SIDING ATTACHMENT: FACTS AND FANTASIES

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Abstract

The use of cementitious lap siding products has grown substantially over the past two decades. In coastal environments, attachment of the siding on buildings is important to minimize damages during code-defined wind events. When these buildings are the subject of construction litigation, criticisms of attachment are common. Some experts opine that complete removal and replacement of the siding is necessary due to attachment issues. However, the authors believe that complete removal and replacement is rarely justified. This presentation will provide the audience with a general knowledge base to correctly evaluate, analyze, and formulate reasonable repairs regarding as-built siding attachment conditions.

Speaker

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DEREK HODGIN has over 20 years of experience as an engineering consultant. He performs facility condition inspections, failure analysis, damage assessments, and forensic engineering investigations of all types of structures. A licensed professional engineer in 18 states, Hodgin is also registered as an RRO, RRC, REWC, RWC, and RBEC with RCI, Inc. His experience includes failure analysis of a wide variety of building envelope and roof systems. A large number of his projects have included analysis of deficient construction cases, including all aspects of the building envelope.

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Siding Attachment: Facts and Fantasies

Introduction
Exterior cladding is a key element to all buildings. The exterior cladding of a structure can include different types of sidings such as wood, hardboard, vinyl, and cementitious lap siding. Over the past two decades, the installation of cementitious lap siding (also known as fiber cement board siding) as an exterior cladding has grown substantially. Specifically, fiber cement board siding is now commonly installed on single- and multifamily residential buildings, as well as light commercial buildings located in coastal environments.

Due to the increased use of fiber cement board siding on buildings located in coastal environments, attachment of the fiber cement board lap siding has become closely scrutinized. When these buildings are subject to construction litigation, criticisms of siding attachment are common. In fact, some expert witnesses assert that when the siding attachment is not installed in accordance with the manufacturer’s installation instructions, complete removal and replacement of the siding is necessary.

Typically, expert witnesses rely on applicable building codes, industry standards, and manufacturer information to formulate their opinions. Additionally, expert witnesses use engineering judgment and experience to correctly evaluate, analyze, and formulate reasonable repairs regarding the as-built siding attachment conditions when necessary. This paper will provide the distinction between real issues (facts) and nonissues (fantasy) regarding siding attachment that have become common in construction litigation.

Attachment Terminology
Like many other siding products, fiber cement board siding can be blind-nailed (concealed) or face-nailed (exposed). These two attachment terms are consistently used in building codes, industry standards, and manufacturers’ installation instructions.

As shown in Figure 1, blind nailing involves fasteners through the bottom course of siding and covered by the course of siding above. The heads of the fasteners are concealed by the overlapping siding. Face nailing involves fasteners driven through the top course and bottom course of siding where the planks overlap. The heads of the fasteners are exposed.

Building Code Requirements
In general, the intent of building codes is to provide the design professional and/or general contractor with minimum requirements to which a building is to be constructed. The minimum requirements in the building code include a combination of prescriptive and performance-based requirements. By definition, prescriptive requirements specifically state how a building is to be constructed (i.e., attach the siding using a 6d common nail that penetrates each wall stud a minimum of one inch), while performance requirements outline a minimum level of building performance (i.e., the siding shall resist a code-defined wind load of 130 mph).

Fiber cement board attachment was not introduced into any of the building codes until the 2003 International Residential Code (IRC). Prior to the 2003 IRC, building codes only provided attachment requirements for other types of exterior cladding. Building codes typically include alternate attachment conditions, such as attaching to light-gauge metal and wood stud wall framing.

Table 1 provides a summary of the fiber cement board attachment requirements set forth by the building codes for fasteners installed into structural panel wall sheathing and wood wall framing.

<table>
<thead>
<tr>
<th>Building Code</th>
<th>Table Number</th>
<th>Fiber Cement Board Siding</th>
<th>Spacing of Fasteners</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003/2006 IRC</td>
<td>R703.4</td>
<td>6d corrosion-resistant nail</td>
<td>Face nailing: 2 nails at each stud</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Footnote: Minimum 0.102-in. smooth shank, 0.25-in. round head</td>
<td>Concealed nailing: One 11-gauge, 1-1/2-in.-long galvanized roofing nail (0.371-in. head diameter, 0.120 shank) or 6d galvanized box nail at each stud</td>
</tr>
<tr>
<td>2009/2012 IRC</td>
<td>R703.4</td>
<td>6d corrosion-resistant nail</td>
<td>Face nailing: One 6d common nail through the overlapping planks at each stud</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Footnote: Fasteners shall comply with the nominal dimensions in ASTM 1667</td>
<td>Concealed nailing: One 11-gauge, 1-1/2-in.-long galvanized roofing nail through the top edge of each plank at each stud</td>
</tr>
</tbody>
</table>

Figure 1 – Blind nailing and face nailing. Source: James Hardie Technical Bulletin #171

Table 1 – Summary of building code fiber cement board siding.
As shown in Table 1, the attachment requirements of the fiber cement board siding were the same for the 2003 IRC and 2006 IRC. Similarly, the attachment requirements of the fiber cement board siding were the same for the 2009 IRC and 2012 IRC. A significant difference between the 2003/2006 IRC requirements and the 2009/2012 IRC requirements is the reduction of two fasteners to one fastener for face nailing applications. Additionally, the footnotes provided in the building codes changed. Specifically, the 2003/2006 IRC recommended a minimum fastener size and head, whereas the 2009/2012 IRC simply stated that the fastener dimensions had to be in compliance with ASTM F1667, Standard Specification for Driven Fasteners: Nails, Spikes and Staples.

As previously stated, the intent of the building code is to provide the minimum requirements for construction. With regard to fiber cement board attachment, the building codes provide the minimum type, size, and location of fasteners; however, when a structure is located in a high-wind area, the design professional should evaluate the attachment because the minimum prescriptive requirements stated in the building code may not be adequate to meet the performance requirement to resist a code-prescribed wind load. Additionally, alternate fasteners not specifically addressed in the building code may be considered an improvement over the fasteners specified in the code.

**INDUSTRY STANDARDS**

In general, industry standards are accepted requirements followed by the members of a particular industry and/or discipline. Industry standards tend to incorporate the state-of-the-art construction practices and manufacturer literature at that time. Some standards are specifically referenced by the applicable building codes (making them a code requirement), while other standards are considered to represent a nonmandatory “best-practices” guide.

With regard to fiber cement board attachment, the building codes do not provide specific industry standard references. However, there are additional sources of information that do provide a best-practices guide regarding the attachment of the fiber cement board siding. One example is the Journal of Light Construction’s JLC Field Guide To Residential Construction: A Manual of Best Practice (JLC Guide). This provides general guidelines regarding the installation of fiber cement board siding. Some of the general guidelines provided in the JLC Guide include:

- Fasteners should not be set below the surface or overdriven into the siding because it will reduce the holding power.
- Specific fasteners should be used for face-nailing or blind-nailing applications.
- Minimum dimensions for face nailing and blind nailing are provided.
- Fasteners must penetrate wood framing.
- Corrosion-resistant fasteners should be used.

FEMA P-499, Home Builder’s Guide to Coastal Construction, is another example of a best-practices industry standard that references the installation of fiber cement board siding. For instance, FEMA P-499 recommends that stainless steel fasteners be used when the building is located within 3,000 feet of the ocean shoreline.

As described above, some of the general guidelines recommended by the JLC Guide and FEMA P-499 provide the design professional and/or contractor with additional information that may or may not be provided in the building code or manufacturers’ literature. In regard to construction litigation, these guides could be used by the expert witness to supplement information in the building code or the manufacturers’ literature. However, noncompliance with best practices does not necessarily mean that there was negligence by the design professional and/or contractor.

**MANUFACTURERS’ LITERATURE**

When fiber cement board siding attachment is the topic of construction litigation, being able to locate and review a specific manufacturer’s product literature is important. The information contained within the manufacturer’s product literature can provide the expert witness with important information regarding the attachment requirements and if its product has been subject to any evaluation testing. It is important for the expert witness to review the manufacturers’ literature that was current at the time of application.

Typical installation instructions describe acceptable substrates to which siding can be attached, types of fasteners, and dimensional tolerances regarding the fastener location and condition of installed fasteners relative to the fiber cement board siding. These prescriptive requirements are important to know when evaluating the adequacy of the fiber cement board siding attachment.

In addition to installation instructions, some manufacturers will produce supplemental documents that include best practices and technical bulletins that discuss alternate attachment details. Some of the supplemental documents include additional information regarding the use of blind- and face-nailing combinations (i.e., double nailing) and the use of alternative fasteners in high-wind areas.

**CODE EVALUATION REPORTS**

In order to verify product compliance with the applicable building codes, manufacturers will have their products evaluated by a certified testing agency. The testing agencies rely on the minimum requirements in the building code and standardized testing methods to produce a code evaluation report. Compliance with the code evaluation report becomes a building code requirement.

Prior to the International Building Code and International Residential Code (the “I” codes), there were several different code evaluation agencies. Some of these code evaluation agencies were specific to a particular building code. It should be noted that these code evaluation reports are not code-referenced. The ideology behind the code evaluation report is that manufacturers would have their product tested to verify compliance with a particular building code or several building codes. Therefore, the installation of the evaluated product would comply with the applicable building code. However, the code evaluation report for a fiber cement board siding product that has been tested and evaluated in accordance with the 2003 IRC would not be in compliance with the 2012 IRC. The evaluation must be specific to the code with which the manufacturer seeks compliance.

**CONSTRUCTION DEFECT LITIGATION**

As stated previously, due to the increase of fiber cement board siding (especially in coastal environments), attachment of the
fiber cement board siding has become a topic of construction defect litigation. When this occurs, an expert witness should identify construction deficiencies or allegations that are based on data collected during a visual survey and an engineering analysis based on the as-built conditions.

**Typical Allegations**

During the course of construction litigation, the primary focus of the plaintiff expert is to identify construction deficiencies that require repair. Provided is typical photographic documentation of allegations regarding fiber cement board siding attachment (see Figures 2 through 7).

According to some expert witnesses, all the above-mentioned typical allegations represent a construction deficiency because they may deviate from applicable building code, industry standards, and/or manufacturers’ installation instructions. It is the opinion of the authors that, while conditions may deviate from written instructions, they do not always represent a construction defect that requires a repair.

**Data Collection**

For an expert witness, data collection relative to the fiber cement board siding attachment is important. Specifically, data collection provides the information that will be used to determine the adequacy of the as-built siding conditions. Provided below are some of the important data needed to evaluate the adequacy of the fiber cement board siding attachment:

- Fastener type (length, shank diameter, head diameter, shank type)
- Horizontal fastener spacing

![Figure 2 – Improper fastener type (not listed in code evaluation).](image)

![Figure 3 – Inadequate fastener spacing (greater than 16 inches on center).](image)

![Figure 4 – Inadequate edge distance (less than 1 inch).](image)
Fasteners come in different types and sizes. With their installation instructions, some manufacturers will provide recommended fastener types and sizes that can be used in the installation of their product. However, it should be noted that alternate fasteners, not specifically mentioned in the installation instructions, could be used in lieu of the recommended fasteners and meet performance requirements of the building code. However, an engineering analysis is needed to determine adequacy. There are expert witnesses that believe the installation of fasteners not specifically referenced in the installation instructions represents a construction deficiency, such that complete removal and replacement is needed. However, some manufacturers provide literature that specifically states alternate fasteners may be used if the design professional can prove that the alternate fasteners are in compliance with the applicable building code. This is referred to as an equivalency analysis.

The horizontal and vertical fastener spacing measurements are used to calculate the tributary area (effective area) of the fastener. The tributary area of the fastener
is used during the engineering analysis. It is the effective area that the fastener will be responsible for in resisting a code-defined wind load.

In their installation instructions, most manufacturers will recommend end distances and edge distances for fasteners. These help to prevent the siding from cracking when subjected to fastener installation, siding shrinkage, or wind loads. It should be noted that a fastener can be installed within the manufacturer-recommended end/edge distances; however, the likelihood that the siding will crack will increase if the fastener is installed closer to the end and/or edge of the siding. The evaluation of a siding failure, where the siding breaks around the fastener due to outward rotation and prying action, is not addressed by this paper. Siding may be vulnerable to this type of failure when blind nailing is used. The risk of this type of failure increases proportionally as the fastener gets closer to the top edge.

As stated by most manufacturers in the literature, and in some industry standards, a fastener should be installed flush to the top surface of the siding. Most manufacturers and industry standards recommend that a fastener should not be installed in an underdriven or overdriven condition. In the event that a fastener is underdriven or overdriven, a supplemental fastener is typically installed adjacent to the original fastener.

Regarding the engineering analysis, it is important to determine the percentage of fasteners that penetrated the wood framing versus those that did not. This statistical percentage, based on the number of fasteners that penetrate the wood framing, provides the expert witness with data that can be used in determining an appropriate repair, if considered to be necessary.

**Engineering Analysis**

It is uncommon for a structural engineer to perform an engineering analysis on the exterior siding attachment as part of the original design process for a residential structure. However, expert witnesses may be required to perform an engineering analysis on the adequacy of the as-built siding attachment details during construction litigation.

In order to adequately evaluate the as-built condition of the fiber cement board siding attachment, the expert witness needs to compare the withdrawal resistance of the as-built conditions to the code-prescribed wind loads. The engineering analysis should include design wind pressure calculations, fastener withdrawal calculations, and comparing the as-built condition of the siding attachment to the code-defined wind load.

Depending on the applicable building code to which the subject structure was originally subjected, the expert witness can calculate the design wind pressures by using information provided in the building code or by using the code-referenced industry standard (i.e., ASCE 7). Expert witnesses should calculate the design wind pressures based on the information provided in the building code that had been adopted at the time of application. The design wind pressure is dependent on the wind speed, exposure category, height of the building, and location on the building (field or corner). If the expert witness has to use a code-referenced industry standard, more information about the structure may need to be known in order to determine the design wind pressures.

**Determination of fastener withdrawal** is based on code-referenced industry standards. For example, the “National Design Specification for Wood Construction” (NDS)\(^{13}\) is the standard that is commonly used by expert witnesses to determine that fastener withdrawal resistance. Fastener withdrawal resistance is based on a mathematical equation that takes into account several factors that may affect the attachment when subjected to different types of loads, environmental conditions, fastener types, and construction conditions. The fastener withdrawal resistance determined from the NDS is expressed in pounds per inch of penetration into the wood substrate. Therefore, one key factor in determining fastener withdrawal resistance is determining the depth of penetration of the fastener into the wood sheathing and wood framing. The type of wall sheathing, the species of the wood framing, and the shank diameter of the fastener are also considered.

When the design wind pressure calculations and fastener withdrawal resistance calculations have been performed, the expert witness can compare the as-built attachment conditions to the code-defined loads. At this point of the engineering analysis, the expert witness takes into account the data that were collected to accurately analyze the siding attachment. For example, the vertical and horizontal spacing of the fastener are used to determine the tributary area of a fastener. The effective area is needed to convert the design wind pressures to fastener withdrawal requirements.

**REPAIR RECOMMENDATIONS**

A reasonable repair regarding the attachment of fiber cement board siding is based on a complete review of the applicable building code, industry standards, and manufacturer literature, in addition to correctly evaluating and analyzing the as-built conditions of the siding attachment. Based on the above-mentioned research and engineering analysis, an expert witness may choose between the following potential repair options:

- No repairs
- Installation of supplemental fasteners
- Complete removal and replacement

A variety of conditions (i.e., environmental, construction) can influence the type of repair needed and can vary from case to case. Depending on the results of the engineering analysis, an expert witness may recommend that a repair not be considered necessary, even when deviations from the manufacturer instructions exist.

If the engineering analysis reveals that the as-built attachment details are insufficient to resist code-defined wind loads, supplemental fastening is the most common repair. A supplemental fastener repair can vary from adding supplemental fasteners at top floor corner zones (where design wind pressures will be the highest) to supplemental fasteners at every floor at a certain horizontal spacing. Some expert witnesses believe that if the siding has been attached in a blind nail condition, one should not add supplemental fasteners because manufacturers do not allow “double” nailing; however, this is not true. Manufacturers will allow a blind nail/facade nail condition for repairs in high-wind coastal areas.

Complete removal and replacement of the fiber cement board siding based on inadequate as-built attachment are rarely justified. Typically, if complete removal and replacement are recommended, it is because of other construction issues (i.e., moisture intrusion, structural conditions) that need to be addressed.
CONCLUSIONS
As described above, the installation of fiber cement board siding includes many variables that affect the adequacy of the attachment to resist code-defined loads. Each of these variables must be considered to determine if the installation is defective and if a repair is needed. It is not reasonable to assert that the siding installation is defective simply because the as-built conditions deviate from the published manufacturer literature. To serve as an engineering expert often requires performance of an engineering analysis to support opinions to a reasonable degree of certainty. Offering opinions without valid support diminishes our roles as experts and compromises the integrity of our profession.

REFERENCES
10. James Hardie Building Products, HardiePlank HZ10 Lap Siding Installation Requirements, November 2012
14. APA, Technical Topics: TT-039C – Recommended Design Values for Nail Withdrawal From APA Plywood and OSB, July 2010
APPENDIX: SIDING ATTACHMENT EXAMPLE

As previously stated, to serve as an engineering expert often requires that an engineering analysis be performed to support opinions to a reason degree of certainty. To simply assert that the siding attachment is defective because the as-built conditions deviate from applicable building code and/or manufacturer literature is not reasonable. The following hypothetical example demonstrates how to correctly evaluate and analyze as-built siding conditions, in addition to formulating a reasonable recommended repair.

Building Information

The subject building is a three-story residential building in Charleston, South Carolina. At the time of original construction, the applicable building code was the 2006 IRC. The subject building is located in an Exposure C. The engineering analysis will be performed at a height of 30 feet (at the third floor). The following data were collected during a visual survey:

- Siding was face-nailed with one fastener per location.
- Average horizontal spacing was measured at 18 in. on-center.
- Vertical spacing was measured to be 7 in. on-center.
- The wood framing was No. 2 southern yellow pine.
- The wall sheathing was OSB and was measured to have a thickness of 7/16 in.
- Two of the observed eight fasteners were installed into the wood framing.
- The fastener was observed to have the following properties:
  - Smooth-shank nail (common nail)
  - Shank diameter of 0.131 in.
  - Length of 2 in.
- The siding was measured to have a thickness of 5/16 in.

Design Wind Pressure Analysis

The code-defined design wind pressures at the subject building can be determined by the 2006 IRC. Specifically, by determining the basic wind speed from the wind speed maps, the velocity wind pressures can be determined for the corner zone (i.e., Zone 5) and the interior zone (i.e., Zone 4). The velocity wind pressures are then adjusted by a height and exposure coefficient to determine the design wind pressure. Table 2 shows the code-defined wind pressure analysis.

Fastener Withdrawal Analysis

Determining fastener withdrawal is based on the code-referenced industry standard, the “National Design Specification for Wood Construction” (NDS). Fastener withdrawal resistance is based on a mathematical equation that takes into account several factors that may affect the attachment when subjected to different types of loads, environmental conditions, fastener type, and construction conditions. A key factor in determining the fastener withdrawal resistance is determining the depth of penetration of the fastener into the wood stud framing and OSB wall sheathing.

Table 3 shows the NDS withdrawal design values for both the wood stud framing and OSB wall sheathing. Additionally, Table 3 shows the adjustment factors that are applied to determine the design withdrawal value for both the wood stud framing and OSB wall sheathing.

As-Built Attachment Conditions vs. Code-Defined Wind Loads

When the design wind pressure calculations and fastener withdrawal resistance calculations have been performed, the as-built attachment conditions can be compared to the code-defined loads. The vertical and horizontal spacing of the fastener are used to determine the tributary area of a fastener. The effective area is needed to convert the design wind pressures to fastener withdrawal requirements.

From the data collected, some of the fasteners did not penetrate the wood stud framing. Therefore, the withdrawal resistance for the OSB wall sheathing and wood stud framing/OSB wall sheathing is compared with the code-described wind loads. Table 4 shows the conversion from a design wind pressure to a design wind load. Additionally, Table 4 shows the comparison of fastener withdrawal resistance to design wind loads for both conditions (i.e., OSB wall sheathing and wood stud framing/OSB wall sheathing).
Table 3 – Withdrawal analysis (wood framing and sheathing).

<table>
<thead>
<tr>
<th>Wood Framing - Withdrawal Analysis</th>
<th>Wall Sheathing - Withdrawal Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fastener Information</strong></td>
<td><strong>Fastener Information</strong></td>
</tr>
<tr>
<td>Type of Fastener: Smooth-Shank (common)</td>
<td>Type of Fastener: Smooth-Shank (common)</td>
</tr>
<tr>
<td>Shank Diameter: 0.131 inches</td>
<td>Shank Diameter: 0.131 inches</td>
</tr>
<tr>
<td>Length: 2.0 inches</td>
<td>Length: 2.0 inches</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Framing Information</th>
<th>Framing Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Framing Species: No. 2 Southern Pine (Specific Gravity = 0.50)</td>
<td>Framing Species: OSB (Specific Gravity = 0.40, APA TT-039C)</td>
</tr>
<tr>
<td>Framing Penetration: 0.9375 inches</td>
<td>Framing Penetration: 0.4375 inches</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Withdrawal Design Value</th>
<th>Withdrawal Design Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(W = ) 32 lbs./inch of penetration</td>
<td>(W = ) 18 lbs./inch of penetration</td>
</tr>
</tbody>
</table>

| Table 11.2C                       | Table 11.2C                       |

<table>
<thead>
<tr>
<th>Adjustment Factors</th>
<th>Adjustment Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration Factor: (C_D = 1.6)</td>
<td>Duration Factor: (C_D = 1.6)</td>
</tr>
<tr>
<td>Wet Service Factor: (C_M = 1.0)</td>
<td>Wet Service Factor: (C_M = 1.0)</td>
</tr>
<tr>
<td>Temperature Factor: (C_t = 1.0)</td>
<td>Temperature Factor: (C_t = 1.0)</td>
</tr>
<tr>
<td>End-Grain Factor: (C_{eg} = 1.0)</td>
<td>End-Grain Factor: (C_{eg} = 1.0)</td>
</tr>
<tr>
<td>Toenail Factor: (C_{tn} = 1.0)</td>
<td>Toenail Factor: (C_{tn} = 1.0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adjusted Withdrawal Design Value</th>
<th>Adjusted Withdrawal Design Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(W'_{FRAMING} = ) 48 lbs.</td>
<td>(W'_{TOTAL} = ) 61 lbs.</td>
</tr>
<tr>
<td>(W'_{OSB} = ) 13 lbs.</td>
<td>(W'_{TOTAL} = ) 61 lbs.</td>
</tr>
</tbody>
</table>

**Recommended Repair**

The engineering analysis revealed that the as-built attachment conditions are insufficient to resist code-prescribed wind loads at some locations. Specifically, a fastener that penetrated both the wood stud framing and OSB wall sheathing is adequate to resist code-defined wind loads. However, a fastener that penetrated just the OSB wall sheathing is not adequate to resist code-defined wind loads in both Zone 4 and Zone 5. Based on the engineering analysis, the authors would recommend installing supplemental fasteners at a specific on-center spacing (to be calculated) to resist the code-defined wind loads. Additionally, the supplemental fasteners would have to be installed in accordance with the manufacturer’s literature.

Table 4 – Withdrawal resistance vs. code-defined wind load.

### Withdrawal Resistance vs. Designed Wind Load

<table>
<thead>
<tr>
<th>Tributary Area</th>
<th>Framing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Horizontal Spacing</strong>: 18 inches</td>
<td>Zone 4: 48 lbs. &gt; 37.24 lbs.</td>
</tr>
<tr>
<td><strong>Vertical Spacing</strong>: 7 inches</td>
<td>Zone 5: 48 lbs. &gt; 37.24 lbs.</td>
</tr>
<tr>
<td><strong>Area</strong>: 0.875 ft²</td>
<td>Zone 4: 48 lbs. &lt; 37.24 lbs.</td>
</tr>
<tr>
<td><strong>Zone 5</strong>: 48 lbs. &lt; 37.24 lbs.</td>
<td>N.G.</td>
</tr>
<tr>
<td><strong>Designated Wind Pressure To Designed Wind Load</strong></td>
<td>Zone 4: 48 lbs. &gt; 37.24 lbs.</td>
</tr>
<tr>
<td>Zone 5: 48 lbs. &gt; 37.24 lbs.</td>
<td>OK</td>
</tr>
</tbody>
</table>

### Withdrawal Resistance vs. Designed Wind Load

<table>
<thead>
<tr>
<th>OSB</th>
<th>Total (Framing and OSB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 4: 13 lbs. &lt; 37.24 lbs.</td>
<td>Zone 4: 61 lbs. &gt; 37.24 lbs.</td>
</tr>
<tr>
<td>Zone 5: 13 lbs. &lt; 37.24 lbs.</td>
<td>Zone 5: 61 lbs. &gt; 37.24 lbs.</td>
</tr>
</tbody>
</table>

**Table 4 – Withdrawal resistance vs. code-defined wind load.**