

**CLIENT:** **ZS2 TECHNOLOGIES LIMITED**  
#203 – 5005 Elbow Drive, S.W.  
Calgary, Alberta  
T2S 2T6 Canada

**Engineering Evaluation: T14370-10ENG-1**

**Date: November 29, 2022**

**PRODUCT ID:** ZS2 Technologies TechPanel™ Structurally Insulated Panel with 12 mm (1/2") TechBoard™ covered with either 16 mm (5/8") Type X or 12 mm (1/2") TechBoard™ facing interior where joints are offset a minimum of 610 mm (24") from base layer.

**AUTHORIZATION:** Proposal 22JL11251r1 dated November 25, 2022 signed by ZS2 Technologies Ltd. personnel Doug Brown, CTO November 25, 2022.

**EVALUATION REQUESTED:** Engineering Evaluation for compliance of TechPanel™ structurally insulated panel wall assembly finished with 2 layers on the interior surface as described in this report, for maintaining a 1-hour restricted load-bearing fire-resistance rating determined in accordance with the following method:

- CAN/ULC S101-14 *Standard Methods of Fire Endurance Tests of Building Construction and Materials* (CAN/ULC S101).
- ASTM E119-20 *Standard Methods for Fire Tests of Building Construction and Materials* (ASTM E119).

**CONCLUSION:** Based on the rationale presented in this report, ZS2 TechPanel™ with interior finish of 12 mm (1/2") TechBoard™ with joints firestopped or finished with 16 mm (5/8") Type X gypsum board compliant with ASTM C1396 with joints taped and mudded where the joints are offset a minimum 610 mm (24") from the base layer 12 mm (1/2") TechBoard™ interior sheathing, complies with the conditions of acceptance for a 1-hour restricted load-bearing application where the maximum applied load is 32.1 kN/m (2,220 lbs/ft) for assembly height 2.74 m (9 ft).

**Prepared By**

**Signed for and on behalf of  
QAI Laboratories Ltd.**



Matt Lansdowne  
Director of Engineering

Lawrence Gibson  
Executive Vice President

## **EVALUATION PURPOSE:**

At the request of ZS2 Technologies Ltd. QAI has evaluated TechPanel™ structurally insulated panels (SIP) where finished with either 12 mm (1/2") TechBoard™ Magnesium Oxide (MgO) sheathing with joints firestopped or 16 mm (5/8") Type X gypsum wall board complying with ASTM C1396 with joints taped and mudded. In both cases the interior finish joints are should be offset 610 mm (24") from the base layer TechBoard™ 12 mm (1/2") interior sheathing.

This evaluation was conducted to determine if the above-described assembly maintains compliance with the requirements of CAN/ULC S101 and ASTM E119 in a restricted load-bearing condition, where the maximum applied load is 32.1 kN/m (2,220 lbs/ft) at a 2.74 m (9 ft) TechPanel™ height. The evaluation was based on review of QAI testing conducted on ZS2 Technologies Ltd. TechPanel™ assemblies to CAN/ULC S101 and ASTM E119 in load-bearing applications as outlined in QAI test report T1437-7 dated June 14, 2022 and QAI test report T1437-5 dated December 13, 2021.

Additional details of the installed TechPanel™ assembly including interior 12 mm (1/2") TechBoard™ or 16 mm (5/8") Type X gypsum wall board are outlined in Assembly Description section of this report.

## **ASSEMBLY DESCRIPTION:**

A description of TechPanel™ SIP evaluated by QAI for use in 1-hour restricted load-bearing wall assemblies is outlined below.

<b>TechPanel™ Structurally Insulated Panel</b>	Dimensions:	1.22 m (48 in.) wide by 2.74 m (9 ft.) high by 102 mm (6.5 in.) thick. Final assembly was 12 ft wide x 9ft tall.	
	Insulation:	Plastifab Type 1 (0.92 pcf) EPS foam.	
	Framing:	38 mm x 140 mm (Nominal 2 in. x 6 in.) SPF wood stud and plates. The framing consisted of double studs at the joint, single studs at the sides, double top plate and single bottom plate. The MgO was fastened to the studs using #8 x 63.5 mm (2-1/2 in.) construction screws every 152.4 mm (6 in.).	
	Panel Sheathing:	One layer of TechBoard™ Magnesium Sulfate sheathing 12 mm (1/2 in.) thick board on the front and back of the panel. The board is fastened to the insulation using Adfoam Bond Plus 1851 adhesive and fastened to the framing using #8 x 63.5 mm (2-1/2 in.) construction screws every 152.4 mm (6 in.).	
	Adhesive:	Two 9.5 mm (3/8 in.) bead of PL construction adhesive were used on both edges of each stud and plate.	
	Firestop:	3M FD 150+ latex-based elastomeric fire barrier sealant was placed along the joint between the MgO board filling a 1.6 to 3.2 mm (1/16 to 1/8 in.) gap.	
<b>Interior Finish (interior surface only)</b>	Type:	ASTM C1396 Type X Gypsum	TechBoard™
	Min. Thickness:	16 mm (5/8")	12 mm (1/2")
	Installation:	Vertical installation with joints offset at 610 mm (24") from underlying TechBoard™ base layer interior sheathing. Gypsum is to be installed with minimum 57 mm (2-1/4") length Type S drywall screws, spaced at 204 mm (8 inches) on center around perimeter and in the field into underlying TechPanel™ framing members. Joints to be taped and mudded per industry standard.	Vertical installation with joints offset at 610 mm (24") from underlying TechBoard™ base layer interior sheathing. Interior facing TechBoard™ is to be installed with minimum 57 mm (2-1/4") length Type S drywall screws or #8 coarse thread wood screws, spaced at 152 mm (6 inches) on center around perimeter and in the field into underlying studs. Joint is firestopped with Hilti CFS-S-SIL GG firestop flush to the surface to seal gap.

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## **REFERENCED STANDARDS AND REPORTS:**

- CAN/ULC S101-14 *Standard Methods of Fire Endurance Tests of Building Construction and Materials* (CAN/ULC S101).
- ASTM E119-20 *“Standard Methods for Fire Tests of Building Construction and Materials”* (ASTM E119).
- QAI test report T1437-7 dated June 14, 2022 for 1-hour load-bearing fire-resistance testing per ASTM E119.
- QAI test report T1437-5 dated December 13, 2021 for 2-hour nonload-bearing fire-resistance rating per CAN/ULC S101 and ASTM E119.

## **ENGINEERING EVALUATION:**

ZS2 Technologies Ltd. TechPanel™ structurally insulated panels are composed of 12 mm (1/2") TechBoard™ MgO sheathing laminated to Type 1 expanded polystyrene (EPS) foam plastic insulated core, laminated to 12 mm (1/2") TechBoard™ MgO. TechPanels™ include 2 x 6 Spruce-Pine-Fir (SPF) Grade 2 studs spaced at 610 mm (24 inches) on center, with double (2) studs located at panel joints as described in Assembly Description section of this report. TechPanel™ evaluated for 1-hour load-bearing fire-resistance rating experienced failed due to maximum temperature rise at 42:00 minutes, and failed maximum average temperature rise after 51:00 minutes of fire endurance when exposed to the standard time-temperature curve of ASTM E119. This standardized time-temperature curve is identical to the time-temperature curve of CAN/ULC S101.

TechPanel™ 1-hour restricted load-bearing fire-resistance evaluated assembly incorporated only TechPanel™ interior sheathing exposed to the interior, with no additional interior finish layers. During evaluation, the fire was observed to enter the stud cavity by 14:00 minutes, as noted by observations of increased flaming at the interior panel joints that caused structural deterioration through reduction of the stud areas by 38:00 into fire endurance testing (see QAI test report T1437-7 dated June 14, 2022). The fire is considered to have entered the stud cavity through the joints early into the test.

Considering application of 16 mm (5/8") Type X gypsum board as interior finish to the described TechPanel™ evaluated assembly where joints are offset, the penetration of the fire into the stud cavity would be retarded by the gypsum presence. The 2015 National Building Code of Canada and 2018 British Columbia Building Code, Appendix D Table D-2.3.4-A *Time Assigned to Protective Membranes on Fire-Exposed Side of Wood-Framed and Cold-Formed-Steel-Framed Walls* outlined the inclusion of 15.9 mm Type X gypsum board provides 40 minutes of protection to load-bearing wood stud assemblies. As TechPanel™ consists of 610 mm (24") SPF Grade #2 lumber framing in the SIP, this framing is considered to simulate standard wood frame construction. Thus the 40-minute protection noted applies where the Type X gypsum board is installed with Type S drywall screws at maximum 204 mm (8 inch) on center spacing<sup>1</sup>. A TechPanel™ assembly including an interior finish of 16 mm (5/8") Type X gypsum board with joints offset 610 mm (24") on center is considered by QAI compliant with the requirements of CAN/ULC S101 and ASTM E119 in a restricted load-bearing condition, where the applied load is 32.1 kN/m (2,220 lbs/ft) at a 2.74 m (9 ft) TechPanel™ height.

Note 1: QAI notes, while the additive method of the building codes referenced does not comply with Section D-2.3.3 as the TechPanel™ system is beyond the assemblies referenced in Appendix D of the applicable codes. However, the estimation of protection provided by 16 mm (5/8") Type X gypsum exceeds the time required for ensuring compliance of the QAI tested TechPanel™ assembly outlined in QAI report T1437-7 dated June 14, 2022 with significant margin of safety. Given the similarity in wood framing connection and the large margin of safety applied, the TechPanel™ assembly incorporating 16 mm (5/8") Type X on the interior face of the built-up assembly is considered by QAI to comply with 1-hour load-bearing fire-resistance rating requirements.

Considering inclusion of a secondary layer of 12 mm (1/2") TechBoard™ installed as interior finish to the described TechPanel™ evaluated assembly where joints offset, the interior finish would cover the noted joints preventing fire from entering the stud cavity. QAI test report T1437-5 dated December 14, 2021 details a 2-hour nonload-bearing fire resistant TechPanel™ assembly including 2 layers of 12 mm (1/2") TechBoard™ on the interior surface facing fire, where the joints were offset 610 mm (24") and exposed TechBoard™ was anchored with 16 gauge staples with 12.7 mm (1/2") crown width and 21 mm (inch) leg length at 76 mm (3 inches) on center spacing. The noted TechPanel™ 2-hour assembly experienced fireside joint opening of the firestopping at 40:00 into fire endurance evaluation to CAN/ULC S101 / ASTM E119. The described assembly-maintained load until 1-hr 28:00 minutes into testing. Compared to 1-hour TechPanel™ tested assembly with 1 layer of TechBoard™ facing fire where load was sustained until 38:00 minutes of testing, the inclusion of the interior finish of TechBoard™ where the joint was finished with Hilti CFS-S-SIL GG firestop improved load-carrying capacity by 50 minutes duration. This improvement is expected as the TechBoard™ when installed on the interior surface, inhibits fire from entering the stud cavity through TechPanel™ joints. TechPanel™ assembly with inclusion of a 12 mm (1/2") TechBoard™ interior finish layer with joints offset 610 mm (24") on center and the exterior Joints are firestopped is considered by QAI compliant with the requirements of CAN/ULC S101 and ASTM E119 in a restricted load-bearing condition, where the applied load is 32.1 kN/m (2,220 lbs/ft) at a 2.74 m (9 ft) TechPanel™ height.

## **CONCLUSIONS:**

QAI has evaluated TechPanel™ SIP assemblies where finished with either 12 mm (1/2") TechBoard™ MgO with joints firestopped or where interior finished with 16 mm (5/8") Type X gypsum wall board with joints taped and mudded and where for either option the interior joints are offset 610 mm (24") from the underlying TechBoard™ 12 mm (1/2") interior sheathing panel. This evaluation was conducted to determine if the above-described assembly maintains compliance with the requirements of CAN/ULC S101 and ASTM E119 in a restricted load-bearing condition

It is QAI's professional opinion that the ZS2 TechPanel™ assembly finished on the interior with 12 mm (1/2") TechBoard™ with joints firestopped or finished with 16 mm (5/8") Type X gypsum board compliant with ASTM C1396 with joints taped and mudded and where for either option the joints are offset a minimum 610 mm (24") from the underlying 12 mm (1/2") TechBoard™ interior sheathing, complies with the conditions of acceptance for a 1-hour restricted load-bearing application where the maximum applied load is 32.1 kN/m (2,220 lbs/ft) at 2.74 m (9 ft) height.

## **REPORT REVISION HISTORY**

Date	Version	Change Description		Initials
November 29, 2022	-	Original Report		ML

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