



Evaluation Report CCMC 13016-R Insulspan Structural Insulated Panel (SIP) System

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1. Opinion

It is the opinion of the Canadian Construction Materials Centre (CCMC) that “Insulspan Structural Insulated Panel (SIP) System” (hereafter known as “Insulspan SIP System”), when used as exterior insulated loadbearing wall and roof panels in accordance with the conditions and limitations stated in Section 3 of this Report, complies with the National Building Code of Canada (NBC) 2015*:

- Clause 1.2.1.1.(1)(a) of Division A, using the following acceptable solutions from Division B:
 - Section 4.1., Structural Loads and Procedures
 - Article 4.3.1.1., Design Basis for Wood (i.e., composite panel with lumber studs/joists)
 - Subsection 9.25.2., Thermal Insulation
 - Subsection 9.25.4., Vapour Barriers
- Clause 1.2.1.1.(1)(b) of Division A, as an alternative solution that achieves at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the following applicable acceptable solutions:
 - Section 4.3., Design Requirements for Structural Materials (i.e., EPS core)
 - Subsection 9.23.10., Wall Studs
 - Subsection 9.23.14., Roof and Ceiling Framing
 - Subsection 9.25.3., Air Barrier Systems

* Note: Compliance to the NBC 2010 for the same technical provisions is also maintained.

This opinion is based on CCMC’s evaluation of the technical evidence in Section 4 provided by the Report Holder.

Ruling No. 10-07-244 (13016-R) authorizing the use of this product in Ontario, subject to the terms and conditions contained in the Ruling, was made by the Minister of Municipal Affairs and Housing on 2010-04-12 (revised 2014-10-27) pursuant to s.29 of the *Building Code Act*, 1992 (see Ruling for terms and conditions). This Ruling is subject to periodic revisions and updates.

2. Description

The product consists of structural framing with infill panels of expanded polystyrene (EPS) insulation glued to two 11.0 mm (7/16 in.) oriented strand board (OSB) panels. For wall panels in loadbearing applications, lumber studs are installed as structural ribs at 1.2 m on centre (o.c.) at the panel joints. For roof panels, either lumber or I-joists are installed as structural ribs at 1.2 m o.c. at the panel joints. For nonstructural applications on post-and-beam construction, the panels have OSB splines for joining the panels.

The Type 1 and Type 2 EPS core insulation (see CCMC 12424-L and 12425-L) are certified by a third party and are under a Plasti-Fab Ltd. upgraded quality assurance program that verifies the EPS’s mechanical properties.

The OSB panels are a minimum 11.0 mm (7/16 in.) in thickness and conform to CSA O325-07, “Construction Sheathing,” and are certified by a third party. In addition, Insulspan requires that the OSB manufacturer provide assurance that its OSB panels possess the properties specified in Insulspan’s proprietary specifications entitled “Insulspan SIP Grade OSB.”

The adhesive used to bond the EPS core to the OSB facers is a moisture-cured, one-part urethane adhesive designed for application by bead applicator.

All aspects of the product's manufacturing are verified by an in-plant quality control program. The in-plant quality control and the product are third-party certified by Intertek ETL Listed, providing assurance that the Insulspan SIP panels meet the proprietary specifications in order to maintain the published design values.

The panels are available in thicknesses of 115 mm, 165 mm, 210 mm and 260 mm for walls, and 115 mm, 165 mm, 210 mm, 260 mm and 310 mm for roofs. The spans vary based on the anticipated loading and are outlined in the manufacturer's published span charts as specified in Section 3 of this Report.

Lintels for doors and windows are framed as in conventional framing. The "Insulspan SIP System" panel wall and roof construction is proprietary, with specific construction details for the top and bottom plates, a nailing schedule (size, spacing and angle of nail entry), and a field adhesive/sealant. The field construction sequencing must be in strict accordance with the "Insulspan SIP Installation Guide" (including the checklist within the Guide).

The figures below show the salient features of the product. Please refer to the manufacturer's specifications for detailed requirements.

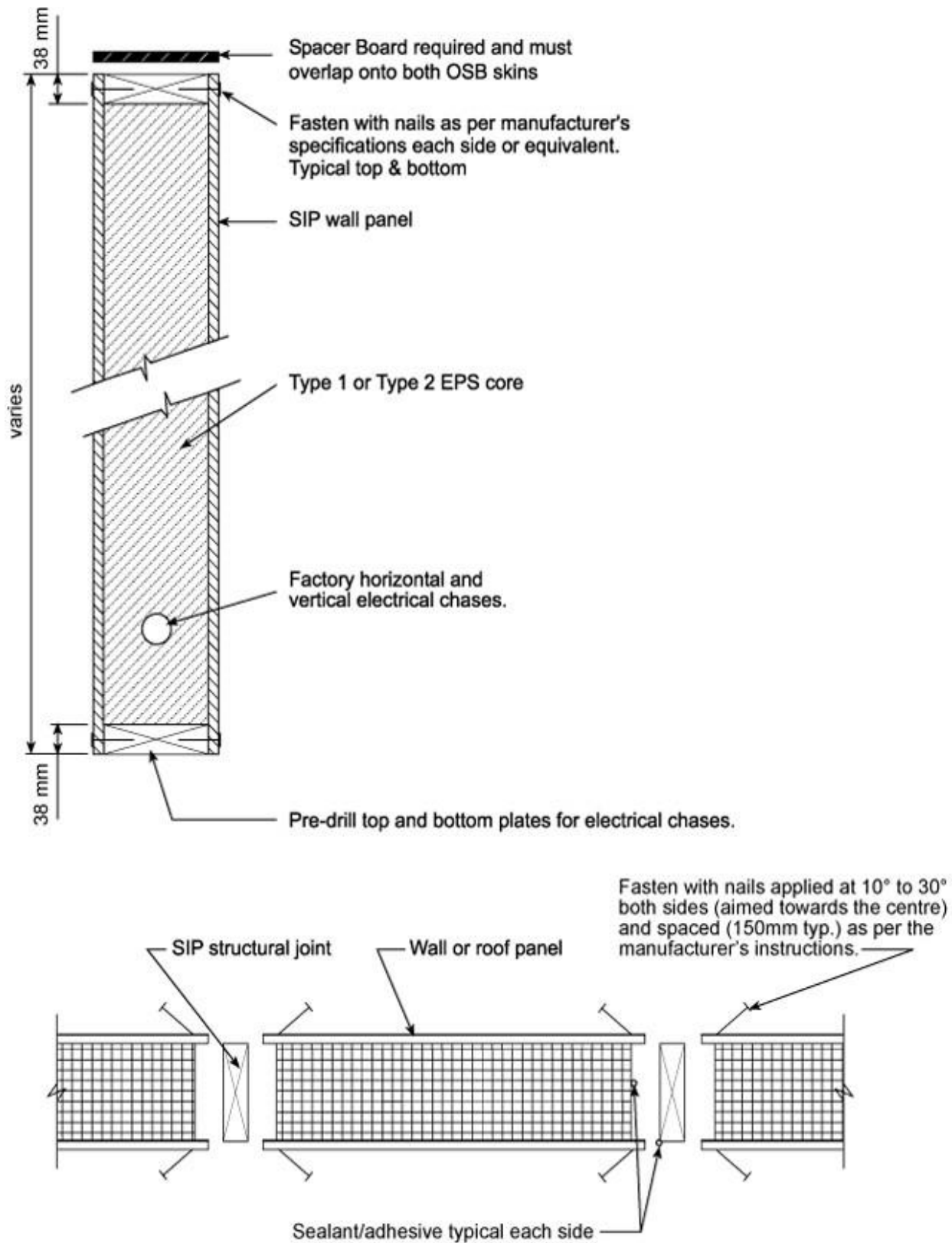


Figure 1. “Insulspan SIP System” wall panels with lumber studs at 1.2 m o.c. Note that lumber studs, top and bottom plates are installed in the field following a specific nailing schedule. See manufacturer’s installation details.

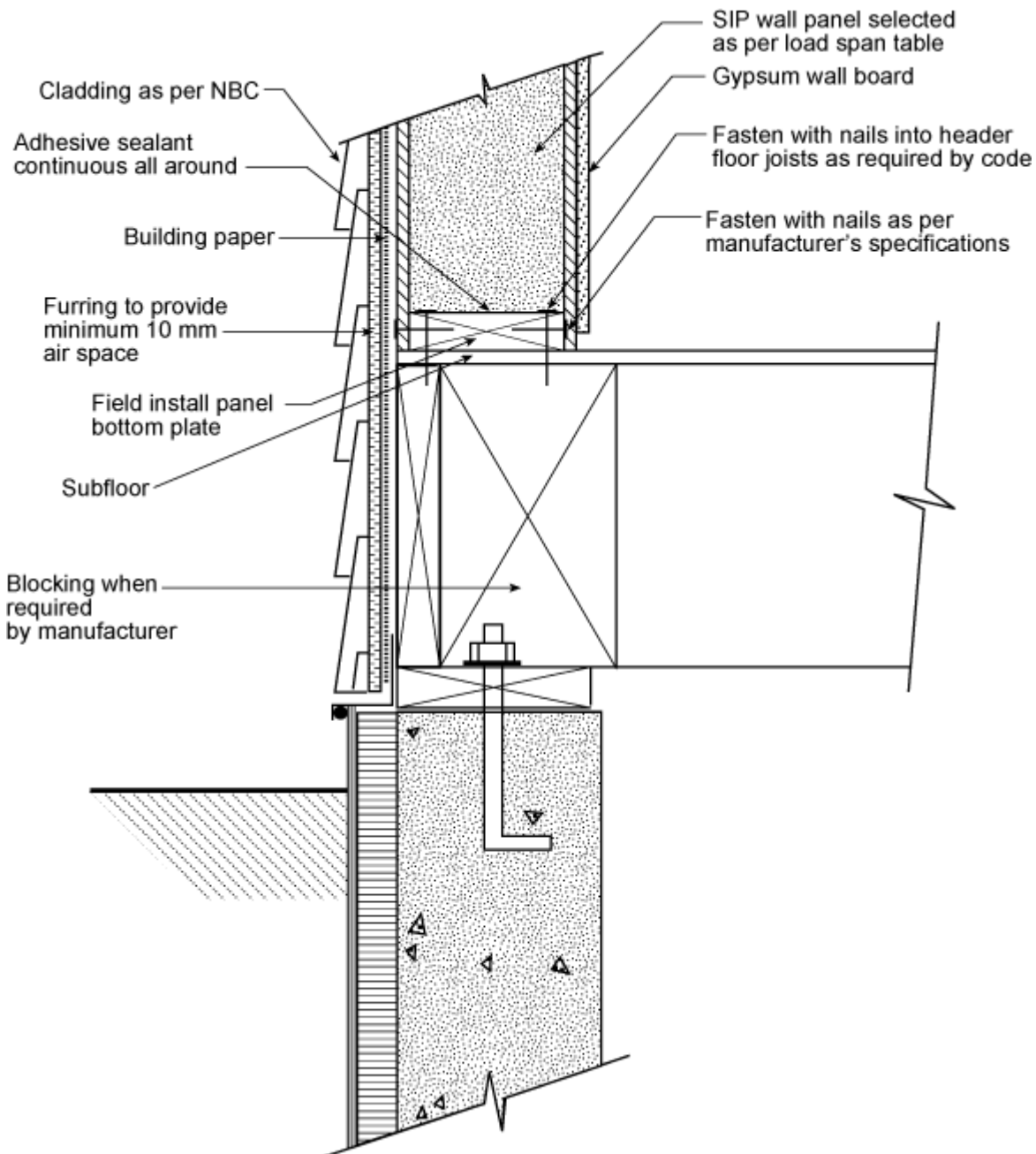


Figure 2. “Insulspan SIP System” – details of a wall panel connection to floors and rainscreen cladding. See manufacturer’s details for sealant and tape requirements.

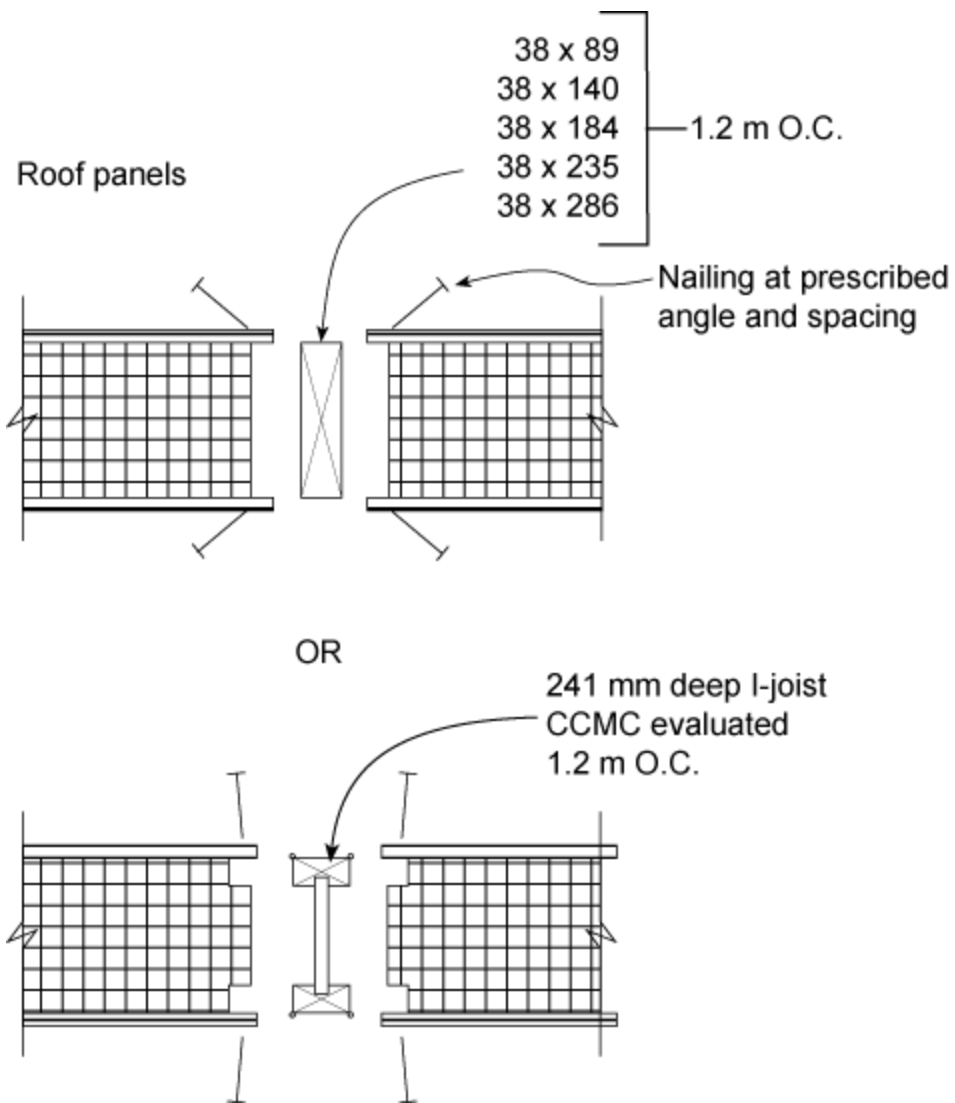


Figure 3. “Insulspan SIP System” – structural roof panels with lumber or prefabricated I-joists at 1.2 m o.c. See manufacturer’s details for sealant and tape requirements.

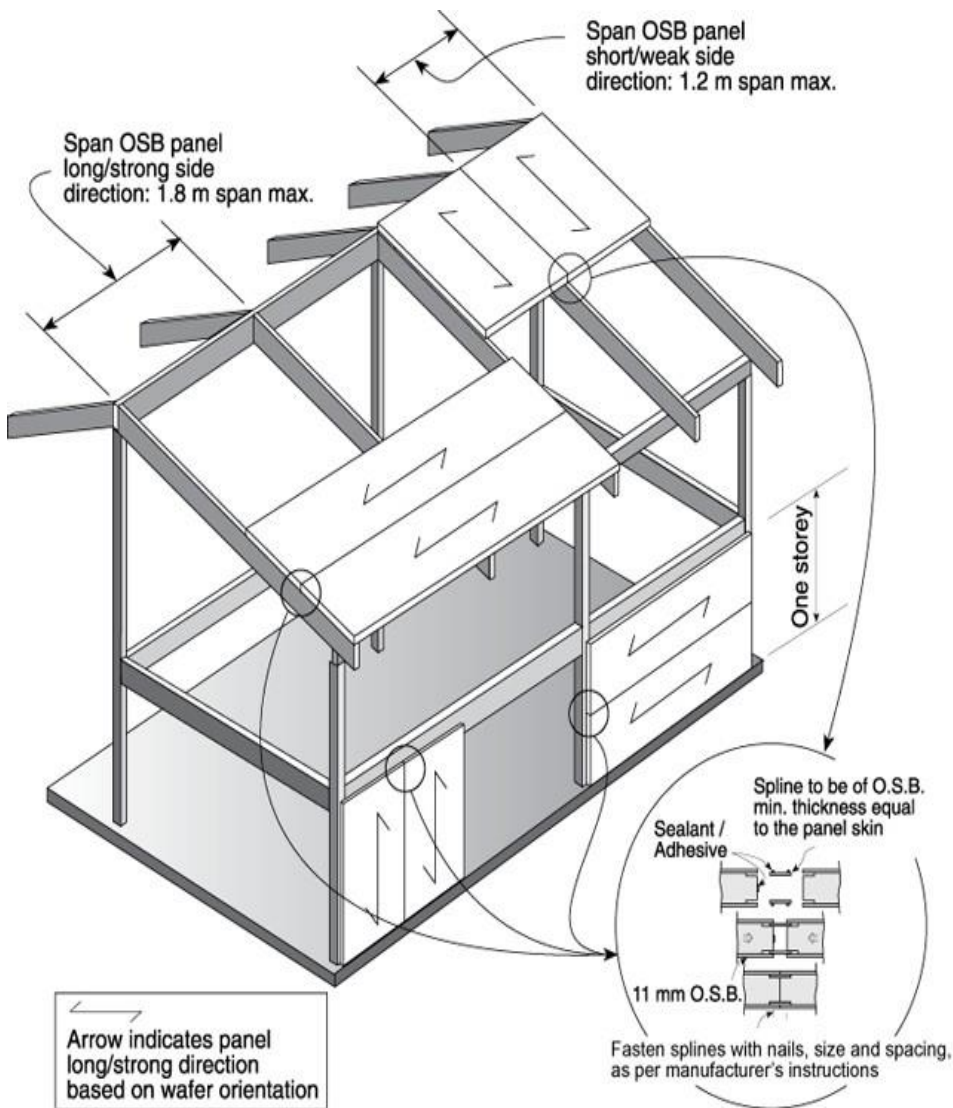


Figure 4. “Insulspan SIP System” – non-axially loaded structural panels with OSB splines on post-and-beam frame with limited roof spans of 1.2 m in OSB weak direction and 1.8 m in OSB strong direction. See manufacturer’s panel-to-structure fastening details.

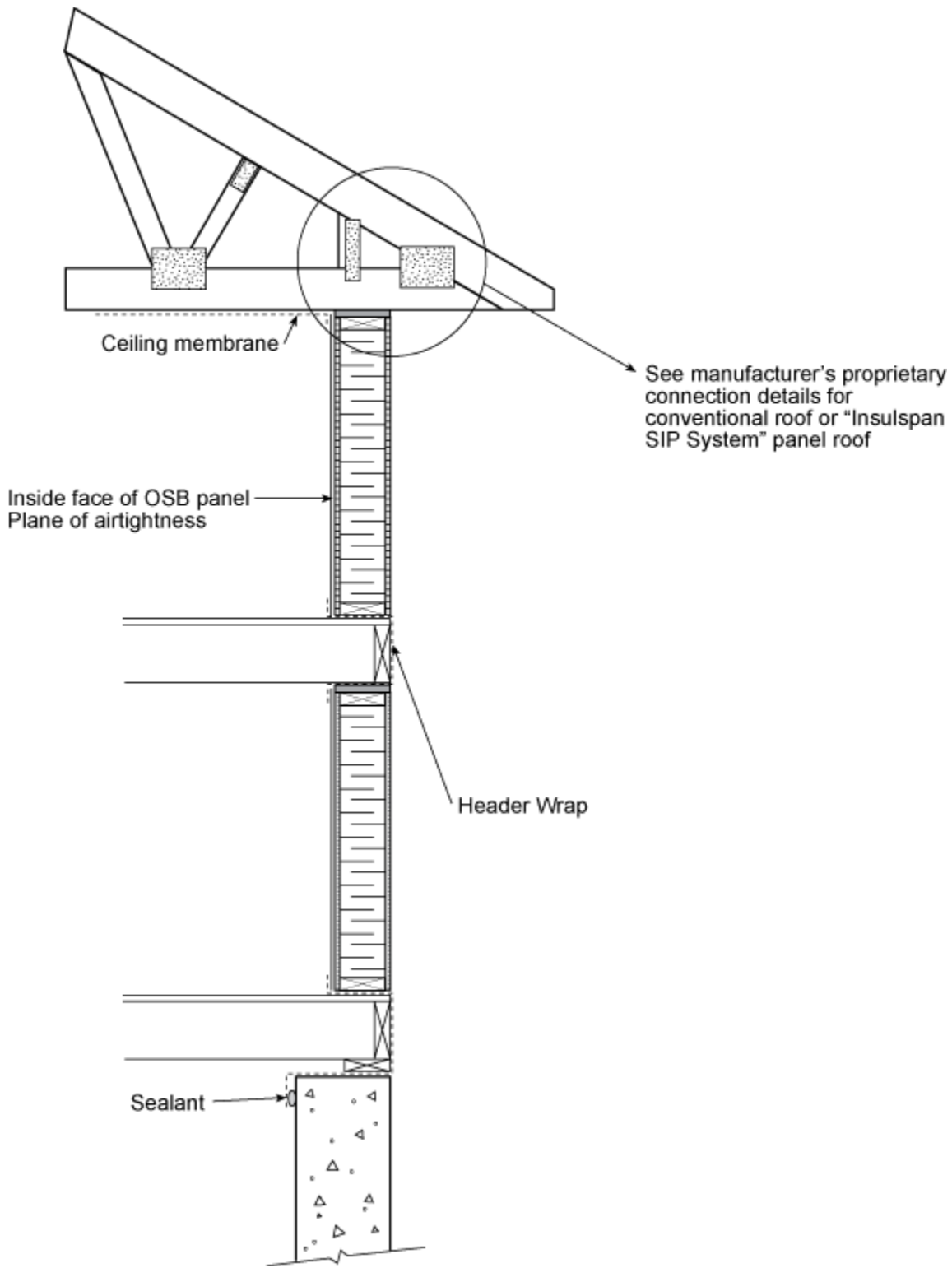


Figure 5. "Insulspan SIP System" – proprietary air barrier system – continuity of seal of the inside barrier face must be maintained.

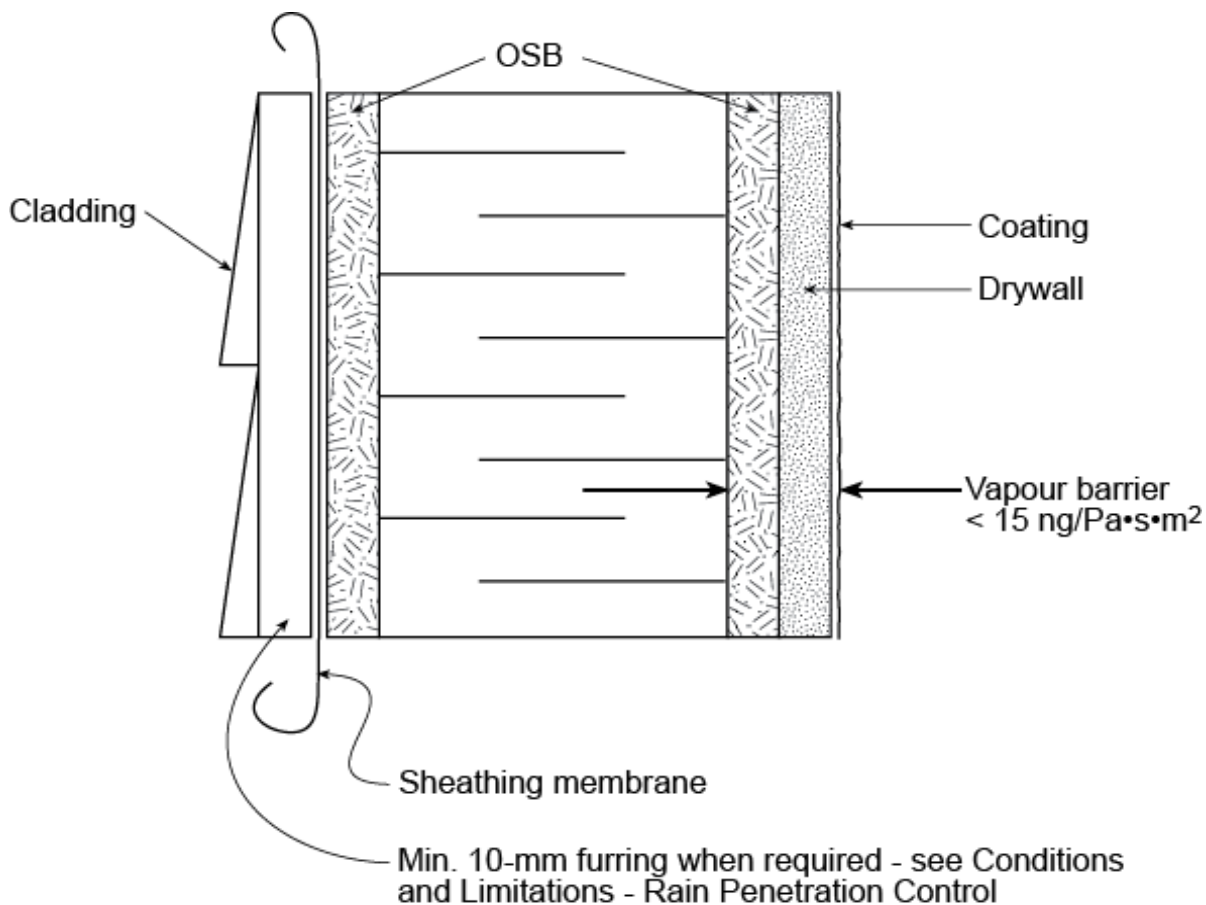


Figure 6. “Insulspan SIP System” – vapour diffusion control

3. Conditions and Limitations

CCMC’s compliance opinion in Section 1 is bound by the “Insulspan SIP System” being used in accordance with the conditions and limitations set out below.

3.1 Application Scope

As the acceptable solutions in Section 9.23., Wood-Frame Construction, of Division B of the NBC 2015 are limited to conventional wood-frame construction, alternative solutions must conform to Subsection 9.4.1., Structural Design Requirements and Application Limitations, which states that the structural design:

- (i) must be carried out in accordance with Part 4 (i.e., **reliability-based proprietary design values be established** and that the subsequent member **design methodology/equations** be in accordance with Part 4 limit states design (LSD) design standards, and
- (ii) the member design may be conducted to **resist loads specified** in Part 4, or for small buildings, loads specified in Part 9.

This CCMC Evaluation Report presents Plasti-Fab Ltd.’s alternative solutions to:

- (i) using the lumber stud tables in Article 9.23.10.1., Stud Size and Spacing, of Division B of the NBC 2015, and lumber rafters in Sentence 9.23.4.2.(1), Span for Joists, Rafters and Beams, of Division B of the NBC 2015, i.e., pre-engineered wall and roof Insulspan panel resistance values for LSD design, for the specified gravity loads, and
- (ii) the building envelope requirements for a Part 9 building. Hence, the structural capacity of the Insulspan panels mentioned in (i), developed in accordance with Part 4, may be used for any building permitted to be of combustible construction that falls under Part 9 or Part 4 of the NBC 2015, for the specified loads.

The scope presented below is limited to single-family houses since fire-resistance ratings, sound ratings, etc. are not provided herein for occupancies beyond single family houses.

3.2 Single-family Houses

The use of the Insulspan panel product as a structural insulating framing system is limited to single-family housing falling within the scope of Part 9 of Division B of the NBC 2015. The product provides:

- (i) an alternative solution to Clause 9.4.1.1.(1)(c), General (Structural Design Requirements and Application Limitations), and Section 9.23., Wood-Frame Construction, of Division B of the NBC 2015, for framing of walls and roof, and
- (ii) an NBC-specified acceptable solution meeting Section 9.25., Heat Transfer, Air Leakage and Condensation Control, of Division B of the NBC 2015, for insulation, air leakage control and vapour diffusion control, when the conditions and limitations outlined below are met.

3.3 Insulspan for Structural Use

3.3.1 Wall and Roof Panels

When used as wall and roof panels, the installation must conform to the signed and sealed load tables for “Insulspan Structural Insulated Panels (SIP),” last revision dated September 16, 2013.

These load tables have been prepared using a proprietary reliability-based SIP computer model with benchmark testing conducted to produce design values meeting the reliability targets of CSA O86-14, “Engineering Design in Wood.” As stated below, design details can be obtained from the manufacturer for custom designs not covered by the pre-engineered span tables.

It should be noted that the load tables outline the total specified live and dead loads permitted, with a ratio of 2:1. As a result, the load tables are presented based on the anticipated local wind load and resulting maximum permitted axial load. Maximum total specified axial loads (live load plus dead load) of: 14.6 kN/m, 21.8 kN/m, 29.2 kN/m (1 000 lbf./ft., 1 500 lbf./ft. or 2 000 lbf./ft.) are permitted as long as the dead load portion does not exceed 4.8 kN/m, 7.3 kN/m, 9.5 kN/m (333 lbf./ft., 500 lbf./ft. and 667 lbf./ft.), respectively. When the latter dead load levels are exceeded, the design must be modified to address duration of load effects.

For structural applications outside the scope of the above-referenced manufacturer’s publication, the drawings or related documents must bear the authorized seal of a professional engineer skilled in wood design and licensed to practice under the appropriate provincial or territorial legislation.

3.3.2 Window and Door Lintel Framing

Window and door lintel framing must be conventional framing. Lintels at door and window openings must be in conformance with Article 9.23.12.3., Lintel Spans and Sizes, of Division B of the NBC 2015. Point loads within the wall assembly must also be addressed in a conventional manner with adequate columns as per the NBC 2015.

3.3.3 Other Construction Details

Except for conventional treatment of lintels and point loads, the remainder of the SIP panel wall and roof construction is proprietary with specific construction details for top and bottom plates, wall-to-roof connections, proprietary screw and nail schedule (number, spacing and angle of nail entry), and field adhesive/sealant. The field construction sequencing must be in strict accordance with the “Insulspan Installation Guide” dated rev: 2015-11-09 and the more detailed Insulspan “Construction Assembly Details,” dated 2016. Note that only the Insulspan System with a structural stud or joist at 1.2 m (4 ft.), on centre, is CCMC-evaluated, as well as, the limited applications over a structural timber frame as shown in Figure 4. Any other panel installations, in particular loadbearing applications without structural members, is not CCMC-evaluated and panels shall not bear the CCMC mark.

In addition, Insulspan provides field plans and field advisory service (when specified) for assurance on the proper installation of the panels.

3.3.4 Design, Handling and Installation

All details of design, handling, and installation must comply with the manufacturer’s current specification and instruction manual titled “Insulspan Structural Insulated Panel System – Installation Guide,” dated 2015-11-09. It is important that the construction sequence of the panel erection (i.e., bottom plate attachment to floor, panel erection, stud installation, top plate and second cover plate, nail spacing and angle of nail entry, adhesive, etc.) be followed to ensure panel performance.

3.3.5 Construction in Areas of High Wind and High Seismicity

For areas of high wind and high seismicity, designers should consult the manufacturer for proprietary shear wall test data for comparison with current table of shear wall design values in CSA O86. With no hold-downs, the “Insulspan SIP System” is limited for use in geographical locations where the $q_{1/50}$ wind load is less than 0.6 kPa and the 5% damped spectral response acceleration, $S_a(0.2) < 0.7$.

3.4 Air Leakage Control

The product panel can be used as an air barrier material within the manufacturer's proprietary air barrier system. Two layers of OSB and an EPS foam core meet the 0.02 l/sm² at 75 Pa air leakage rate requirement and are equivalent to materials specified in Note A-9.25.5.1(1), Air and Vapour Permeance Values, of the NBC 2015. To be installed as the designated air barrier system, the panels must have joints sealed to maintain airtightness and continuity (i.e., CCMC-evaluated header wrap around floors, sealed at penetrations, etc.) in accordance with Article 9.25.3.3., Continuity of the Air Barrier System, of Division B of the NBC 2015. See the manufacturer's proprietary air barrier system details and Figure 5.

Alternatively, if a separate proprietary air barrier system is to be installed, Insulspan recommends a sheathing membrane-type air barrier material and system as outlined in CCMC 13280-R or 13290-R.

3.5 Vapour Diffusion Control

When used to provide vapour diffusion control, the "Insulspan SIP System" wall panels, consisting of two layers of OSB and EPS foam core, meet the requirements of Subsection 9.25.4. of Division B of the NBC 2015, when interior painted drywall with a composite water vapour permeance of 15 ng/(Pa·s·m²) is installed on the warm side of the wall assembly and a 10-mm air space is installed on the cold side (see Figure 6).

3.6 Rain Penetration Control

The product's performance depends on continuous protection of the SIP panels from water penetration for the projected lifetime of the structure. In conventional wood-frame structures, when a failure of the roof or wall cladding occurs, water will normally leak into the occupant's space. Such leakage alerts the occupants to failure and repairs can be undertaken.

In the case of closed panels, such as SIPs, the occupants may not be alerted of any water penetration until the exterior OSB skins have absorbed excessive moisture increasing the risk of failure. The use of OSB in wet conditions is not permitted as per CSA O86 and the NBC 2015, hence the cladding design must prevent the OSB from being subjected to wet conditions.

As a result, the cladding solutions in Section 9.27., Cladding, of Division B of the NBC 2015, which apply to conventional wood-frame must be enhanced for both wall and roof installations by installing an appropriate "second line of defence" against water penetration in line with the occupant's expectations of performance, maintenance and inspection.

3.7 Wall Cladding – Rainscreen System

The wall cladding must be installed as a rainscreen system with a minimum 10-mm air space to allow for drainage of any water that may breach the cladding. The 10-mm air space for drainage must be outboard of a sheathing membrane protecting the SIP panel. The membrane must be properly installed in conjunction with top and bottom window flashing to shed water to the exterior.

3.8 Roof Cladding – Design Installation

The strength of conventional roof structures, whether they consist of roof trusses or roof rafters, is largely unaffected by the initial stages of any water penetration. In the case of SIPs, failure of the roof covering could lead to the rapid accumulation of moisture in the top skin accompanied by changes in the performance of the panels and likely, permanent sagging of the roof panels.

Hence, the design of the roof cladding for use with SIPs must perform to provide a reduced risk of water penetration when compared with conventional roof structures. The roof cladding installed must have a second line of defence based on the anticipated wind-driven rain, snow and ice conditions for the geographical location.

Examples of a second line of defence include, in conjunction with eave protection from ice damming, single or multiple layers of 15-lb. or 30-lb. asphalt-impregnated membranes or modified bituminous membranes over the entire roof beneath the roof cladding. The selection should be based on the climatic loads at the building location, anticipated roof slope, quality of the roof cladding selected and occupant performance expectations and maintenance envisioned.

Note: The venting requirements in Subsection 9.19.1., Venting, of Division B of the NBC 2015, do not apply to qualified SIP panel construction since it is a closed-cavity design building component with the top and bottom OSB facers intimately adhered in the plant fabrication and there is the specified interior vapour diffusion protection and air leakage protection provided by the designated air barrier system. In addition, the required exterior second line of defence from occasional minor water penetration is in place, as specified above. Thus, a SIP panel does not include spaces within the panel as moisture from the said sources should not occur with this alternative solution to conventional roof construction. See additional explanations and exceptions as noted in Note A-9.19.1.1.(1), Venting of Attic or Roof Spaces, of Division B of the NBC 2015 and the Objectives and Functional Statements.

3.9 Construction Moisture During Installation of Roof Panels

Care must be taken in the case where the “Insulspan SIP System” roof panels have been exposed to moisture/rain and where a water and vapour impermeable roof cladding is being installed (i.e., asphalt shingles). As the OSB panel, which has been wetted, cannot dry towards the attic (like in conventional construction), the exposed OSB panel should be allowed to dry before the asphalt shingles are installed. OSB, like other wood products, must be protected from excessive moisture and covered with cladding as soon as possible.

These panels must be identified with the phrase “CCMC 13016-R,” along with the Intertek Testing Services (ITS), Warnock Hersey certification mark.

4. Technical Evidence

The Report Holder has submitted technical documentation for CCMC’s evaluation. Testing was conducted at laboratories recognized by CCMC. The corresponding technical evidence for this product is summarized below.

4.1 Material Requirements

The material properties which must be maintained include, but are not limited to the following:

- the proprietary-grade OSB facers must meet CSA O325 and the enhanced mechanical properties specified by the manufacturer,
- the EPS core must meet CAN/ULC-S701-11, “Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering,
- the adhesive must be the MOR-AD™ M-657 by Dow Chemical (formerly Rohm & Haas),
- the size and type of nail used on the interior and exterior of the panels must adhere to the manufacturer’s fastener specifications, including angle of nail entry,
- for walls, the specified lumber grade for the wood studs,
- for roof panels, the specified lumber or I-joist grade, and
- the header wrap material must be CCMC-evaluated as an air barrier material.

4.2 Prescriptive Requirements

The thermal resistance requirements are met by having demonstrated that the EPS used in the panels comply with CAN/ULC-S701-11 via third-party certification of the EPS boards used.

The air leakage control requirements are met through the Insulspan proprietary air barrier system details where the inner OSB facer is forming the principal plane of airtightness. The continuity details are met via a CCMC-evaluated header wrap with an air leakage rate of $\leq 0.02 \text{ l/s}\cdot\text{m}^2$. The vertical joints of the panels are to be sealed and rendered airtight as per the manufacturer’s details.

The vapour diffusion control requirements are met by combining the inner OSB with a gypsum interior finish and coating (i.e., primer and two coats of paint), that together result in a water vapour permeance value of $\leq 15 \text{ ng}/(\text{Pa}\cdot\text{s}\cdot\text{m}^2)$.

4.3 Performance Requirements

Structural testing of the “Insulspan SIP System” was witnessed by an independent testing agency recognized by CCMC. The scope of the test program, quality control and certification programs are summarized below.

4.3.1 Stiffness

Forty-nine (49) specimens of OSB panels, lumber ribs and wood I-joist ribs were tested for their modulus of elasticity. In addition, testing of EPS to determine the shear modulus and density was conducted. Ninety (90) connection shear tests were also conducted to determine the shear stiffness of the rib-skin interface.

4.3.2 Full-scale Panel Strength Tests

Thirty (30) full-size panels were tested and the results were compared with the predictions of the computer model. The model proved to be reliable in predicting the SIP panel performance for roof and wall panels.

4.3.3 SIP Panel Tests – Weak (Short) OSB Direction

Concentrated static and impact tests (wet and dry) were conducted on panels in accordance with CAN/CSA-O325.1-88, “Test Methods for Construction Sheathing.” All specimens met the criteria for 1.2-m span rating contained in CSA O325.

4.3.4 SIP Panel Tests – Strong (Long) OSB Direction

Panel bending tests were conducted, before and after wetting, to determine the effect of moisture on the strength of the exposed panels. The loss of strength was in the order of 10%, but remained well above the permitted specified ultimate transverse load.

4.3.5 Creep and Recovery

Three (3) pairs of full-scale panel bending tests were conducted with a sustained 24-hour specified load imposed. The CCMC criteria of a maximum 25% creep and recovery of L/1440 were met. The permitted specified loads were then doubled and no failures occurred after 24 hours.

4.3.6 OSB/EPS Adhesive Qualification

Adhesive shear testing conducted to date, before and after aging, has demonstrated shear strength in excess of the EPS foam core.

4.3.7 Ongoing Quality Control (QC) and Certification

All manufacturing plants listed in this Report participate in third-party certification currently provided by Intertek Testing Services (ITS), a certification organization accredited by the Standards Council of Canada for this type of product. ITS has extended certification for the listed plant locations based upon:

- a review of Insulspan’s “Panel and SIP Engineering Model Program,”
- a review of panel qualification tests conducted by an independent testing agency recognized by CCMC, and
- implemented quality control procedures for staff, components, equipment and panel tolerances with panel testing at each of the listed plant locations. Ongoing audits of Insulspan manufacturing plants are conducted to verify continued compliance with all requirements.

4.4 Design Requirements

4.4.1 Loads as per NBC and Wood Design

4.4.1.1 Design Model

Many of the structural panel tests and connection tests were used to calibrate and validate a reliability-based design computer model. The design model was then used for the engineering design of the panel for the various load configurations.

Structural test data for plant qualification to manufacture the product is consistent with test data used to validate the reliability-based design model. Insulspan plants are listed based on the accredited third-party plant qualification and the ongoing quality control as part of the product certification.

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