



Code Connection

Roof Truss-to-Wall Connection Requirements in the 2003 IRC

by WTCA Staff

Sometimes good intentions to solve a problem result in onerous requirements in the code. We'll take a look at one example and how to deal with it.

A provision has been added to the 2003 edition of the International Residential Code® (IRC) requiring roof trusses to be attached to the top plate(s) of load bearing walls with connectors capable of resisting an uplift of at least 175 lbs. More specifically, Section R802.10.5 states (in part):

Trusses shall be connected to wall plates by the use of approved connectors having a resistance to uplift of not less than 175 pounds (79.45 kg) and shall be installed in accordance with the manufacturer's specifications.

Here are the arguments used to justify the need for this provision:

- The "standard practice" of toe-nailing the truss to the top plate of the wall results in an inferior connection when compared to a "conventionally" framed roof.
- Toe-nailing can potentially cause splits in the bottom chord of the truss, thereby weakening the connection and compromising the stability of the truss.

Based on these arguments, Section R802.10.5 was adopted with the intention of ensuring "that the proper framing anchor is used for the truss-to-wall connection in order to maintain the same structural integrity as expected in a conventionally framed roof."

While Section R802.10.5 may be a well-intentioned effort to address a perceived problem, we believe it is an onerous requirement that causes unnecessary cost and confusion, and does not deal with all the design considerations required for truss to wall connections.

Truss Design Drawings are required in Section R802.10.1 of the IRC to include the applicable wind loads to which the truss has been designed as well as the magnitude and direction of the reaction force, if any, resulting from these loads. This information should be used to determine the connection requirements for attaching the truss at the bearing locations. The origin of the 175-lb requirement was not included with the supporting information when the language in Section R802.10.5 was proposed. It appears to be an arbitrary value with no apparent relation to actual design parameters. It may also be misinterpreted as limiting uplift resistance requirements to 175 lbs when a greater resistance is required.

Toe-nailing has long been recognized in building codes as an acceptable means of attaching wood members such as rafters and trusses to wood bearing walls to provide resistance to uplift and lateral forces. In order to maximize the strength of this type of connection, it is recommended that the nails be driven at an angle of approximately 30° with the member and held back from the end of the member by a distance of approximately one-third (1/3) the length of the nail (see Figure 1).

There are many applications and design conditions where a toe-nailed connection between the truss and top plate of the wall is sufficient to resist the required uplift forces. Section B8 of Building Component Safety Information (BCSI 1), which is referenced in Section R802.10.3 of the IRC, provides a summary table of the nominal uplift design capacities (i.e., load duration factor = 1.0) for 12 commonly used nail types in combination with the five most common species of wood used in

Continued on page 24

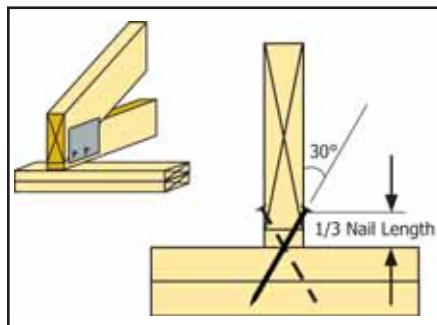


Figure 1.

at a glance

- ☐ Toe-nailing has long been recognized in building codes as an acceptable means of attaching wood members to wood bearing walls.
- ☐ WTCA has submitted a code change proposal to the IRC regarding the truss-to-wall connection requirements.

TECHNICAL NOTES

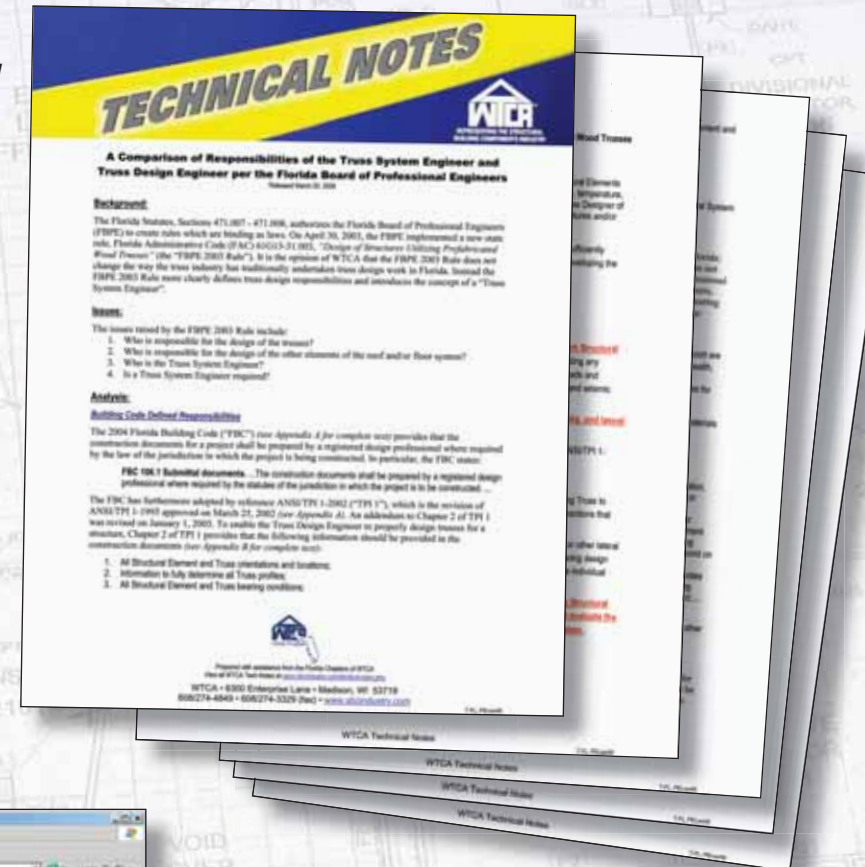


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Nail Type	Maximum Uplift Resistance Capacity (lbs.)		
	2 toe-nails	3 toe-nails	4 toe-nails
16d Common	118	178	237
16d Box	99	149	198
12d Common	99	149	198
16d Gun Nail	96	144	192
12d Sinker	96	144	192
16d Sinker	93	139	186
10d Common	93	139	186
12d Box	86	130	173
12d Gun Nail	80	120	160
10d Box	80	120	160
10d Gun Nail	74	110	147
10d Sinker	70	106	141

Notes:

1. Toe-nail design values derived from NDS 1997 and NER-272.
2. For normal load duration multiply the values in the table by 0.63 and for snow load duration multiply the value in the table by 0.72.
3. Assumes a top plate of Spruce Pine Fir (SPF).
Per NDS 1997 12.4.1 edge distances, end distances and spacing shall be sufficient to prevent the splitting of the wood.

Code Connection

Continued from page 22

construction in North America. The information provided in BCSI-B8 can be used to easily and quickly determine if a toe-nailed connection can provide sufficient uplift resistance. If the net uplift reaction exceeds the resistance that can be provided by a toe-nailed connection, a mechanical connector such as a framing anchor, hurricane tie or strap will be required.

WTCA has submitted the following code change proposal to the IRC regarding the truss-to-wall connection requirements:

R802.10.5 Truss to wall connection. Trusses shall be connected to wall plates by the use of approved connectors having a resistance to uplift of not less than 175 pounds (79.45 kg.) and shall be installed in accordance with the manufacturer's specifications. For roof assemblies subject to wind uplift pressures of 20 pounds per square foot (0.958 kN/m²) or greater, as established in Table R301.2(2), adjusted for height and exposure per Table R301.2(3), see section R802.11.

R802.11 Roof tie-down.

R802.11.1 Uplift resistance. Roof assemblies which are subject to wind uplift pressures of 20 pounds per square foot (0.958 kN/m²) or greater shall have roof rafters or trusses attached to their supporting wall assemblies by connections capable of providing the resistance required in Table R802.11. Wind uplift pressures shall be determined using an effective wind area of 100 square feet (9.3m²) and Zone 1 in Table R301.2(2), as adjusted for height and exposure per Table R301.2(3).

Exception: For trusses designed per Section R802.10.1, the connections shall resist the uplift force, if any, specified on the Truss Design Drawing. In areas where the basic wind speeds do not exceed 90 mph, truss to wall connections shall be permitted to be in accordance with rafter connections per Table R602.3(1).

A continuous load path shall be provided to transmit the uplift forces from the rafter or truss ties to the foundation.

If this proposed change is accepted, it will not be incorporated into the IRC until the 2009 edition. In the meantime, WTCA will continue to advocate that truss-to-wall connections be determined based on the uplift reactions provided on the Truss Design Drawings, to ensure that these connections are adequate for the appropriate design conditions. **SBC**

For more information about how to get involved in the code process, contact WTCA staff at 608/274-4849 or codes@sbcmag.com.

Next Edition of BCSI-B8: Toe-Nailing for Uplift Reactions

In an effort to make BCSI-B8 more "field friendly," WTCA has considered adding a simplified toe-nailed connection table that provides the maximum uplift resistance capacity for various multi-nail, toe-nailed connections assuming a duration of load for wind (i.e., LDF = 1.6) and a Spruce-Pine-Fir (SPF) top plate. This table could be used to quickly determine the adequacy of toe-nailed connections to resist uplift reactions due to wind loads. Assuming SPF for the top plate is conservative, since the nail withdrawal resistance in SPF is less than the nail withdrawal resistance in other commonly used species groups such as Douglas Fir-Larch, Southern Pine or Hem-Fir. If the uplift resistance capacity is desired for a different duration of load, it can easily be determined by multiplying the table value by the new LDF and dividing this product by 1.6.

The table at left is an example of how this information may be presented. For more information, please contact WTCA's Technical Department at 608/274-4849.



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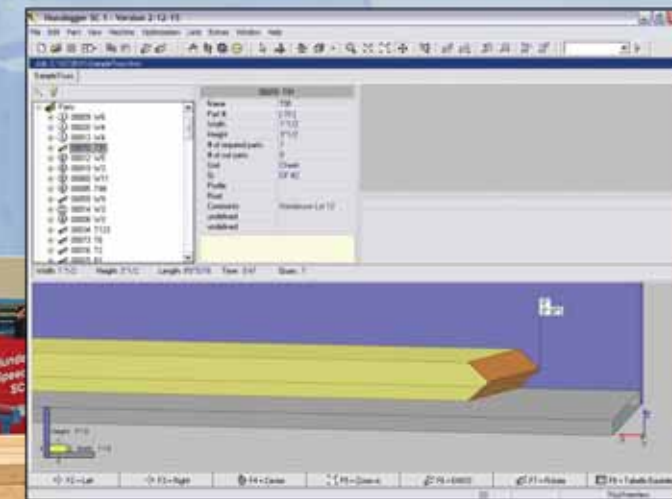
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