FM Global Property Loss Prevention Data Sheet 1-49 (LPDS 1-49) states: "The majority of roof covering failures resulting from windstorms involve improperly designed or constructed perimeter flashings."

The perimeter of the roof assembly sustains the highest wind loads during wind events, the proper application of woodblocking will serve to strengthen the roof system by providing a strong attachment base for the connection of the roof assembly and metal flashings.

Both adhered and systems bonded to mechanically-attached base sheets have the advantage of physical bonding or attachment to the deck. However, all of these roof assemblies depend on the strength and attachment of the woodblocking to resist wind loads placed on flashings and perimeter membranes. The loss of attachment from the woodblocking can potentially mean the loss of the roof system, at least at perimeters and corners.

In general, there are three types of loads perimeter woodblocking anchors must withstand when securing a roof system and perimeter flashings (see Figure 1).

- **Tensile Load**: Applied parallel to the axis of the anchor;
- **Shear Load**: Applied perpendicular to the axis of the anchor; and
- **Oblique Load**: Also known as a combination load, it applies stress with the qualities of both a tensile and a shear load.

Load conditions at the perimeter vary depending on wind speed, perimeter conditions, and substrate material.

Figure 1 - Loads which woodblocking anchors must withstand

Following recommended guidelines for woodblocking attachment is critical in preventing catastrophic damage caused by poorly maintained or improperly installed roof components. If installed correctly, perimeter woodblocking can play a crucial role in strengthening and protecting a building’s roof system, no matter what design or material is being utilized.

**Recommendations for Securing Perimeter Woodblocking**

Both FM Global Loss Prevention Data Sheet 1-49 and industry standards provide recommendations and guidelines on woodblocking construction and attachment. FM Global ("FMG") publishes recommendations only for concrete, masonry and steel decks in the Loss Prevention Data Sheets.

While Industry standard guidelines do address a variety of attachment methods and formulas, they do not address safety factors related to specific deck types; instead providing general recommendations for spacing and attachment. The phrase most commonly found in guideline specifications is “attachment of woodblocking to resist a minimum pull-out resistance of 175 lbf/ft in all directions”. In some specifications, this recommendation has been increased to 350 lbf/ft in all directions.

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1 Factory Mutual Global Loss Prevention Data Sheet 1-49: Perimeter Flashings.
While these guidelines might provide a useful starting formula for attaching woodblocking, the following recommendations addressing specific deck types, and based on laboratory and field testing, provide detailed guidelines for woodblocking attachment.

Concrete
For concrete and masonry, FMG recommends a minimum ½” diameter corrosion resistant anchor, combined with a minimum 1” diameter bearing washer embedded into the woodblocking. It is further recommended that the anchor and washer be recessed into woodblocking at least 1 ½” thick, spaced at a maximum of 48” o.c. (24” at corners). Note withdrawal resistance testing should be carried out in compliance with ANSI/SPRI FX-1-20062 or Metro Dade TAS 1053.

For buildings with concrete decks, the fastener design load should not be less than 250 lbf/ft after application of a 4:1 safety factor. The pull-over value should not be less than 125% of the design load and, if necessary, a larger bearing washer should be utilized to achieve this requirement. A variety of different fasteners and anchors can be utilized to achieve these recommendations, though certain conditions, such as concrete substrates with a compressive strength of less than 2,500 psi or thickness less than 2 ½”, will require on-site performance testing to ensure design criteria are being met.

<table>
<thead>
<tr>
<th>Table 1 - Anchor type, size and spacing criteria for concrete decks</th>
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<tbody>
<tr>
<td>ANCHOR TYPE</td>
</tr>
<tr>
<td>Wedge Anchor</td>
</tr>
<tr>
<td>Sleeve Anchor</td>
</tr>
<tr>
<td>Threaded Concrete Anchor</td>
</tr>
<tr>
<td>Drive Anchor</td>
</tr>
<tr>
<td>Spike Anchor</td>
</tr>
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</table>

Steel
For steel decks, FM Global recommends ¾” diameter bolts drilled and tapped into a structural steel member or bar joists spaced between 48” and 72” o.c. depending on perimeter conditions. Woodblocking attached to 18 to 22 ga. steel roof deck can be carried out using #14 or #15 diameter threaded fasteners. These fasteners have an average withdrawal 460 lbf from the 33 KSI, 22 gauge steel decking. The industry accepted margin of safety is 1.5:1 with a pull-over value of not less than 125%.

Where woodblocking is attached perpendicular to the deck flutes, it is recommended that fasteners be positioned over the high flanges of the deck, 12” o.c. (6” in corners). Where woodblocking runs parallel to the flutes, similar spacing is recommended, with the addition of ¼” diameter self-tapping screws through the woodblocking deck and bar joist, spaced not greater than 6’. A #14 type ‘B’ fastener can be installed into a pre-drilled hole using a #1 twist drill. The possibility exists that the steel deck is poorly attached to structural components, especially on re-roofing projects. The decking can be mechanically attached to the bar joists with either a self-tapping fastener or a #4 or #5 pt. self-driller with a minimum 7/8" bearing washer.

For those metal decks using light gauge metal (less than 22 ga.), the following formula can be utilized to determine fastener spacing: Xmn x FS = Xfst ÷ MS (Xmn = Minimum withdrawal resistance = Known (1); FS = Fastener spacing = Unknown; Xfst = Average fastener withdrawal = known; MS = Margin of safety = 2). As with standard metal decks, woodblocking attached parallel to the ribs should be secured to steel angles, or mechanically secured to bar joists using self-trapping or self-drilling fasteners.

“Lightweight” Decks (Gypsum, Tectum, Lightweight Insulating and Cellular Concrete)
Due to the low density of these deck materials and the load combinations they sustain, attaching woodblocking to lightweight decks is not recommended. In general, the deck should not be used as an

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attachment substrate unless the chosen anchor can clamp to the underside of the deck or attach to a structural member below, and achieve not less than 425 lbf ultimate load.

In order to determine fastener spacing, the following formula with a 4:1 margin of safety should be used: 
\[ X_{mn} \times FS = X_{fst} + MS \] 
(\(X_{mn}\) = Design withdrawal resistance = 250 lbf/lineal foot; \(FS\) = Fastener spacing = Unknown; \(X_{fst}\) = Average fastener withdrawal resistance = Known; \(MS\) = Margin of safety = 4). Toggle bolts are not recommended for fastening as they require a large hole for installation and rely on a trunion nut to hold the toggle rod to the wing.

**Vertical walls**
Woodblocking can also be attached to vertical walls (See Figure 2). In these cases, the woodblocking should have a minimum thickness of 1 ½" with fasteners spaced not greater than 12" apart. Each anchor should have a minimum withdrawal resistance value of 800 lbf. Larger diameter threaded concrete anchors or hammer-in anchors are preferred in order to draw the blocking tight to the substrate.

![Figure 2 - Woodblocking attachment to vertical wall](image-url)