PERFORMANCE OF AN INNOVATIVE ROOF TO TOP-PLATE
CONNECTION

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ABSTRACT: The effects of hurricanes and tornadoes on traditional residential timber construction can be devastating, as emphasized by recent events in New Orleans and Oklahoma. One significant cause of poor structural performance in these high wind events is due to the connection of the roof truss to the top-plate. The conventional connection based on toe nailing the truss member to the top-plate provides low uplift capacity to resist high suction forces that can be caused by hurricanes and tornadoes. Several products have been introduced into the market to improve the roof to top-plate connection. While the uplift capacity for these proprietary products is improved over that of toe nailing, the installation of these products can often be labor intensive and result in higher costs. East Set Inc. has developed an innovative tornado strap that provides high uplift resistance and is quick and easy to install. This paper highlights the performance of a series of uplift tests on the innovative tornado strap and compares the performance to previous tests of existing products in the market.

The focus of the testing program was to determine the uplift capacity of the innovative roof to top-plate connection. Eleven (11) individual connections were tested. The testing apparatus included a 55 kip closed-loop hydraulic actuator and loading frame. A 10,000 lbf loading strap was attached to the actuator head and wrapped around the bottom chord as close as possible to each side of the bracket. One (1) foot from the center of the connection, nominal 4 x 4 in. lumber was used to hold down the ends of the top-plate. Uplift loading was applied to the connection at a rate of 0.2 in./min. LVDT’s were used to measure the vertical displacement of the top-chord relative to the top-plate; one LVDT placed on each side of the top chord. Each test was run to determine the peak load and continued post peak until 60 – 80% of the peak load was reached. The test setup can be seen in Figure 1.

Figure 1: Single Connection Test Setup

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The results discussed in the paper indicate that the Easy Set connector performed very comparably to other proprietary products currently on the market and markedly better over that of toe nails only. The connectors are robust and can sustain significant load past the ultimate resistance. The two primary failure modes of the connector included (1) nail/screw pullout and (2) center lag screw withdrawal with bending of the plate between the brackets.

**Table 1: Test Results**

<table>
<thead>
<tr>
<th>Specimen Connection</th>
<th>Number of Specimens tested</th>
<th>Average Maximum Load (lbs.)</th>
<th>Uplift Capacity at 1/8” Displacement (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nails</td>
<td>5</td>
<td>2706</td>
<td>1199</td>
</tr>
<tr>
<td>Screws</td>
<td>6</td>
<td>2927</td>
<td>1162</td>
</tr>
</tbody>
</table>

Table 1 shows the results of the eleven (11) uplift tests, including the peak uplift resistance and the uplift resistance at 1/8” deflection. The paper also discusses the observed failure modes. The average uplift capacity for the connectors with nails and the connectors with screws was 2706 lbf and 2927 lbf, respectively.

While the connection performed very well, the authors recommend a continuation of the study of these connectors to determine the shear capacity, both longitudinal and transverse to the top-plate, to fully document the resistance of this connection. Additionally, it would be beneficial to contractors to publish an installation rate for the product.