1. Code Compliance Process Evaluated:

1.1. Attachment of exterior wall coverings through Foam Plastic Insulating Sheathing (FPIS) to wood wall framing

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.

1.3. This code compliance report can be used to obtain product approval in any country that is an IAF MLA Signatory (all countries found here) and covered by an IAF MLA Evaluation per the Purpose of the MLA (as an example, see letter to ANSI from the Standards Council of Canada). Manufacturers can go to jurisdictions in the U.S., Canada and other IAF MLA Signatory Countries and have their products readily approved by authorities having jurisdiction.

1.4. Building code regulations require that evaluation reports are provided by an approved agency meeting specific requirements. Any agency accredited in accordance with ANSI ISO/IEC 17065 meets this requirement within ANSI’s scope of accreditation. For a list of accredited agencies, visit ANSI’s website. For more information, see drjcertification.org.

1.5. Requiring an evaluation report from a specific organization (ICC-ES, IAPAMO, CCMC, DrJ, etc.) can be viewed as discriminatory and is a violation of international, federal, state, provincial and local anti-trust and free trade regulations.

1.6. Where assistance is needed with any aspect of the foregoing information please contact DrJ at email DrJ or 608-310-6748. For further support information please visit DrJ’s ANSI accreditation or drjengineering.org.
2. Applicable Codes and Standards:
   2.2. 2012, 2015, and 2018 International Residential Code (IRC)
   2.3. ANSI/SBCA FS100 – Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies
   2.4. ASCE 7 – Minimum Design Loads for Buildings and Other Structures
   2.5. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
   2.10. National Design Specification® (NDS®) for Wood Construction

3. Evaluation Scope:
   3.1. This research report examines the attachment of exterior wall coverings through FPIS, with thickness up to 4”, to wood wall studs.
   3.2. This research report also provides a step-by-step approach for the design process of attaching exterior wall coverings through FPIS to wood wall framing.
   3.3. This evaluation and design methodology considers only the weight of the exterior covering on fasteners cantilevered though the FPIS and into wall framing.
   3.4. Wind pressure resistance of the exterior covering is outside the scope of this research report. Consult the cladding manufacturer for cladding and attachment instructions for required wind pressure resistance. For wind pressure resistance of FPIS, consult the FPIS manufacturer’s installation instructions and wind pressure resistance data complying with ANSI/SBCA FS100.
   3.4.1. The intent of this research report is not to reduce minimum fastener size, penetration and spacing required to resist wind loads. Where fastener requirements for wind load resistance are more stringent than those included herein for the purpose of supporting cladding weight, they shall control the design.
   3.5. Attachment of window flanges over FPIS is outside the scope of this research report. For this application see DRR No. 1304-01.
   3.6. Any code compliance issues not specifically addressed in this section are outside the scope of this evaluation.

4. FPIS Product Description and Materials for Use with This Report:
   4.1. FPIS products used in accordance with this research report shall comply with the following material standards:
       4.1.1. Expanded polystyrene (EPS) manufactured in compliance with ASTM C578
       4.1.2. Extruded polystyrene (XPS) manufactured in compliance with ASTM C578
       4.1.3. Polyisocyanurate (Polyiso) manufactured in compliance with ASTM C1289
   4.2. FPIS products used in accordance with this research report shall have a minimum compressive strength of 15 psi.
   4.3. Where wind pressure resistance is required, FPIS products used in accordance with this research report shall comply with ANSI/SBCA FS100.

1 Unless otherwise noted, all references in this research report are from the 2018 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 2000-2015 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.
4.4. FPIS products are produced under proprietary manufacturing processes and are formed into rigid insulation panels.

4.5. FPIS products are typically available in the following sizes:

4.5.1. Thicknesses range from ½” to 6”.

4.5.2. The standard product width is 48”.

4.5.3. Standard lengths include 96”, 108” and 120”.

4.6. Consult the manufacturer for the availability of a given product with non-standard width or length.

4.7. The following FPIS products meet the requirements of Section 4.1 and 4.2:


4.7.3. GAF – “EnergyGuard™ POLYISO INSULATED SHEATHING”


4.7.5. Johns Manville – “AP Foil Faced Foam Sheathing”


5. Applications:

5.1. Design Procedure

5.1.1. Determine an appropriate cladding attachment requirement in accordance with Section 5.2 through 5.4.

5.2. Select one of the following methods of cladding attachment:

5.2.1.1. Direct attachment of cladding through FPIS to wall framing, Figure 1a.

5.2.1.2. Furring attachment through FPIS to wall framing, Figure 1b, whereby cladding is attached to furring in accordance with the applicable building code and the cladding manufacturer’s installation instructions.

5.2.1.3. Direct attachment of cladding to qualifying wood structural panels, Figure 1c.

5.2.1.3.1. Exterior wall coverings weighing not more than 3 psf are permitted to be fastened through FPIS up to 2 inches in thickness into wood structural panel sheathing without penetrating into the framing. The attachment shall be in accordance with the manufacturer’s instructions and supported by a testing report, or a product certification report, or shall be fastened in accordance with the 2018 IRC Section R703.3.3 and Table R703.3.3.
5.3. From Table 1a for “direct attachment” method or Table 1b and Table 1c for “furring attachment” method, determine the maximum allowable FPIS thickness based on a selected minimum fastener size, maximum fastener spacing and the cladding system weight.

5.3.1. To determine cladding system weight, add the weight of all materials on the exterior side of the foam sheathing. This includes, but is not limited to the cladding material, structural sheathing, furring, or other
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materials located exterior of the FPIS that supported by the fastener extending through the FPIS and into the stud.

5.3.2. Use actual weights for the materials installed. Actual cladding weights of materials can be obtained from the cladding manufacturer’s material specifications. Other typical weights of building materials can be found in the Commentary to ASCE 7.

5.3.2.1. Examples of cladding included in each weight category: 3 psf – vinyl siding, wood lap siding, most fiber cement siding; 11 psf – 3-coat stucco, 18 psf – medium weight adhered masonry veneer, 25 psf heavy adhered masonry veneer. Examples are not inclusive of all claddings. Refer to cladding manufacturer data for actual unit weight.

5.3.2.2. For reservoir claddings such as stone or masonry, the designer should consider using the saturated weight of the cladding as defined in the manufacturer’s product data as appropriate.

<table>
<thead>
<tr>
<th>Cladding Fastener Through Foam Plastic Sheathing into:</th>
<th>Siding Fastener Type &amp; Minimum Size</th>
<th>Maximum Thickness of Foam Plastic Insulating Wall Sheathing (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>16” o.c. Fastener Horizontal Spacing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Max Cladding Weight:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 psf</td>
</tr>
<tr>
<td>Wood Framing (minimum 1¼” penetration)</td>
<td>0.113” diameter nail</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>0.120” diameter nail</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>0.131” diameter nail</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>0.162” diameter nail</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

For SI: 1” = 25.4 mm; 1 pound per square foot [psf] = 0.0479 kPa
1. Tabulated requirements are based on wood framing of Spruce-Pine-Fir or any wood species with a specific gravity of 0.42 or greater in accordance with AWC/ND®.
2. See ABTG Research Report 1503-02 for information on how the table values were derived.
3. Nail fasteners shall comply with ASTM F1667, except nail length shall be permitted to exceed ASTM F1667 standard lengths. Other approved fasteners of equivalent or greater diameter and bending strength shall be permitted.
4. For cladding system weights exceeding 25 psf with any thickness of foam sheathing, a design professional should be consulted.
5. Table 1a solutions are limited to 4” maximum thickness of foam sheathing. Design is required for thicknesses of foam sheathing greater than 4”.
6. Foam sheathing shall have a minimum compressive strength of 15 psi in accordance with ASTM C578 or ASTM C1289.
7. Metal lath shall be minimum 2.5 lbs./yd.² diamond mesh in accordance with ASTM C947. Metal lath lock washers on fasteners are highly recommended.
8. Vertical spacing of fasteners in metal lath shall not exceed 7” o.c., in accordance with ASTM C1063 and the Masonry Veneer Manufacturer Association (MVMA) Installation Guide except where an approved design is provided.
9. Where adhered masonry is used, it shall be installed in accordance with the MVMA Installation Guide or an approved design.
10. Linear interpolation between cladding weight categories is not permissible.
11. DR = Design Required.
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Table 1b: Furring Minimum Fastening Requirements for Application Over Foam Plastic Insulating Sheathing to Support Cladding System Weight

<table>
<thead>
<tr>
<th>Furring Material</th>
<th>Framing Member</th>
<th>Fastener Type &amp; Minimum Size</th>
<th>Minimum Penetration into Wall Framing (in.)</th>
<th>Fastener Spacing in Furring (in.)</th>
<th>Maximum Thickness of FPIS (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nail (0.120&quot; Shank; 0.271&quot; Head)</td>
<td>1 1/4&quot;</td>
<td>8</td>
<td>3 psf</td>
</tr>
<tr>
<td>Minimum 1x3 Wood Furring</td>
<td>1x3 Stud</td>
<td>Nail (0.131&quot; Shank; 0.281&quot; Head)</td>
<td>1 1/4&quot;</td>
<td>8</td>
<td>3.00</td>
</tr>
<tr>
<td>Minimum 2x Wood Stud</td>
<td>2x Stud</td>
<td>0.162&quot; diameter nail</td>
<td>1 1/4&quot;</td>
<td>8</td>
<td>4.00</td>
</tr>
<tr>
<td>#10 wood screw</td>
<td></td>
<td>1&quot;</td>
<td></td>
<td></td>
<td>4.00</td>
</tr>
<tr>
<td>1/8&quot; lag screw</td>
<td></td>
<td>1 1/2&quot;</td>
<td></td>
<td></td>
<td>4.00</td>
</tr>
</tbody>
</table>

For SI: 1" = 25.4 mm; 1 pound per square foot (psf) = 0.0479 kPa

1. Table values are based on:
   a. Minimum 1/4" (19.1 mm) thick wood furring and wood studs of Spruce-Pine-Fir or any softwood species with a specific gravity of 0.42 or greater per AF&PA/NDS®.
   b. Nail fasteners shall comply with ASTM F1667, except nail length shall be permitted to exceed ASTM F1667 standard lengths. Wood screws and lag screws shall comply with AWC/NDS Appendix L and ANSI/ASME B18.8.1. Other approved fasteners of equivalent or greater diameter and bending strength shall be permitted.
   c. Furring shall be spaced a maximum of 24" o.c. in a vertical or horizontal orientation.
   a. In a vertical orientation, furring shall be located over wall studs and attached with the required fastener spacing.
   b. Where placed horizontally, wood furring shall be preservative treated wood in accordance with IRC Section R317.3 or naturally durable wood and fasteners shall be corrosion resistant in accordance IRC Section R317.3.

2. Furring strips installed in a horizontal direction shall be fastened at each stud with a number of fasteners equivalent to that required by the fastening spacing. If the required nail spacing is 12" o.c. and the studs are 24" o.c., then two (2) nails would be required at each stud (24/12=2). In no case shall fasteners be spaced more than 24" (0.6 m) apart.

3. Lag screws shall be installed with a standard cut washer.

4. Lag screws and wood screws shall be pre-drilled in accordance with AWC/NDS®.

5. A minimum 2x wood furring shall be used where the required siding fastener penetration into wood material exceeds 1/4" (19.1 mm) and is not more than 1 1/2" (38.1 mm), unless approved deformed shank siding nails or siding screws are used to provide equivalent withdrawal strength, allowing the siding connection to be made to a 1x wood furring.

6. For cladding system weights exceeding 25 psf with any thickness of foam sheathing, a design professional should be consulted.

7. Table 1b solutions are limited to 4" maximum thickness of foam sheathing. Design is required for thicknesses of foam sheathing greater than 4".

8. Foam sheathing shall have a minimum compressive strength of 15 psi, in accordance with ASTM C578 or ASTM C1289.

9. Linear interpolation between cladding weight categories is not permissible.

11. DR = Design Required
Table 1c: Furring Minimum Fastening Requirements for Application Over Foam Plastic Insulating Sheathing to Resist Allowable Stress Wind Pressure

<table>
<thead>
<tr>
<th>Furring Material</th>
<th>Framing Member</th>
<th>Fastener Type &amp; Minimum Size</th>
<th>Minimum Penetration into Wall Framing (in.)</th>
<th>Fastener Spacing in Furring (in.)</th>
<th>Allowable Wind Pressure Resistance of Furring Attachment (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x3 Wood Furring</td>
<td>Minimum 2x Wood Stud</td>
<td>Nail (0.120&quot; shank; 0.271&quot; head)</td>
<td>1¼&quot;</td>
<td>8</td>
<td>42.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Nail (0.131&quot; shank; 0.281&quot; head)</td>
<td>1¼&quot;</td>
<td>8</td>
<td>46.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.162&quot; diameter nail</td>
<td>1¼&quot;</td>
<td>8</td>
<td>57.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>#10 wood screw</td>
<td>1&quot;</td>
<td>12</td>
<td>38.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>⅛&quot; lag screw</td>
<td>1½&quot;</td>
<td>12</td>
<td>79.0</td>
</tr>
</tbody>
</table>

For SI: 1" = 25.4 mm; 1 pound per square foot (psf) = 0.0479 kPa
1. Table values are based on:
   a. Minimum ¾" (19.1 mm) thick wood furring and wood studs of Spruce-Pine-Fir or any softwood species with a specific gravity of 0.42 or greater per AF&PA/NDS®.
2. Nail fasteners shall comply with ASTM F1667, except nail length shall be permitted to exceed ASTM F1667 standard lengths. Wood screws and lag screws shall comply with AWC/NDS Appendix L and ANSI/ASME B18.6.1. Other approved fasteners of equivalent or greater withdrawal shall be permitted.
3. Furring shall be spaced a maximum of 24" o.c. in a vertical or horizontal orientation.
   a. In a vertical orientation, furring shall be located over wall studs and attached with the required fastener spacing.
   b. Where placed horizontally, wood furring shall be preservative treated wood in accordance with IRC Section R317.1 or naturally durable wood and fasteners shall be corrosion resistant in accordance IRC Section R317.3.
   c. Furring strips installed in a horizontal direction shall be fastened at each stud with a number of fasteners equivalent to that required by the fastener spacing. If the required nail spacing is 12" o.c. and the studs are 24" o.c., then two (2) nails are required at each stud (24/12=2) and the wind load resistance of the furring installation should be based on a 24" fastener spacing in furring. In no case shall fasteners be spaced more than 24" (0.6 m) apart.
4. Lag screws shall be installed with a standard cut washer.
5. Lag screws and wood screws shall be pre-drilled in accordance with AWC/NDS®.
6. A minimum 2x wood furring shall be used where the required siding fastener penetration into wood material exceeds ¾" (19.1 mm) and is not more than 1½" (38.1 mm), unless approved deformed shank siding nails or siding screws are used to provide equivalent withdrawal strength, allowing the siding connection to be made to a 1x wood furring.
7. For allowable stress design wind loads exceeding the tabulated allowable wind pressure resistance above, an approved design providing equivalent wind pressure resistance and lateral load resistance shall be permitted.
8. DR = Design Required

5.4. The minimum fastening requirement shall be the more stringent of that required by:

5.4.1. Fastening schedule determined in accordance with Section 5.3 of this research report.

5.4.2. Fastener type, head size, diameter, spacing, and penetration into framing required by the applicable building code for the specific cladding material and the cladding manufacturer’s installation instructions2.

5.4.2.1. For buildings within the scope of the IRC and where the seismic provisions of IRC Section R301.2.2 apply, the wall assembly shall not exceed the weight limits of Section R301.2.2.1, unless an engineered design is provided in accordance with Section R301.1.3.

5.4.2.2. For buildings within the scope of the IBC and where the seismic load provisions of IBC Section 1613 apply, the cladding attachment shall be verified to provide resistance to meet or exceed minimum required earthquake loads.

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2 An example of this would be lath attachments for stucco where a maximum of 7" o.c. spacing is required.
5.4.3. Attachments using fasteners with different characteristics than prescribed in Section 5.4.2 shall be designed to provide at least equivalent support of cladding weight, resistance to wind loading, and seismic loads as required by the applicable building code.

5.5. Allowable wind load resistance shall be verified to meet or exceed the minimum required allowable stress design wind load of the applicable code, or an approved design shall be required. (See Appendix A for an example design including verification of connections for wind pressure resistance)

5.5.1.1. Refer to IRC Table R301.2(2) for components and cladding wind loads for the applicable wall wind zone (i.e., corner zone or interior zone) and for an effective wind area of 10 square feet.

5.5.1.2. For IBC required wind loads, see IBC Section1609.

5.5.1.3. For wind load resistance of wood furring and attachments, refer to Table 1c or a design in accordance with the NDS

5.5.1.4. For wind load resistance of cladding materials and attachments, refer to the cladding manufacturer’s data and installation instructions, or an approved design.

6. Installation:

6.1. Verify that materials comply with the following provisions of this research report:

6.1.1. FPIS materials shall comply with the requirements of Section 4, unless otherwise approved by the manufacturer evaluation report for the product and thickness intended.

6.2. Wall framing materials shall comply with Section 5, specifically the minimum wood framing member requirements in the footnotes to Tables 1a, 1b, and 1c, as applicable.

6.3. Cladding or furring fastener type and size, including fastener length to obtain required penetration into or through framing members, complies with the solution determined in accordance with Section 5.4, or Section 5.2.1.3 where attachment to qualified wood structural panel sheathing is used.

6.4. Fasteners shall be driven flush and snug such that gaps between layers are removed, except where a gap under the cladding fastener head is required for attachment of vinyl siding.

6.5. Fasteners shall be installed in a workmanlike manner and not over-driven, resulting in material damage or excessive distortion of cladding, furring or FPIS materials.

6.6. Ensure framing members or blocking are provided as required to allow for attachment of siding and trim materials at transitions such as corners and wall penetrations. Refer to DRR No. 1205-05 for construction detailing concepts.

6.7. Ensure that a code-compliant water-resistive barrier system and flashing is provided prior to or during the installation of cladding materials; refer to DRR No. 1205-05 for construction detailing concepts and DRR No. 1410-05 for applications of FPIS as a water-resistive barrier system.

6.8. Where required by contract documents, the project owner or owner’s agent, or good practice, construct a mock-up assembly to demonstrate constructability and a proper integration of components.

7. Test and Engineering Substantiating:

7.1. The product(s) evaluated by this research report falls within the scope of one or more of the model, state or local building codes for building construction. The testing and/or substantiating data used in this research report is limited to buildings, structures, building elements, construction materials and civil engineering related specifically to buildings.

7.2. The provisions of model, state or local building codes for building construction do not intend to prevent the installation of any material or to prohibit any design or method of construction. Alternatives shall use consensus standards, performance-based design methods or other engineered alternative means of compliance. This research report assesses compliance with defined standards, generally accepted engineering analysis, performance-based design methods, etc. in the context of the pertinent building code requirements.


DrJ Research Report

7.5. Applied Building Technology Group Research Report No. 1503-02, Attachment of Exterior Wall Coverings Through Foam Plastic Insulating Sheathing (FPIS) to Wood or Steel Wall Framing, 2017

7.6. 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.

7.7. 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.

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

7.9. 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.

8. Findings:

8.1. This research report uses professional engineering law, the building code, ANSI/ASTM consensus standards and generally accepted engineering practice as its criteria for all testing and engineering analysis. DrJ’s professional engineering work falls under the jurisdiction of each state Board of Professional Engineers, when signed and sealed.

8.2. The prescriptive solutions, specifications, and installation requirements outlined in this research report may be used to attach exterior wall coverings through foam sheathing to wood wall framing. For design of alternative solutions, refer to ABTG Research Report No. 1503-02 for the design methodology serving as the basis for prescriptive solutions included in this DRR and also in the 2018 editions of the IBC and IRC.

8.3. The 2018 IRC Section R703.3 and R703.15 and IBC Section 2603.13 (Appendix B) include provisions for the attachment of cladding and/or furring over FPIS to appropriately resist the required design wind loads.

8.4. 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. References

9.1. The Foam Sheathing Committee (FSC) of the American Chemistry Council sponsors research and tools to support the reliable, efficient, and economic design and installation of foam sheathing. This report is developed by DrJ from a grant provided by FSC. Learn more about foam sheathing at www.continuousinsulation.org. DrJ is a professional engineering company, an independent approved source and an ANSI accredited 17065 certification body.

10. Conditions of Use:

10.1. Where required by the authority having jurisdiction (AHJ) in which the project is to be constructed, this report and the installation instructions of the cladding and FPIS manufacturers shall be submitted at the time of permit application or shall be made available on site during inspection.

10.2. The attachment of cladding materials through the FPIS described in this research report comply with the 2012, 2015, and 2018 versions of the IBC and IRC and are compliant with the intent of previous versions of the code as defined in the alternative means and methods section(s) subject to the following conditions:

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3 http://www.appliedbuildingtech.com/m/1503-02
10.2.1. Installation shall comply with the manufacturer’s installation instructions and this research report. In the event of a conflict between the manufacturer’s installation instructions and this research report, the more restrictive shall govern.

10.2.2. Installation shall be on exterior walls with code-compliant wood framing meeting the minimum requirements as indicated in Tables 1a, 1b, and 1c.

10.3. Design

10.3.1. Building Designer Responsibility

10.3.1.1. 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.

10.3.1.2. 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.

10.3.2. Construction Documents

10.3.2.1. 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.

10.4. Responsibilities

10.4.1. 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.

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

10.4.3. The engineering evaluation was performed on the dates provided in this research report, within DrJ’s professional scope of work.

10.4.4. 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.

11. Identification:

11.1. The foam sheathing described in this research report is identified by a label on the board or packaging material bearing the manufacturer’s name, product name, label of the third-party inspection agency, and other information to confirm code compliance.

11.2. Cladding materials, fasteners, and other materials referenced in this research report shall comply with the standard as indicated or as required by the locally applicable building code.

12. Review Schedule:

12.1. This research report is subject to periodic review and revision. For the most recent version of this report, visit drjengineering.org.

12.2. For information on the current status of this report, contact DrJ Engineering.
Appendix A:
Weights of Cladding Materials & Design Example
(from ABTG RR # 1503-02)

Cladding manufacturer’s data should be consulted for the unit weight of specific cladding materials. For the cladding weight categories described in the IBC and IRC connection provisions based on this Research Report, typical examples are as follows:

3 psf cladding weight category: wood lap siding, vinyl siding, fiber cement siding (most types), panel siding, etc.
11 psf: 3-coat Portland cement stucco (see calculation below)
18 psf: medium weight adhered masonry veneer
25 psf: heavy adhered masonry veneer

Weight of Portland Cement Plaster (Stucco)
On wood framing, three-coat plaster is typically installed over metal lath to a 7/8” nominal thickness. A typical plaster mixture weighs about 142 lbs. per cubic foot, roughly the same as mortar, and this amount of material would cover about 13.7 sq. ft. at 7/8” thick. The metal lath may add a small additional amount of weight, so the end result is that three-coat stucco weighs about 10.4 lbs. per sq. ft. (psf) installed.


Typical weight of softwood dimensional framing materials are as follows (1x3, 1x4, 2x3, and 2x4 are common furring choices):

<table>
<thead>
<tr>
<th>Nominal Size (in x in)</th>
<th>Actual Size (in x in)</th>
<th>(mm x mm)</th>
<th>Weight (lb/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 3</td>
<td>3/4 x 2 1/2</td>
<td>19 x 64</td>
<td>0.47</td>
</tr>
<tr>
<td>1 x 4</td>
<td>3/4 x 3 1/2</td>
<td>19 x 89</td>
<td>0.64</td>
</tr>
<tr>
<td>2 x 3</td>
<td>1 1/2 x 2 1/2</td>
<td>38 x 64</td>
<td>0.94</td>
</tr>
<tr>
<td>2 x 4</td>
<td>1 1/2 x 3 1/2</td>
<td>38 x 89</td>
<td>1.28</td>
</tr>
</tbody>
</table>

*Weight is based on softwood lumber having a weight of 35 lbs./ft.³

Design Example:

**Given**

- Foam Sheathing Thickness: 4”
- Cladding Material: Fiber cement lap siding
- Design Wind Speed/Exposure: 90/B
- Seismic Design Category: B (exempt)
- Wood Framing: 2x6 at 24” o.c.

**Solution**

**STEP 1**: Use 1x3 (min) wood furring (vertical orientation over studs per Figure 1b). Direct siding attachment using **Table 1a** (without furring per Figure 1a) could also be considered in similar fashion, but direct cladding attachment is generally more feasible for foam sheathing thicknesses not in excess of about 2 inches.
STEP 2: Consult siding manufacturer data for siding weight (2.3 psf) and add 0.24 psf for furring. Total = 2.54 psf (Use 3 psf).

Note: The material weight for the 1x3 furring in the table above is listed as 0.47 pounds per lineal foot. At 24” o.c., this equates to 0.24 pounds per square foot.

STEP 3: Using Table 1b (and column for 3 psf siding weight), min 1x3 wood furring at 24" o.c. attached to studs can be attached with a ¼" diameter lag screw at 24" o.c. through furring and foam sheathing and penetrating framing a minimum of 1½". Other fastening solutions in Table 1b are also possible.

STEP 4: Check to ensure the allowable wind pressure resistance of the selected furring and attachment schedule (Step 3) is capable of resisting the allowable stress design wind load required by the building code (refer to Section 5.5). For direct cladding attachments (or the cladding attachment to furring), the allowable wind load resistance of the specific cladding material is usually specified by the cladding manufacturer or the building code (if specifically addressed in the code). In this example which uses 1x3 furring spaced at 24"oc and attached with a ¼" diameter lag screw at 24"oc along the furring, Table 1c is used to determine an allowable wind pressure resistance of 23.4 psf for the furring and its attachment (building codes generally do not address furring wind load resistance prescriptively). Consulting the 2018 IRC Table R301.2(2), this will satisfy the components and cladding allowable stress wind load for wind speeds of at least 120 mph (and slightly less than 130 mph) for wind Exposure B (suburban/wooded terrain) for buildings with a mean roof height up to 30 feet. For other wind exposure and building height conditions, refer to IRC Table R301.2(2) or an allowable stress design wind load calculated in accordance with ASCE 7. To gain greater wind load resistance, the fastener spacing in the furring could be decreased (providing more support than needed for the cladding weight per Step 3 above).

STEP 5: The minimum length of fastener required is 0.75" (furring) + 4" (foam) + 1.5" (penetration) = 6.25". Select a 6½" or 7" lag screw. Note: Add length for thickness of additional sheathing material layer behind foam, if included. Verify furring provides adequate thickness for siding fastener per code or siding manufacturer’s installation instructions. If needed, specify a thicker furring (i.e., 2x4) or an appropriate siding fastener for use in ¾”-thick furring.

STEP 6: Ensure installation follows the practices required in Section 6.
Appendix B: Prescriptive Code Requirements

The following code excerpts are from the 2018 editions of the IRC and IBC as justified by the test data and engineering analysis methodology presented in this Research Report. In addition, a provision added by others to the 2015 edition of the IRC allows connection directly to wood structural panels with certain limitations and is included at the end of this appendix due to its relevance.

2018 IRC Section R703.15 Cladding attachment over foam sheathing to wood framing. Cladding shall be specified and installed in accordance with Section R703, the cladding manufacturer's approved instructions including any limitations for use over foam plastic sheathing, or an approved design. In addition, the cladding or furring attachments through foam sheathing to framing shall meet or exceed the minimum fastening requirements of Section R703.15.1, Section R703.15.2, or an approved design for support of cladding weight.

Exceptions:
1. Where the cladding manufacturer has provided approved installation instructions for application over foam sheathing, those requirements shall apply.
2. For exterior insulation and finish systems, refer to Section R703.9.
3. For anchored masonry or stone veneer installed over foam sheathing, refer to Section R703.7.

R703.15.1 Direct attachment. Where cladding is installed directly over foam sheathing without the use of furring, cladding minimum fastening requirements to support the cladding weight shall be as specified in Table R703.15.1.

<table>
<thead>
<tr>
<th>CLADDING FASTENER THROUGH FOAM SHEATHING</th>
<th>CLADDING FASTENER TYPE AND MINIMUM SIZEb</th>
<th>CLADDING FASTENER VERTICAL SPACING (inches)</th>
<th>MAXIMUM THICKNESS OF FOAM SHEATHINGc (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>16” o.c. Fastener Horizontal Spacing</td>
<td>24” o.c. Fastener Horizontal Spacing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cladding Weight:</td>
<td>Cladding Weight:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 psf 11 psf 18 psf 25 psf 3 psf 11 psf 18 psf 25 psf</td>
<td></td>
</tr>
<tr>
<td>Wood Framing (minimum 1-1/4 -inch penetration)</td>
<td>0.113” diameter nail</td>
<td>6 2.00 1.45 0.75 DR 2.00 0.85 DR DR</td>
<td>2.00 0.85 DR DR</td>
</tr>
<tr>
<td></td>
<td>8 2.00 1.00 DR DR</td>
<td>2.00 0.55 DR DR</td>
<td>1.85 DR DR DR</td>
</tr>
<tr>
<td></td>
<td>12 2.00 0.55 DR DR</td>
<td>1.85 DR DR DR</td>
<td>1.85 DR DR DR</td>
</tr>
<tr>
<td></td>
<td>0.120” diameter nail</td>
<td>6 3.00 1.70 0.90 0.55 3.00 1.05 0.50 DR</td>
<td>3.00 1.05 0.50 DR</td>
</tr>
<tr>
<td></td>
<td>8 3.00 1.20 0.60 DR</td>
<td>3.00 0.70 DR DR</td>
<td>3.00 0.70 DR DR</td>
</tr>
<tr>
<td></td>
<td>12 3.00 0.70 DR DR</td>
<td>2.15 DR DR DR</td>
<td>2.15 DR DR DR</td>
</tr>
<tr>
<td></td>
<td>0.131” diameter nail</td>
<td>6 4.00 2.15 1.20 0.75 4.00 1.35 0.70 DR</td>
<td>4.00 1.35 0.70 DR</td>
</tr>
<tr>
<td></td>
<td>8 4.00 1.55 0.80 DR</td>
<td>4.00 0.90 DR DR</td>
<td>4.00 0.90 DR DR</td>
</tr>
<tr>
<td></td>
<td>12 4.00 0.90 DR DR</td>
<td>2.70 0.50 DR DR</td>
<td>2.70 0.50 DR DR</td>
</tr>
<tr>
<td></td>
<td>0.162” diameter nail</td>
<td>6 4.00 3.55 2.05 1.40 4.00 2.25 1.25 0.80</td>
<td>4.00 2.25 1.25 0.80</td>
</tr>
<tr>
<td></td>
<td>8 4.00 2.55 1.45 0.95 4.00 1.60 0.85 0.50</td>
<td>4.00 1.60 0.85 0.50</td>
<td>4.00 1.60 0.85 0.50</td>
</tr>
<tr>
<td></td>
<td>12 4.00 1.60 0.85 0.50</td>
<td>4.00 0.95 DR DR</td>
<td>4.00 0.95 DR DR</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa, 1 pound per square inch = 6.895 kPa.

DR = Design required.

o.c. = on center

a. Wood framing shall be Spruce-pine-fir or any wood species with a specific gravity of 0.42 or greater in accordance with AWC NDS.
b. Nail fasteners shall comply with ASTM F 1667, except nail length shall be permitted to exceed ASTM F 1667 standard lengths.
c. Foam sheathing shall have a minimum compressive strength of 15 psi in accordance with ASTM C 578 or ASTM C 1289.


**DrJ Research Report**

**R703.15.2 Furred cladding attachment.** Where wood furring is used to attach cladding over foam sheathing, furring minimum fastening requirements to support the cladding weight shall be as specified in Table R703.15.2. Where placed horizontally, wood furring shall be preservative-treated wood in accordance with Section R317.1 or naturally durable wood and fasteners shall be corrosion resistant in accordance Section R317.3.

**TABLE R703.15.2**

**Furring Minimum Fastening Requirements for Application Over Foam Plastic Sheathing to Support Cladding Weight**

<table>
<thead>
<tr>
<th>Furring Material</th>
<th>Framing Member</th>
<th>Fastener Type and Minimum Size</th>
<th>Minimum Penetration Into Wall Framing (inches)</th>
<th>Fastingner Spacing in Furring (inches)</th>
<th>Maximum Thickness of Foam Sheathing (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum 1x Wood Furring</td>
<td>Minimum 2x Wood Stud</td>
<td>0.131” diameter nail</td>
<td>1-1/4</td>
<td>8</td>
<td>16.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.162” diameter nail</td>
<td>1-1/4</td>
<td>8</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No.10 wood screw</td>
<td>1</td>
<td>12</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1/4” lag screw</td>
<td>1-1/2</td>
<td>12</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>24</td>
<td>4.00</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa, 1 pound per square inch = 6.895 kPa.

DR = Design required.

o.c. = on center

a. Wood framing shall be Spruce-pine-fir or any wood species with a specific gravity of 0.42 or greater in accordance with AWC NDS.
b. Nail fasteners shall comply with ASTM F 1667, except nail length shall be permitted to exceed ASTM F 1667 standard lengths.
c. Where the required cladding fastener penetration into wood material exceeds 3/4 inch and is not more than 1 1/2 inches, a minimum 2x wood furring or an approved design shall be used.
d. Foam sheathing shall have a minimum compressive strength of 15 psi in accordance with ASTM C 578 or ASTM C 1289.
e. Furring shall be spaced not more than 24 inches on center, in a vertical or horizontal orientation. In a vertical orientation, furring shall be located over wall studs and attached with the required fastener spacing. In a horizontal orientation, the indicated 8-inch and 12-inch fastener spacing in furring shall be achieved by use of two fasteners into studs at 16 inches and 24 inches on center, respectively.

**2018 IBC Section 2603.13 Cladding attachment over foam sheathing to wood framing.** Cladding shall be specified and installed in accordance with Chapter 14 and the cladding manufacturer’s installation instructions. Where used, furring and furring attachments shall be designed to resist design loads determined in accordance with Chapter 16. In addition, the cladding or furring attachments through foam sheathing to framing shall meet or exceed the minimum fastening requirements of Section 2603.13.1, Section 2603.13.2, or an approved design for support of cladding weight.

**Exceptions:**

1. Where the cladding manufacturer has provided approved installation instructions for application over foam sheathing, those requirements shall apply.
2. For exterior insulation and finish systems, refer to Section 1408.
3. For anchored masonry or stone veneer installed over foam sheathing, refer to Section 1405.

**2603.13.1 Direct attachment.** Where cladding is installed directly over foam sheathing without the use of furring, cladding minimum fastening requirements to support the cladding weight shall be as specified in Table 2603.13.1.
2603.13.2 Furred cladding attachment. Where wood furring is used to attach cladding over foam sheathing, furring minimum fastening requirements to support the cladding weight shall be as specified in Table 2603.13.2. Where placed horizontally, wood furring shall be preservative treated wood in accordance with Section 2303.1.9 or naturally durable wood and fasteners shall be corrosion resistant in accordance with Section 2304.10.5.

### TABLE 2603.13.1

<table>
<thead>
<tr>
<th>CLADDING FASTENER THROUGH FOAM SHEATHING</th>
<th>CLADDING FASTENER TYPE AND MINIMUM SIZE</th>
<th>MAXIMUM THICKNESS OF FOAM SHEATHING (inches)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood Framing (minimum 1-1/4-inch penetration)</td>
<td>0.113” diameter nail</td>
<td>16” o.c. Fastener Horizontal Spacing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 psf</td>
<td>11 psf</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>0.120” diameter nail</td>
<td>6</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>0.131” diameter nail</td>
<td>6</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>0.162” diameter nail</td>
<td>6</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12</td>
<td>4.00</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa, 1 pound per square inch = 6.895 kPa.
DR = Design required.
o.c. = on center

a. Wood framing shall be Spruce-pine-fir or any wood species with a specific gravity of 0.42 or greater in accordance with AWC NDS.
b. Nail fasteners shall comply with ASTM F 1667, except nail length shall be permitted to exceed ASTM F 1667 standard lengths.
c. Foam sheathing shall have a minimum compressive strength of 15 psi in accordance with ASTM C 578 or ASTM C 1289.
### TABLE 2603.13.2
FURRING MINIMUM FASTENING REQUIREMENTS FOR APPLICATION OVER FOAM PLASTIC SHEATHING TO SUPPORT CLADDING WEIGHT

<table>
<thead>
<tr>
<th>MINIMUM PENETRATION INTO WALL FRAMING (inches)</th>
<th>FURRING MATERIAL</th>
<th>FRAMING MEMBER</th>
<th>FASTENER TYPE AND MINIMUM SIZE</th>
<th>MAXIMUM THICKNESS OF FOAM SHEATHING[^d] (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 psf</td>
<td>11 psf</td>
<td>18 psf</td>
<td>25 psf</td>
</tr>
<tr>
<td></td>
<td>16” o.c. Furring[^a]</td>
<td>24” o.c. Furring[^a]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siding Weight:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 psf</td>
<td>1.05</td>
<td>0.80</td>
<td>0.75</td>
<td>DR</td>
</tr>
<tr>
<td>11 psf</td>
<td>1.40</td>
<td>1.20</td>
<td>1.10</td>
<td>0.70</td>
</tr>
<tr>
<td>18 psf</td>
<td>2.85</td>
<td>2.65</td>
<td>2.50</td>
<td>1.50</td>
</tr>
<tr>
<td>25 psf</td>
<td>3.25</td>
<td>3.05</td>
<td>2.90</td>
<td>1.90</td>
</tr>
</tbody>
</table>

[^a]: For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa, 1 pound per square inch = 6.895 kPa.
[^b]: DR = Design required.
[^c]: o.c. = on center
[^d]: a. Wood framing and furring shall be Spruce-pine-fir or any wood species with a specific gravity of 0.42 or greater in accordance with AWC NDS.
[^e]: b. Nail fasteners shall comply with ASTM F 1667, except nail length shall be permitted to exceed ASTM F 1667 standard lengths.
[^f]: c. Where the required cladding fastener penetration into wood material exceeds 3/4 inch and is not more than 1-1/2 inches, a minimum 2x wood furring or an approved design shall be used.
[^g]: d. Foam sheathing shall have a minimum compressive strength of 15 psi in accordance with ASTM C 578 or ASTM C 1289.
[^h]: e. Furring shall be spaced a maximum of 24 inches (610 mm) on center in a vertical or horizontal orientation. In a vertical orientation, furring shall be located over wall studs and attached with the required fastener spacing. In a horizontal orientation, the indicated 8 inch (203 mm) and 12 inch (305 mm) fastener spacing in furring shall be achieved by use of two fasteners into studs at 16 inches (406 mm) and 24 inches (610 mm) on center, respectively.
In addition to the above model code provisions based on engineering methods and data as documented in this research report, the following additional provision for cladding attachments through foam sheathing to wood structural panels is included in the 2015 and 2018 editions of the IRC:

**R703.3.2 Fasteners.**

Exterior wall coverings shall be securely fastened with aluminum, galvanized, stainless steel or rust-preventative coated nails or staples in accordance with Table R703.3(1) or with other approved corrosion-resistant fasteners in accordance with the wall covering manufacturer’s installation instructions. Nails and staples shall comply with ASTM F 1667. Nails shall be T-head, modified round head, or round head with smooth or deformed shanks. Staples shall have a minimum crown width of 7/16 inch (11.1 mm) outside diameter and be manufactured of minimum 18-gage wire. Where fiber-board, gypsum, or foam plastic sheathing backing is used, nails or staples shall be driven into the studs. Where wood or wood structural panel sheathing is used, fasteners shall be driven into studs unless otherwise permitted to be driven into sheathing in accordance with either the siding manufacturer’s installation instructions or Table R703.3.2.

**TABLE R703.3.2**

**OPTIONAL SIDING ATTACHMENT SCHEDULE FOR FASTENERS WHERE NO STUD PENETRATION NECESSARY**

<table>
<thead>
<tr>
<th>APPLICATION</th>
<th>NUMBER AND TYPE OF FASTENER</th>
<th>SPACING OF FASTENERS$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior wall covering (weighing 3 psf or less) attachment to wood structural panel sheathing, either direct or over foam sheathing a maximum of 2 inches thick.$^a$</td>
<td>Ring shank roofing nail (0.120&quot; min. dia.)</td>
<td>12&quot; o.c.</td>
</tr>
<tr>
<td></td>
<td>Ring shank nail (0.148&quot; min. dia.)</td>
<td>15&quot; o.c.</td>
</tr>
<tr>
<td></td>
<td>No. 6 screw (0.138&quot; min. dia.)</td>
<td>12&quot; o.c.</td>
</tr>
<tr>
<td></td>
<td>No. 8 screw (0.164&quot; min. dia.)</td>
<td>16&quot; o.c.</td>
</tr>
</tbody>
</table>

For SI: 1 inch = 25.4 mm.

$^a$ Fastener length shall be sufficient to penetrate back side of the wood structural panel sheathing by at least 7/16 inch. The wood structural panel sheathing shall be not less than 7/16 inch in thickness.

$^b$ Spacing of fasteners is per 12 inches of siding width. For other siding widths, multiply “Spacing of Fasteners” above by a factor of 12/s, where “s” is the siding width in inches. Fastener spacing shall never be greater than the manufacturer’s minimum recommendations.