Construction Details for the Use of Polyisocyanurate (Polyiso) in Light-Frame Construction

Polyisocyanurate Insulation Producing FSC Members

Atlas Roofing Corporation – atlasroofing.com
Dow Building Solutions – building.dow.com
GAF – gaf.com
Hunter Panels – hpanels.com
Johns Manville – jm.com
Rmax – rmax.com

DIVISION: 07 00 00 – THERMAL AND MOISTURE PROTECTION
Section: 07 21 00 – Thermal Insulation
Section: 07 25 00 – Water-Resistive Barriers/Weather Barriers

1. Code Compliance Process Evaluated:
   1.1. Construction detailing concepts for application of polyisocyanurate (polyiso) insulating sheathing from the manufacturers listed in Section 4.1, up to and including 6" thickness, when used as a continuous insulation material on light-frame wood or cold-formed steel exterior wall assemblies¹.

   1.2. For the most recent version of this report, visit drjengineering.org. For more detailed state professional engineering and code compliance legal requirements and references, visit drjengineering.org/statelaw. DrJ is fully compliant with all state professional engineering and code compliance laws.

¹ While the information in this report is believed to be accurate, DrJ cannot and does not warrant the accuracy, correctness, or completeness of any interpretation, research, analysis, or recommendation for a particular use. The report is to be accepted "AS IS" and DrJ makes no representation or warranty, express or implied, of any kind or description in respect thereto, and that any actions taken in reliance on this report shall be an end-user responsibility.

The scope of this research report is as defined herein. This examination, report, and any opinions herein have been conducted and prepared in accordance with standard practice guidelines within the engineering profession, based on the information readily available to DrJ as referenced herein. Where appropriate, DrJ relies on the derivation of design values, which have been codified into law through the codes and standards (e.g., IRC, WFCM, IBC, SDPWS, etc.), to undertake review of test data, related research, and analysis, and references such. Also, DrJ may rely upon proprietary research, testing, and analysis, and references such.

DrJ reserves the right to supplement or revise this research report, based on new scientific, testing, or analytical information that becomes available to DrJ. Updates may also be made based on any peer review or critique of any DrJ report.

The most recent version of any DrJ research report will be found at drjcertification.org.
2. Applicable Codes and Standards:
   2.2. 2009, 2012 and 2015 International Residential Code (IRC)
   2.4. ASTM C1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
   2.5. ANSI/SBCA FS100 – Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies

<table>
<thead>
<tr>
<th>RESEARCH REPORT NOTE</th>
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<td>Details in this research report only illustrate solid wood structural framing members. However, the same principles apply for typical shapes used for cold-formed steel light-frame construction.</td>
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3. Evaluation Scope:
   3.1. This research report addresses the general construction framing details for applying polyiso continuous insulation in wood or steel light-frame exterior wall assemblies, and integrating with various code required wall components such as cladding, water-resistant barriers (WRB), vapor retarders, and air barriers.
   3.2. Specific code compliance considerations are outside of the scope of this research report and must be verified by the user for a given selection and arrangement of materials or products for a given building location and climate condition, including, but not limited to, continuous insulation amounts, wall cavity insulation amount and type, location and type of WRB, location and type of vapor retarder, location and type of air barrier, structural requirements, thermal resistance or fire endurance, and flame spread characteristics.
   3.3. Consult the polyiso manufacturer and the manufacturers of other wall components for material property data regarding vapor permeability, WRB qualification, air barrier qualification, fire performance properties, and other matters required to ensure an overall code compliant wall assembly.
   3.4. Any code compliance issues not specifically addressed in this section are outside the scope of this evaluation.
   3.5. For guidance on specific matters of code compliance, refer to the applicable building code, manufacturer installation instructions for specified materials, and the research reports listed in Section 7 that address specific code compliance topics for appropriate application of the polyiso materials.

4. Product Description and Materials:
   4.1. This research report applies to the following manufacturers and products:
      4.1.3. GAF – "EnergyGuard™"
      4.1.4. Hunter Panels – "Xci CG", "Xci Foil", "Xci Class A", "Xci 286" and "Xci Ply"
      4.1.5. Johns Manville – "AP Foil Faced Foam Sheathing"
   4.2. Polyiso products used in accordance with this research report shall be manufactured in compliance with ASTM C1289.

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2 Unless otherwise noted, all references in this research report are from the 2012 version of the codes and the standards referenced therein, including, but not limited to, ASCE 7, SDPWS and WFCM. This product also complies with the 2000-2009 and 2015 versions of the IBC and IRC and the standards referenced therein. As required by law, where this research report is not approved, the building official shall respond in writing, stating the reasons this research report was not approved.

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4.3. Polyiso products are produced under proprietary manufacturing processes and are formed into rigid insulation panels.

4.4. Where wind pressure resistance is required, polyiso products used in accordance with this research report shall comply with ANSI/SBCA FS100.³

4.5. Polyiso insulating sheathing complying with ASTM C1289 must have facings on both sides.

4.6. Polyiso products are typically available in the following sizes:

4.6.1. Thicknesses range from ½" to 6".⁴

4.6.2. The standard product width is 48".

4.6.3. Standard lengths include 96", 108" and 120".

4.7. Consult the manufacturer for availability of product in non-standard widths or lengths.

4.8. Consult the polyiso manufacturer and the manufacturers of other wall components for material property data regarding vapor permeability, WRB qualification, air barrier qualification, fire performance properties, and other matters required to ensure an overall code compliant wall assembly. See Section 7 for additional information.

5. Applications:

5.1. General Requirements

5.1.1. All wall assembly components shall be approved, installed, and inspected in accordance with the applicable building code, approved construction documents, manufacturer installation instructions, and good practice.

5.1.2. Polyiso products shall be attached to and supported by the wall framing in accordance with the manufacturer’s installation instructions.

5.2. Terminology

5.2.1. Air Barrier – Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material or a combination of materials.

5.2.2. Continuous Insulation (CI) – Insulating material that is continuous across all structural members without thermal bridges other than fasteners and service openings. It is installed on the interior or exterior or is integral to any opaque surface of the building envelope.

5.2.3. Flashing – Materials used to aid in the integration of fenestration products and penetrations into a wall assembly to direct liquid water to the exterior side of the WRB. Flashing materials consist of many types based on application (e.g., head, jamb, cap, sill, etc.) and may be attached using various methods (e.g., mechanical, self-adhered, liquid or spray applied, etc.).

5.2.4. Vapor Retarder – Material placed within a wall assembly to control the flow of water vapor through the assembly.

5.2.5. Water-Resistive Barrier (WRB) – A material behind an exterior wall covering assembly or cladding that is intended to resist liquid water that has penetrated behind the exterior covering from further intruding into the exterior wall assembly. Function may be provided by taped joints and penetrations of polyiso, if tested by the manufacturer and installed per the manufacturer’s installation instructions. A separate WRB membrane may also be placed to the inside or outside of the polyiso.

6. Installation:

6.1. The details shown in this research report are conceptual in nature and are intended to provide the user with code compliance and best practices for detailing walls using polyiso. Suitability for a specific application is the responsibility of the building designer. See Section 9 for specific conditions of use.

6.2. Basic Wall Assembly Variations

³ For polyiso applied directly over an approved structural sheathing material (“oversheathing”) separately capable of resisting the full wind load, polyiso is not required to comply with ANSI/SBCA FS100 for wind pressure resistance.

⁴ For polyiso thicknesses over 2” or 3”, it is preferable to layer polyiso and off-set the joints. If polyiso is specified as the WRB in a layered application, only the outer layer of polyiso functions as the WRB.
6.2.1. Wall assembly showing: structural framing (e.g., wood or cold-formed steel), interior finish, vapor retarder, cavity insulation, wall bracing (e.g., structural sheathing or wood let-in brace or metal strap brace), polyiso (continuous insulation), WRB, and exterior finish (siding and trim).

6.2.1.1. Light-frame wall with LIB bracing, polyiso, WRB (no furring) and lap siding

![Diagram of wall assembly showing polyiso, WRB, and lap siding](image)

**Figure 1a:** Generic Wood-Frame Wall (LIB) with Exterior Finish of Polyiso, WRB & Lap Siding

6.2.1.2. Light-frame wall with LIB bracing, polyiso (joints taped) as WRB, furring

![Diagram of wall assembly showing polyiso, WRB, and lap siding](image)

**Figure 1b:** Generic Wood-Frame Wall (LIB), Polyiso as WRB, Furring & Lap Siding

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5 Furring as shown in Figure 1b is optional, unless specifically required for the cladding installation (e.g., horizontal furring for wood shake and shingle installation). Furring is recommended for applications where additional drainage and ventilation of cladding is preferable and where polyiso thickness exceeds approximately 2".
6.2.1.3. Light-frame wall with LIB bracing, polyiso, WRB and furring

Figure 1c: Generic Wood-Frame Wall (LIB) with Exterior Finish of Polyiso, WRB & Lap Siding

6.2.1.4. Light-frame wall with LIB bracing, WRB, polyiso, furring, lap siding

Figure 1d: Generic Wood-Frame Wall (LIB) with Exterior Finish of WRB, Polyiso, Furring & Lap Siding
6.2.1.5. Light-frame wall with LIB bracing, polyiso, stucco

6.2.1.6. Light-frame wall with LIB bracing, polyiso, two (2) layers WRB, brick veneer (anchored and separately supported)

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6 See the stucco provisions in 2015 IBC Section 2510.6 and 2015 IRC Section R703.7.3 regarding water resistant barrier (WRB) application. WRB Layer 1 is not necessary where FPIS with taped joints is used as the WRB Layer 1. WRB Layer 2 is not necessarily required where self-furring lath is used to create a drainage space and separate the PC Stucco from bonding to the WRB surface. However, WRB Layer 2 is recommended to provide added protection WRB Layer 1 during installation of lath.
6.2.1.7. Light-frame wall with LIB bracing, polyiso as WRB, furring, lath, stucco veneer

![Figure 1g: Generic Wood-Frame Wall (LIB), Polyiso, Stucco](image)

6.3. Inside corner – Light-frame wall, polyiso, WRB, no furring

![Figure 2a: ISC Generic Wood-Frame Wall with Continuous Insulation, Polyiso, WRB, & Lap Siding](image)

Provide sufficient framing to attach siding trim & siding as well as interior finish.

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7 See the stucco provisions in [IBC Section 2510.6](https://www.icbo.org) regarding WRB application. The WRB layer would not be required if the FPIS were approved and specified as a WRB and joints sealed with an approved tape or sealing method.
6.4. Inside corner – Light-frame wall, polyiso taped for WRB, furring

Figure 3: ISC Generic Wood-Frame Wall with Continuous Insulation, Polyiso Taped as WRB, Furring, Lap Siding
Provide sufficient framing to attach siding trim & siding as well as interior finish.

6.5. Outside corner – Light-frame wall, polyiso, WRB, siding

Figure 4: OSC Generic Wood-Frame Wall with Continuous Insulation, Polyiso Taped (WRB), Furring & Lap Siding
Provide sufficient framing to attach siding trim & siding as well as interior finish.
6.6. Polyiso at bottom of wall (not code required and typically recommended with polyiso thickness over 1")

**Figure 5a:** Bottom of Polyiso Covered with Flashing & Extending Down Foundation

**Figure 5b:** Polyiso Extending Over Foundation with Protection Board Where Exposed Above Grade
6.7. Top of wall – Gable (unconditioned attic space illustrating non-polyiso sheathing at gable)
6.8. Top of wall – Gable (conditioned attic space illustrating polyiso sheathing at gable)
6.9. Top of wall – Eave – rafter, standard truss heel, high truss heel, & cantilevered truss

**Figure 8a:** Top of Wall at Eave with Rafter Construction

**Figure 8b:** Top of Wall at Eave with Standard Heel Truss
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Figure 8c: Top of Wall at Eave at Cantilever Truss

Figure 8d: Top of Wall with High Energy Heel Truss
6.10. Roof intersecting with wall (two views of same application)
6.11. Deck Ledger – 2” polyiso at patio door opening (two views of same application) with 1” polyiso behind ledger

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Figure 9b: Roof Intersecting with Wall (from inside) – Blocking

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Figure 10a: Deck Ledger – 2” Polyiso Wall Sheathing, 1” Polyiso Behind Ledger at Patio Door Opening

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An alternative is to specify a separately supported deck. For additional information, see IBC Section 1604.8.3, IRC Section R507 and AWC TR12.
Figure 10b: Deck Ledger – 2" Polyiso Wall Sheathing, 1" Polyiso Behind Ledger at Rim
6.12. Penetration Details

6.12.1. Window/door penetrations (flush behind siding layer) – 2” or less CI

**Figure 11a: Sill Detail – Window Over CI**

**Figure 11b: Jamb Detail – Window Over CI**

**Figure 11c: Head Detail – Window Over CI – 2” or Less CI**
6.12.2. Window/door penetrations (flush behind siding layer) – 2" or more CI (maximum 4") using wood buck

**Figure 11d:** Sill Detail – Window Over CI – 2" or More CI

**Figure 11e:** Jamb Detail – Window Over CI – 2" or More CI

**Figure 11f:** Head Detail – Window Over CI – 2" or More CI
6.12.3. Window/door penetrations (flush to interior finish layer – "Innie") – 2” or more CI (maximum 4”) using wood buck

**WINDOW SILL DETAIL**

Figure 11g: Sill Detail – "Innie" Window Over CI – 2” or More CI

**WINDOW JAMB DETAIL**

Figure 11h: Jamb Detail – "Innie" Window Over CI – 2” or More CI

**WINDOW HEAD DETAIL**

Figure 11i: Head Detail – "Innie" Window Over CI – 2” or More CI
6.13. Other penetrations

![Diagram of Polyiso Taped Joints, Furring, Lap Siding]

**Figure 12:** Penetration – 2" Polyiso Taped Joints, Furring, Lap Siding

7. References:

7.1. DRR No. 1404-01: NFPA 285 Tested Assemblies Using Foam Plastic Insulating Sheathing Products

7.2. DRR No. 1404-02: Polyiso Sheathing Products in Type V Construction

7.3. DRR No. 1404-03: Polyiso Sheathing Products in Type I, II, III, or IV Construction

7.4. DRR No. 1404-05: Attachment of Windows with Integral Flanges through Polyiso Sheathing to Wood Framing

7.5. DRR No. 1410-08: Attachment of Exterior Wall Coverings Through Polyiso Sheathing to Wood or Steel Wall Framing

7.6. DRR No. 1505-08: Polyisocyanurate Products & Accessories Used as a Code Compliant Water-Resistive Barrier (WRB) System

7.7. DRR No. 1505-09: Polyisocyanurate Sheathing Used as an Air Barrier Material in an Air Barrier Assembly

7.8. Installation Guide: Installation Instructions for Attachment of Exterior Wall Coverings Through Polyiso


7.10. Some information contained herein is the result of testing and/or data analysis by other sources, which DrJ relies on to be accurate as it undertakes its engineering analysis.

7.11. DrJ has reviewed and found the data provided by other professional sources are credible. This information has been approved in accordance with DrJ’s procedure for acceptance of data from approved sources.

7.12. DrJ’s responsibility for data provided by approved sources is in accordance with professional engineering law.

7.13. Where appropriate, DrJ relies on the derivation of design values, which have been codified into law through codes and standards (e.g., IRC, WFCM, IBC, SDPWS, etc.). This includes review of code provisions and any related test data that helps with comparative analysis or provides support for equivalency to an intended end-use application.
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8. Findings:

8.1. The details shown in this research report are for the installation of polyiso in accordance with the applicable codes referenced herein.

8.2. IBC Section 104.11 and IRC Section R104.11 (IFC Section 104.9 is similar) state:

104.11 Alternative materials, design and methods of construction and equipment. The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code. ... Where the alternative material, design or method of construction is not approved, the building official shall respond in writing, stating the reasons the alternative was not approved.9

9. Conditions of Use:

9.1. The details shown in this research report are conceptual in nature and are intended to provide the user with code compliance and best practices for detailing walls using polyiso. Suitability for a specific application is the responsibility of the building designer.

9.2. Where required by the authority having jurisdiction (AHJ) in which the project is to be constructed, this report and the installation instructions shall be submitted at the time of permit application.

9.3. The insulated sheathing products listed in Section 4.1 shall be installed in compliance with the manufacturer’s installation instructions, the applicable building code sections, structural requirements, fire requirements, wind pressure requirements, exterior wall covering requirements, flashing requirements, moisture barrier requirements, and this research report.

9.4. Use of the details in the research report is subject to the following conditions.

9.4.1. Interior finish shall comply with the locally applicable building code and approved construction documents (typically ½” gypsum wallboard is used on the interior to comply with thermal barrier requirements for walls with polyiso on the exterior side).

9.4.2. Interior vapor retarder class (Class I, II or III) shall be in accordance with the locally applicable building code and approved construction documents.

9.4.3. Wood or cold-formed steel framing shall comply with the locally applicable building code and approved construction documents. Where required, framing or blocking shall be provided for attachment of interior and exterior finish materials.

9.4.4. Wall bracing method and amount shall comply with the locally applicable building code and approved construction documents. Applicable bracing methods include continuous or intermittent structural panel bracing, wood let-in bracing, and metal strap bracing. Where intermittent panel bracing is used, polyiso continuous insulation thickness shall be reduced to maintain a uniform wall thickness, as permitted by the locally applicable energy code.

9.4.5. Cavity insulation type and amount shall comply with the locally applicable energy code.

9.4.6. Continuous insulation type shall comply with this research report (Section 1.1 and Section 4) and shall be installed in accordance with the manufacturer’s installation instructions and the locally applicable building code. The amount of continuous insulation shall comply with the locally applicable building code (depending on class of interior vapor retarder used, climate zone, and amount of cavity insulation) and the locally applicable energy code (depending on climate zone).

9.4.7. The WRB installation and flashing or sealing method at wall penetrations and transitions or discontinuities shall comply with the locally applicable building code, approved construction documents, WRB and flashing manufacturer installation instructions, and window and door component manufacturer installation instructions. The WRB layer may be a separate membrane, polyiso sheathing, or other method approved for use as a WRB. Refer to additional information in DRR No. 1505-08.

9.4.8. A continuous air barrier layer shall be provided in accordance with the locally applicable energy code. The air barrier layer may be designated as the polyiso layer, the interior finish layer, the WRB layer, the structural sheathing layer, or other continuous material layer meeting the requirements for an air barrier.

9 The last sentence is adopted language in the 2015 codes.
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Joints, penetrations, and transitions shall be sealed to maintain continuity of the air barrier. Refer to manufacturer data and installation instructions for approved air barrier materials, components and assemblies. Refer to additional information in DRR No. 1505-09.

9.4.9. Window and door installations shall comply with the manufacturer installation instructions; where application over polyiso is not addressed, refer to DRR No. 1404-05.

9.4.10. Cladding installation over foam sheathing shall comply with the locally applicable building code, an approved design, or an approved attachment method complying with DRR No. 1410-08. Cladding fasteners shall penetrate into framing members for the required minimum embedment depth. Attachment to an approved sheathing material is permitted when approved by design or specifically permitted by the locally applicable building code. Refer to additional information in Section 7.8.

9.4.11. Furring installation over polyiso, where used as a means of cladding installation, shall comply with the locally applicable building code, approved design, or an approved attachment method complying with DRR No. 1410-08. Cladding attachment to furring shall comply with the cladding manufacturer’s installation instructions and the locally applicable building code.

9.4.12. Fire safety requirements for walls with polyiso shall comply with the locally applicable building code and approved construction documents; refer to DRR No. 1404-01, DRR No. 1404-02, and DRR No. 1404-03.

9.4.13. It is the user’s responsibility to ensure the wall assembly as a whole and all specified materials or components (as generally represented in this TER) are properly integrated as a system that complies with all applicable building code provisions, approved construction documents, manufacturer installation instructions, and good construction practice.

9.4.14. It is the user’s responsibility to determine appropriate construction sequence and inspection sequence to ensure a quality installation meeting or exceeding the administrative and functional intent of the building code. Items that will be concealed during construction, such as the WRB layer and flashing, should be inspected and functionally verified prior to concealment. A functioning WRB layer and flashing system and other necessary weather-resistive barrier components should be installed to prevent moisture intrusion prior to installation of wall cavity insulation, vapor retarders, and interior finishes. It is the responsibility of the user to ensure materials are dry prior to wall enclosure.

9.5. Design

9.5.1. Building Designer Responsibility

9.5.1.1. Unless the AHJ allows otherwise, the Construction Documents shall be prepared by a Building Designer (e.g., Owner, Registered Design Professional, etc.) for the Building and shall be in accordance with IRC Section R106 and IBC Section 107.

9.5.1.2. The Construction Documents shall be accurate and reliable and shall provide the location, direction and magnitude of all applied loads and shall be in accordance with IRC Section R301 and IBC Section 1603.

9.5.2. Construction Documents

9.5.2.1. Construction Documents shall be submitted to the Building Official for approval and shall contain the plans, specifications and details needed for the Building Official to approve such documents.

9.6. Responsibilities

9.6.1. The information contained herein is a product, engineering or building code compliance research report performed in accordance with the referenced building codes, testing and/or analysis through the use of accepted engineering procedures, experience and good technical judgment.

9.6.2. Product, design and code compliance quality control are the responsibility of the referenced company. Consult the referenced company for the proper detailing and application for the intended purpose. Consult your local jurisdiction or design professional to assure compliance with the local building code.

9.6.3. DrJ research reports provide an assessment of only those attributes specifically addressed in the Products Evaluated or Code Compliance Process Evaluated section.

9.6.4. The engineering evaluation was performed on the dates provided in this TER, within DrJ's professional scope of work.
9.6.5. The actual design, suitability and use of this research report for any particular building is the responsibility of the Owner, the Owner’s authorized agent or the Building Designer.

10. Identification:
   10.1. Where required by the applicable building code, wall assembly components shall be marked and bear the label of an approved agency on the product or packaging.

   10.2. Additional technical information and related TERs can be found at the company websites listed on Page 1 and from DrJ Engineering.

11. Review Schedule:
   11.1. This TER is subject to periodic review and revision. For the most recent version of this report, visit drjengineering.org.

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