wall panels to the underlying structure is outside the scope of this report and is to be in accordance with Engineering Design and project specifications.
4. Design Strength determined based on AISI S100 Load and Resistance Factor Design (LRFD) methodology with Resistance Factor $\Phi = 0.80$.
5. Design following Allowable Strength Design (ASD) is to be based on the nominal strength (R_n) noted, with applied Safety Factor $\Omega = 2$.



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Table 6. Greenstone Building Products ICE Panels Racking Shear Capacities:

Racking Shear Capacity for Greenstone ICE Type II 1.5 lbs/ft ³ Density Panels, No Sheathing ^{1,4,5}								
PANEL THICKNESS inches	STUD SPACING Inches	STEEL GAUGE	MAXIMUM ASPECT RATIO	DRIFT LIMIT lbs/ft			DESIGN STRENGTH, R _a (lbs/ft)	NOMINAL STRENGTH R _n (lbs/ft)
				H/500	H/360	H/240		
7.5	16	20	1.1	153	180	226	414	828
Racking Shear Capacity for Greenstone ICE Type II 1.5 lbs/ft ³ Density Panels with 7/16 inc. PS2 Rated Exterior Grade Oriented Strand Board on Exterior Face ^{1,2,4,5}								
PANEL THICKNESS inches	STUD SPACING Inches	STEEL GAUGE	MAXIMUM ASPECT RATIO	DRIFT LIMIT lbs/ft			DESIGN STRENGTH, R _a (lbs/ft)	NOMINAL STRENGTH R _n (lbs/ft)
				H/500	H/360	H/240		
7.5	16	20	1:1	594	594	594	594	1,187
Racking Shear Capacities for Greenstone ICE Type II 1.5 lbs/ft ³ Density Panels, with 16 Gauge, 33 ksi G60 Steel Strapping Exterior Face ^{1,3,4,5}								
PANEL THICKNESS inches	STUD SPACING Inches	STEEL GAUGE	MAXIMUM ASPECT RATIO	DRIFT LIMIT lbs/ft			DESIGN STRENGTH, R _a (lbs/ft)	NOMINAL STRENGTH R _n (lbs/ft)
				H/500	H/360	H/240		
7.5	16	20	1:1	381	507	567	567	1,134

1. Connection details including attachment of floor and roof panels, and connection of wall panels to the underlying structure is outside the scope of this report, and is to be in accordance with Engineering Design and project specifications.
2. OSB is to be installed with minimum #6- 1-1/2 in. (38 mm) self-tapping screws, spaced at 6 in. (153 mm) around the perimeter, and 12 in. (305 mm) in the field with minimum 1 in. (25 mm) distance from OSB panel edges at perimeter installation. OSB joints are to be blocked with 16 Ga. steel straps, with fasteners staggered along each panel joint at 6 in. (152 mm) where OSB joints are not over studs.
3. 2. Steel straps are required to be minimum 5-1/4 in. (133 mm) width and extend from panel corner to panel corner at maximum 8 ft (2432 mm) lengths. Steel straps are required to be connected to Greenstone ICE panels with three minimum #10-3/4 in. (19 mm) self-tapping screws at each strap end, and two #10-3/4 in. (19 mm) self-tapping screws installed at each stud location.
4. Design Strength determined in accordance with AISI S100, following Load and Resistance Factor Design (LRFD) methodology with Resistance Factor $\Phi = 0.50$.
5. Design following Allowable Strength Design (ASD) is to be based on the nominal strength (R_n) noted, with applied Safety Factor $\Omega = 3$ applied per AISI S100 requirements.

8.2 Fire-Resistance-Rated Assembly Details

8.2.1. Greenstone ICE Panels – 1 Hour Load-Bearing¹ Fire-Resistance Rated Assembly Rated Interior Facing Fire

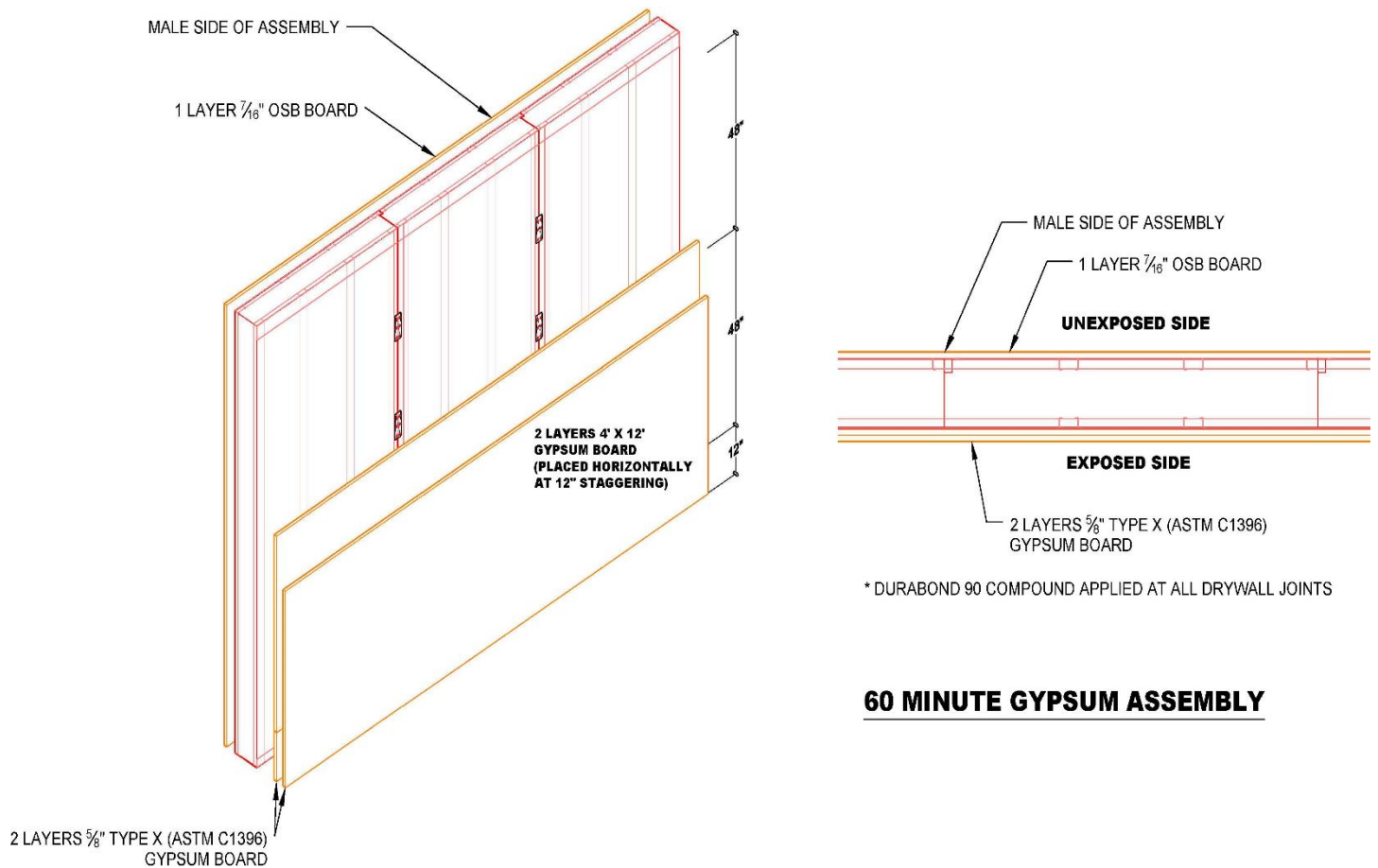


Figure 2. Greenstone ICE Panel 1 Hour Load-Bearing Fire-Resistance Rated Wall Details



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Table 6. Greenstone ICE Panels – 1 Hour Load-Bearing Fire-Resistance Rated Assembly Description^{1,2,3}

COMPONENT	DESCRIPTION	
Wall Assembly	Manufacturer:	Greenstone Insulated Composite Envelope (ICE) Panel.
	Thickness:	7.5 in. (191 mm) minimum.
	Installation Description:	ICE panels installed with 2 layers of 5/8 in. (16 mm) Type X gypsum on each panel face. Panel connections to top track, bottom track and adjacent panels per Greenstone Connection details manual and this report. Exterior coverings as outlined below.
Wall Stud1	Minimum 20 Ga (1.25 mm) x 2-1/2 in. (64 mm) x 1-3/16 in. (30 mm) steel C-channel wall studs. The end studs at the joint have a 1/8 in. (3 mm) x 1 in. (25 mm) jog in the channel along the 2-1/2 in. (64 mm) dimension. Studs are to be spaced at maximum 16 in. (406 mm) on center (OC).	
Top Track1	Minimum 16 Gauge (1.65 mm) x 3-1/2 in. (89 mm) x 1-1/4 in. (32 mm) J-shaped steel channel with a 1/2 in. (13 mm) return. Fastened to the wall studs with #10x3/4 in. length (19 mm) self-tapping pan head screws.	
Bottom Track1	Minimum 2 in. (51 mm) x 2 in. (51 mm) steel angle shall be placed underneath the bottom track on both sides of the wall. Fastened to each stud with one #10x3/4 in. (19 mm) length self-tapping pan head screw.	
Connection Plates1	Minimum 18 Gauge (1.25 mm) x 6 in. (152 mm) x 2 in. (51 mm) steel plates fastened using six #10 x 3/4 in. (19 mm) self-tapping pan head screws. The plates are to be placed at maximum 2 ft (610 mm) starting 6 in. (152 mm) from panel top.	
Foam Insulation	Type:	Type 2 (Type II) Expanded Polystyrene (EPS) per CAN/ULC S701 / ASTM C578, listed by approved agency.
	Density:	1.65 lbs/ft ³
Interior Sheathing	Type:	2 layers of Type X gypsum board compliant with ASTM C1396, listed by approved agency.
	Minimum Thickness:	5/8 in. (16 mm).
	Fastener Detail:	Both layers are to be fastened at maximum 8 in. (203 mm) OC around the perimeter and in the field. The first layer is to be fastened using #6 x 1-1/4 in. (32 mm.) Type S drywall screws. The second layer shall be fastened using #6 x 2 in. (51 mm) Type S drywall screws. All screw heads are to be covered with code compliant drywall compound.
Exterior Coverings ⁴	Type:	Exterior Coverings of the Following Types: - Fiber-cement, minimum 1/4 inch (6 mm) thickness meeting ASTM C1186 Type A Grade II. - Cementitious Stucco, installed in accordance ASTM C926 or with the appropriate building code per site. - Exterior Gypsum complying with ASTM C1177 of minimum thickness 1/2 inches (13 mm). - Exposure 1 rated plywood of minimum 3/8 inch (11 mm) thickness or per Engineering Design. - Metal claddings complying with IBC Table 1405.2 or per Engineering Design.
	Fastener Detail:	Exterior cladding materials are to be installed in accordance with site designs to resist the anticipated loads per the Engineering Design, or as approved by the Authority Having Jurisdiction.

Notes:

1. The maximum applied loading for the fire-resistance rated assembly is 50% of the allowable load capacity calculated per AISI S100 and per Table 5 of this report.
2. All steel materials shall be in accordance with Engineering Design, with the minimum thickness of materials met.
3. The listed assembly is evaluated for interior fire exposure only.

8.2.2 Greenstone ICE Panels – 2 Hour Non-Load-Bearing Fire-Resistance Rated Assembly Rated Interior Facing to Fire

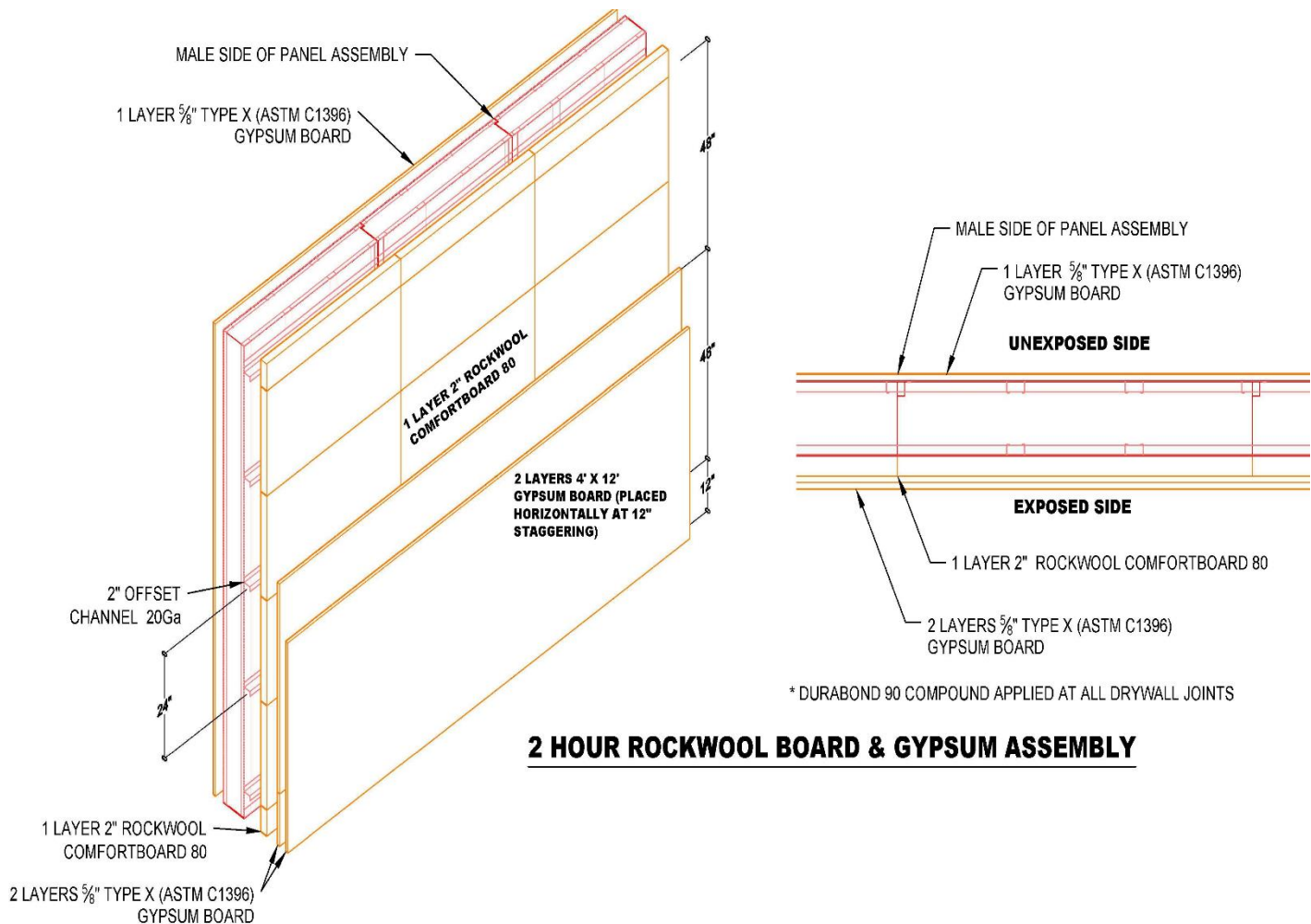


Figure 3. Greenstone ICE Panel 2 Hour Non-Load-Bearing Fire-Resistance Rated Wall Details



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Table 8. Greenstone ICE Panels – 2 Hour Non-Load-Bearing Fire-Resistance Rated Assembly Description

COMPONENT	DESCRIPTION	
Wall Assembly	Manufacturer:	Greenstone Insulated Composite Envelope (ICE) Panel.
	Thickness:	7.5 in. (191 mm) minimum.
	Installation Description:	ICE panels installed with 2 layers of 5/8 in. (16 mm) Type X gypsum on each panel face. Panel connections to top track, bottom track and adjacent panels per Greenstone Connection details manual and this report. Assembly incorporates mineral batt insulation at 2 in. (51 mm) thickness on assembly side exposed to fire (interior).
Wall Stud1	Minimum 20 Ga (1.25 mm) 1 x 2-1/2 in. (64 mm) x 1-3/16 in. (30 mm) steel C-channel wall studs. The end studs at the joint have a 1/8 in. (3 mm) x 1 in. (25 mm) jog in the channel along the 2-1/2 in. (64 mm) dimension. Studs are to be spaced at maximum 16 in. (406 mm) on center (OC).	
Top Track1	Minimum 16 Gauge (1.65 mm) x 3-1/2 in. (89 mm) x 1-1/4 in. (32 mm) J-shaped steel channel with a 1/2 in. (13 mm) return. Fastened to the wall studs with #10x3/4 in. length (19 mm) self-tapping pan head screws.	
Bottom Track1	Minimum 2 in. (51 mm) x 2 in. (51 mm) steel angle shall be placed underneath the bottom track on both sides of the wall. Fastened to each stud with one #10x3/4 in. (19 mm) length self-tapping pan head screw.	
Connection Plates1	Minimum 18 Gauge (1.25 mm) x 6 in. (152 mm) x 2 in. (51 mm) steel plates fastened using six #10 x 3/4 in. (19 mm) self-tapping pan head screws. The plates are to be placed at maximum 2 ft (610 mm) starting 6 in. (152 mm) from panel top.	
Foam Insulation	Type:	Type II Expanded Polystyrene (EPS) per ASTM C578, listed by approved agency.
	Density:	1.65 lbs/ft3
Interior Insulation Channel	Dimensions:	20 Gauge (0.95 mm) thickness Z-bar of 3 in x 2 in. x 3 in. (76 mm x 51 mm x 76 mm), connected to the Greenstone ICE wall studs.
	Spacing:	24 inches (610 mm) on center, oriented horizontally.
Interior Mineral Wool Insulation	Manufacturer:	Rockwool
	Type:	ComfortBatt 80
	Thickness:	Minimum 2 in. (51 mm)
	Installation:	Insulation is friction fit between interior insulation channel on the interior Greenstone ICE panel face.
Interior Sheathing	Type:	2 layers of Type X gypsum board compliant with ASTM C1396, listed by approved agency. Gypsum is oriented horizontally.
	Minimum Thickness:	5/8 in. (16 mm).
	Fastener Detail:	Both layers are to be fastened at maximum 8 in. (203 mm) OC along the longitudinal perimeter, and at 24 into each Z-bar at vertical gypsum edges. Spacing of fasteners is 12 in. (305 mm) in the field. The first layer is to be fastened using #6 x 1-1/4 in. (32 mm.) Type S drywall screws. The second layer shall be fastened using #6 x 2 in. (51 mm) Type S drywall screws. Screws are anchored into horizontal insulation Z bar channel. All screw heads are to be covered with code compliant drywall compound. Gypsum joints are offset a minimum of 24 in. (610 mm) OC. Vertical joints of the gypsum board do not require blocking.



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Table 8. Greenstone ICE Panels – 2 Hour Non-Load-Bearing Fire-Resistance Rated Assembly Description
Continued

Exterior Sheathing	Type:	1 layer of Type X gypsum board compliant with ASTM C1396, listed by approved agency. Gypsum is oriented horizontally.
	Thickness:	5/8 in. (16 mm) minimum.
	Fastener Detail:	Fastened at maximum 16 in. (406 mm) OC around perimeter and in the field. Fasteners shall be #6 x 1-1/4 in. (32 mm.) Type S drywall screws. All screw heads are to be covered with code compliant drywall compound. Gypsum joints are offset a minimum of 24 in. (610 mm) OC. from the interior wall face 1 st layer gypsum joints.

Notes:

1. All steel materials shall be in accordance with Engineering Design and project specifications, with the minimum thickness and dimensions of steel noted above met.
2. The listed assembly is evaluated for interior fire exposure to fire only.

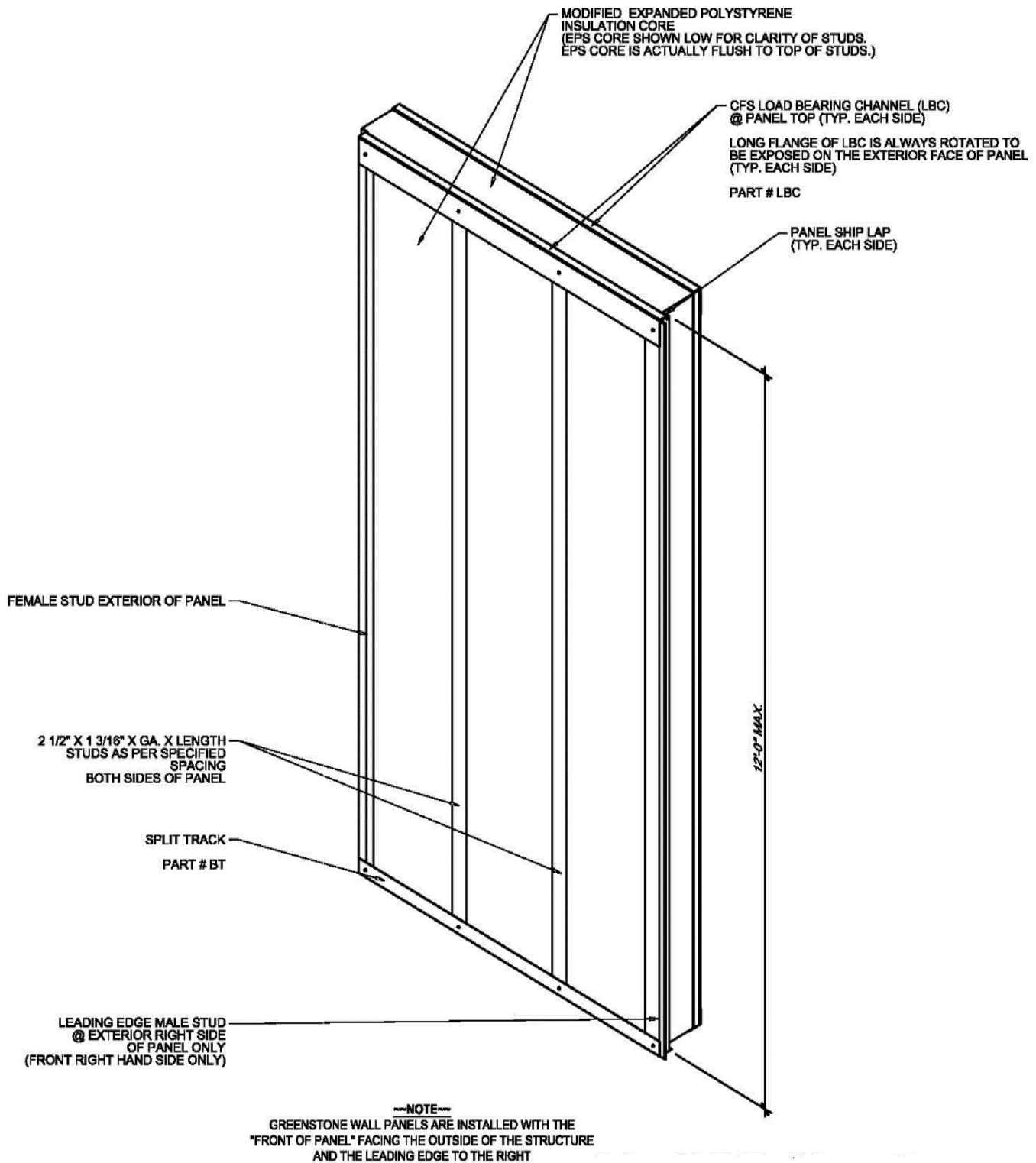


Figure 4. Greenstone ICE Panel Diagram

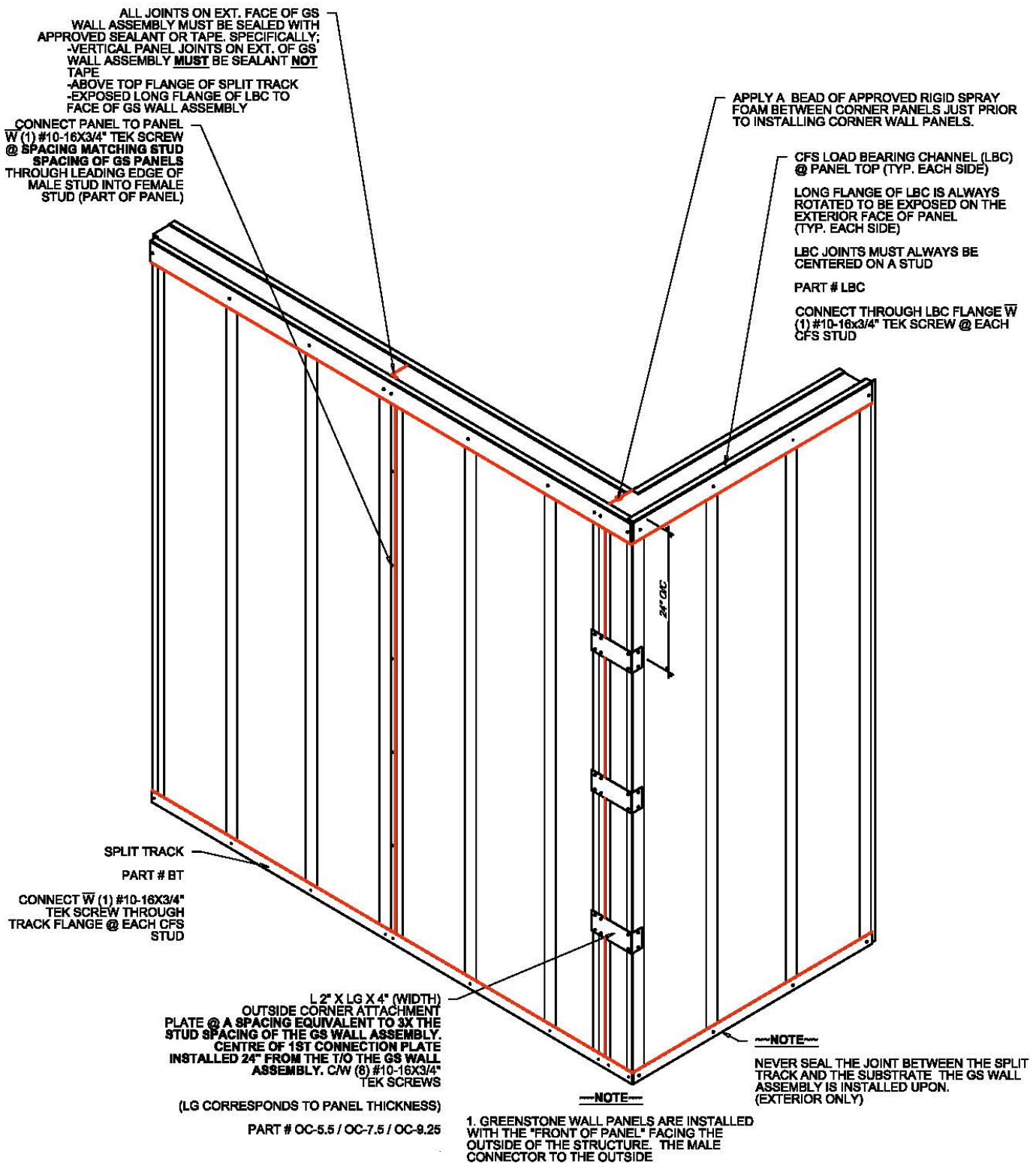


Figure 5. Greenstone ICE Panel Exterior Face Details Including Panel to Panel and Corner Connections

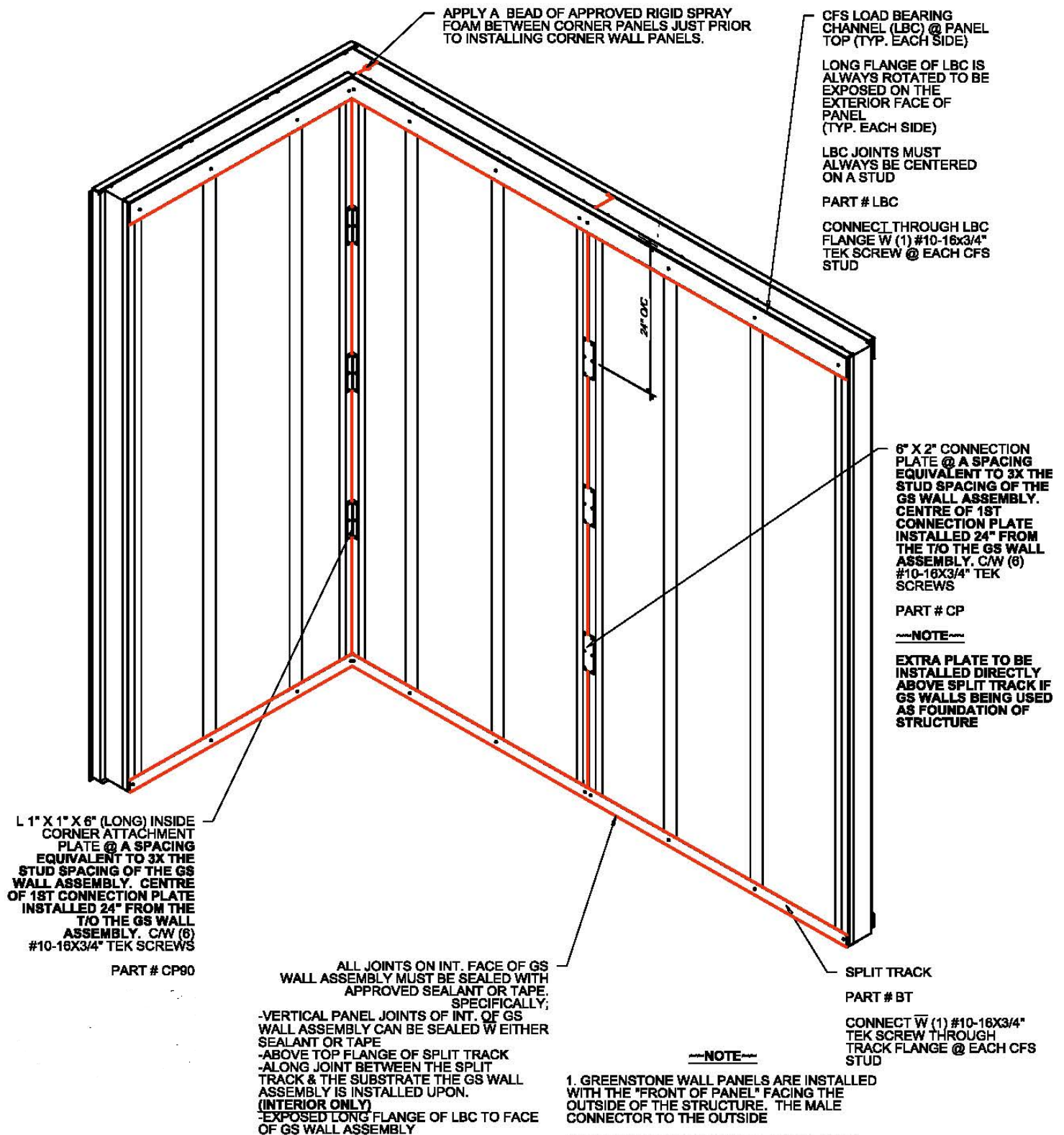


Figure 6. Greenstone ICE Panel Interior Face Details Including Panel to Panel and Corner Connections

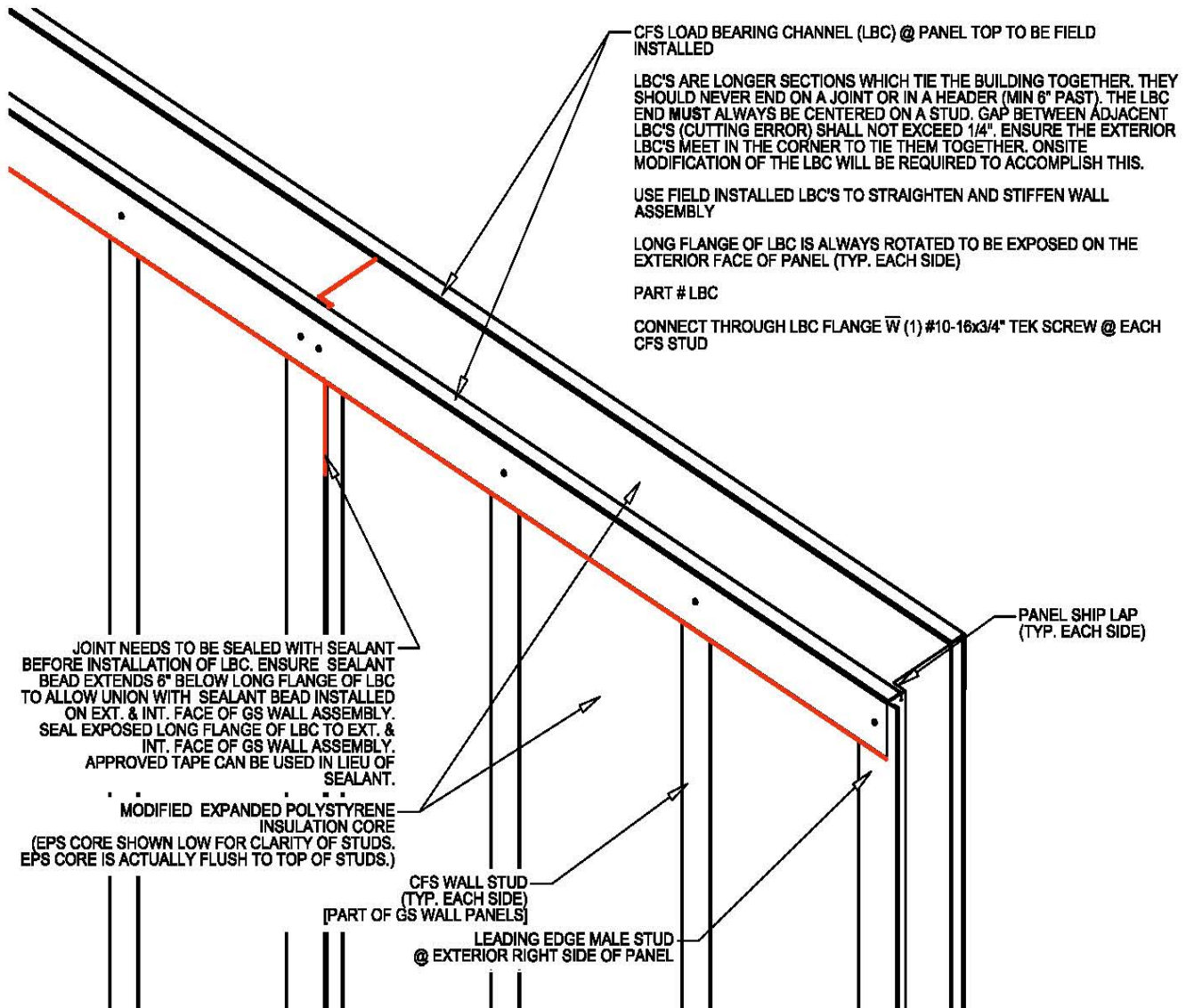


Figure 7. Greenstone ICE Panel Top Track (LBC) to Steel Stud Connection Details

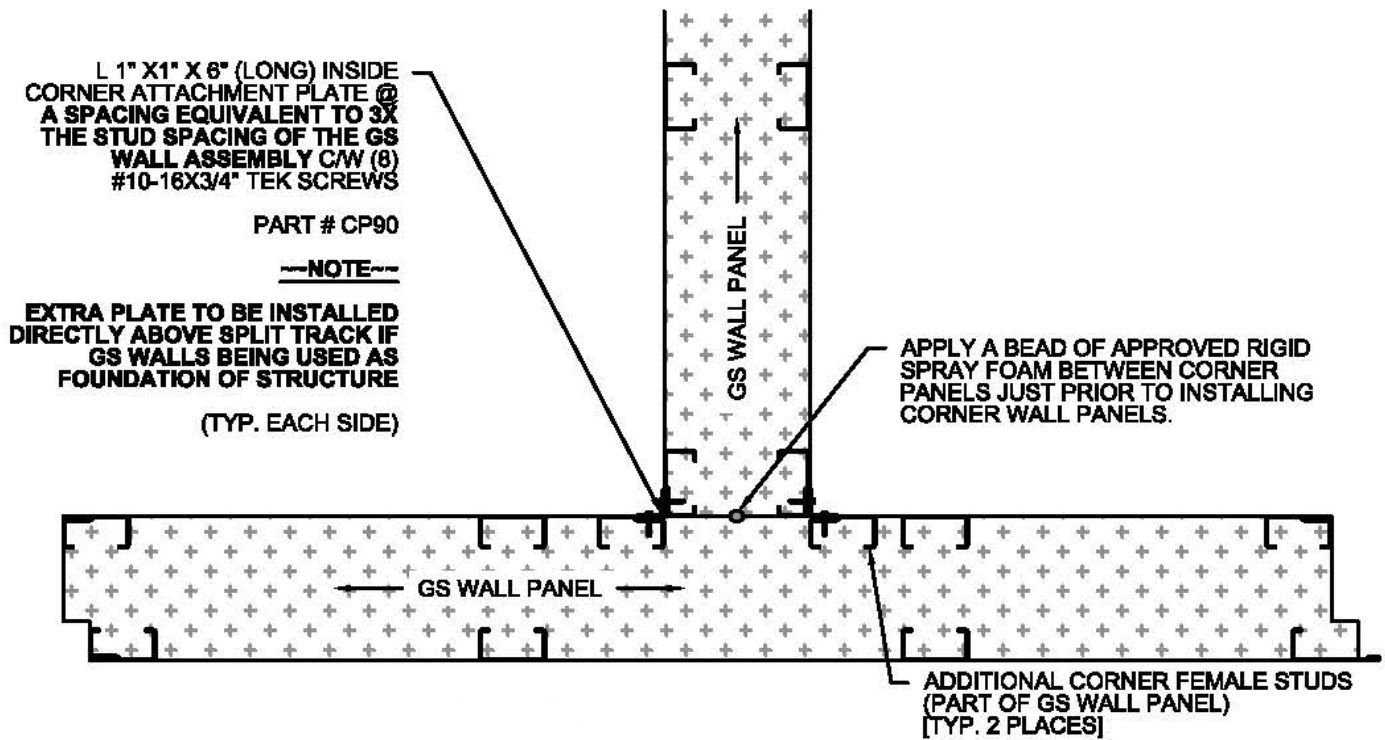


Figure 8. Greenstone ICE Panel Intersection Connection Detail

9.0 ELIGIBILITY OF REPORT

The attached report has been reviewed and approved by a QAI Registered Professional Engineer approved by the specific state Board of Professional Engineers noted on the specific P.E. Stamp(s).

Per section 1703 of the 2018 / 2015 IBC, QAI is an independent third-party testing, inspection and certification agency accredited by the International Accreditation Service, Inc. (IAS) for this specific scope (see IAS PCA-118, PCA-119). QAI can confirm that based on its IAS accreditation it meets 2018 / 2015 IBC Section 1703.1 on Independence, Section 1703.1.2 on Equipment and Section 1703.1 on Personnel.

This Evaluation report has been designed to meet the performance requirements of 2018 / 2015 IBC Section 1703.4 and contains the required information to show the product, material or assembly meets the applicable code requirements.

The product is labeled per section 2018 / 2015 IBC 1703, see QAI listing B1122 for details and subject to follow-up inspection per IBC 1703.6 using QAI IAS accredited ISO 17020 inspection program (see IAS AA-635, AA-723).

For more information regarding QAI Laboratories, please visit www.qai.org.



The above is an example of the QAI registered Listing mark. The Listing mark may only be used by the Report Holder per the QAI service agreement on products defined in this report. The 'us' indicator in the lower bottom right indicates the product complies with the properties evaluated with limitations outlined in this report for use in the US market. A 'c' indicator in the lower bottom left indicates the product has been evaluated for use in the Canadian market.

10.0 REFERENCED STANDARDS

UL 723-2008 *Test for Surface Burning Characteristics of Building Materials.*

ASTM C578-15 *Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.*

ASTM C1396/C1396M-14a *Specification for Gypsum Board.*

NFPA 275-17 *Standard Method of Fire TSTS for the Evaluation of Thermal Barriers.*

ASTM E119-16 *Standard Test Methods for Fire Tests of Building Construction and Materials.*

AISI S100-16 *North American Specification for the Design of Cold-Formed Steel Structural Members.*