Question of the Day
By Stan Sias
“Can you send me the section in the standard that clearly states our position as component manufacturers on specifying (or lack thereof) of hurricane ties and/or other holdowns (truss to wall connections)?

Thanks for your question. I will apologize here and now as there is no short answer to your question because several factors come into play. Looking broadly at the question, one might also ask, “*Who is responsible if the design of the connection is for a joist or rafter to top of wall?”* The correct answer is the same as it is for truss construction.

The discussion regarding design responsibilities is always a contentious debate. There are folks on either side of the question and both typically have equally passionate positions. I will try and make sense out of the truss industry’s position, as clearly stated in the ANSI National Design Standard for Metal Plate Connected Wood Truss Construction [Chapter 2]. ANSI TPI 1-2007 is the current standard. Most, if not all, job specifications reference this standard as do the major model building codes. I do not have the contract documents and/or specifications from any of the jobs that you are referencing in your question, so I will attempt to keep the scenario as generic as possible. Please be aware that via contract language, specific sections of TPI 1 can be modified and/or deleted entirely, so long as all parties agree to the revised declarations of the assumed scopes of work.

Before we delve into TPI 1, Chapter 2, let’s look at the connection in question (individual truss to top of wall or other structural element, e.g. beam, girder, etc.) and the mechanics, loads and solutions that may be available to adequately resolve not only the engineering, but also the installation.

The connection between a joist, rafter or truss and the top of the bearing is subjected to loading in several different directions. There can be download and uplift, as well as forces parallel and perpendicular to the bearing itself. These loads are caused by gravity [download], wind [uplift] and wind or seismic activity [lateral loads acting either parallel or perpendicular]. Remember, the floor, wall and roof diaphragms deliver loads to these connections, too. The perpendicular-to-wall load typically is the result of either wind pressure (or suction depending on wind direction) or seismic activity. The parallel-to-wall loads are shear loads being delivered to the bearing from the diaphragm edges. Also keep in mind that large cantilevers or bearings that are very close together can cause significant uplift scenarios. Below are graphic depictions of typical loading directions from the industry’s Building Component Safety Information (BCSI), Section B8.

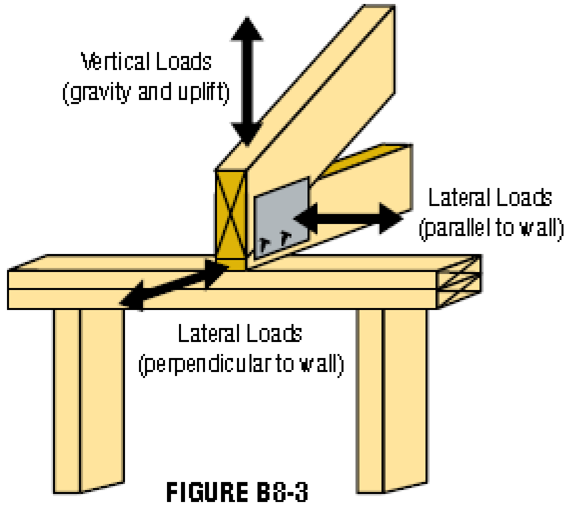


FIGURE B8-3

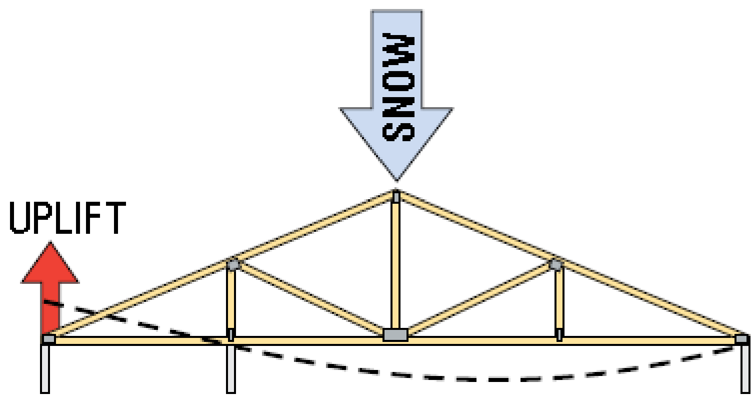


FIGURE B8-4

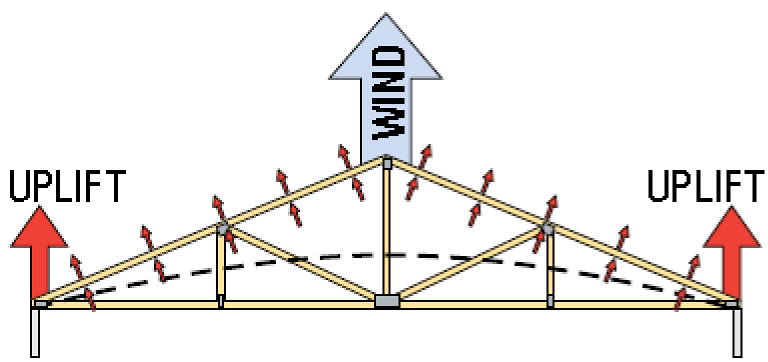
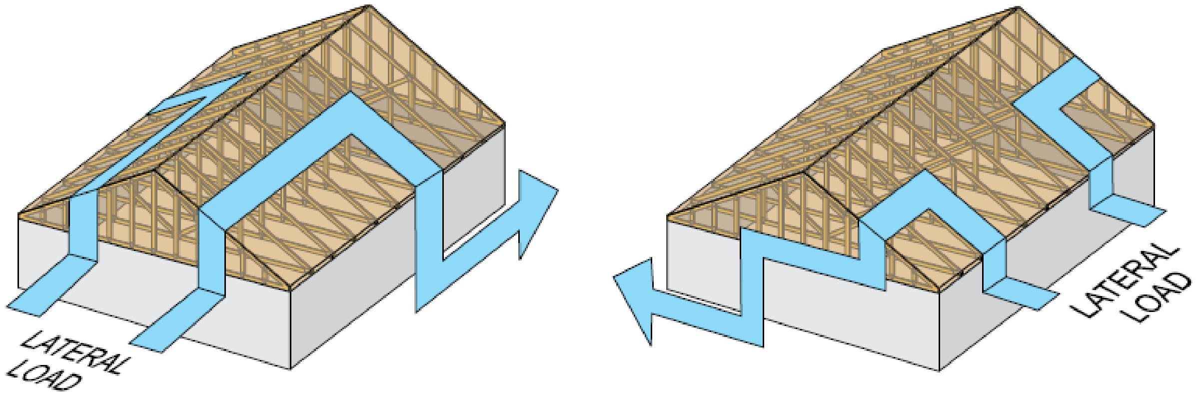


FIGURE B8-5

Example of lateral Load paths through the roof of a Building



Lateral Load applied to end wall

Lateral Load applied to side wall

FIGURE B8-6

Lateral Load transfer between the roof Diaphragm and supporting wall is through the heel of the Truss unless some other means is provided to transfer this Load directly between the roof sheathing and the wall plate.

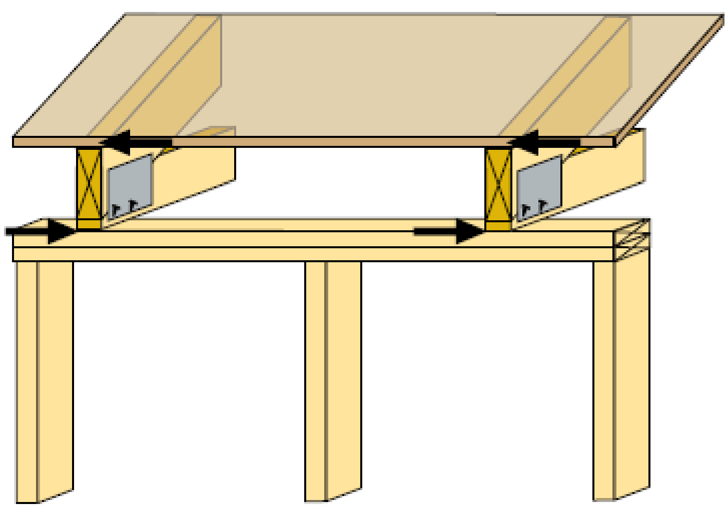


FIGURE B8-7

Understanding the multiple loads being resisted by the connection is a critical part of maintaining a continuous load path from the structure down into the ground. Further, these loads are often acting simultaneously and the connection must take that into consideration. For instance, when the wind blows, it affects the roof framing [uplift], but it also affects the wall framing [positive or negative pressure]. What is supporting the top of the wall if it isn't the joist, rafter or truss attached to it? How much load is it? What is the intended load path? Whose responsibility is it to detail or specify? After all, that is the question we are trying to answer, right?

Having an understanding of the complexity of this connection and the need to know all of the loads [magnitude and directions], we can now look at ANSI/TPI 1, Chapter 2, Standard Responsibilities in the Design and Application of Metal-Plate-Connected Wood Trusses. Chapter 2 in Section 2.1 General Purposes, "…defines and draws attention to Responsibilities of the Owner, Building Designer, Registered Design Professional for the Building, Truss Manufacturer, and Truss Designer or Truss Design Engineer, with respect to the application of trusses in the construction of a Building." The chapter is then broken down into two specific sections with regards to whether the local legal requirements mandate a registered design professional for the design of the building [more broadly, IBC® or IRC®].

Section 2.3 defines the appropriate Responsibilities Where the Legal Requirements mandate a Registered Design Professional for Buildings and Section 2.4 defines the responsibilities when there is **not** a registered design professional on the project. In each section, the responsibilities of each party involved in the project are clearly assigned. When one reads and applies the divisions of responsibility within the code-referenced standard, the answer to today's Question of the Day becomes crystal clear.

Section 2.3.2 defines the Requirements of the Registered Design Professional. Specifically, Section 2.3.2.4 defines Required Information in the Construction Documents:

"**2.3.2.4 Required Information in the Construction Documents**

The Registered Design Professional for the Building, through the Construction Documents, shall provide information sufficiently accurate and reliable to be used for facilitating the supply of the Structural Elements and other information for developing the design of the Trusses for the Building, and shall provide the following:

- (a) All Truss and Structural Element orientations and locations.
- (b) Information to fully determine all Truss profiles
- (c) All Structural Element and Truss support locations and bearing conditions (including allowable bearing stress).
- (d) The location, direction and magnitude of all dead, live, and lateral loads applicable to each Truss including, but not limited to: roof, floor, partition, mechanical, fire sprinkler, attic storage, rain and ponding, wind, snow (including snow drift and unbalanced snow), seismic; and any other loads on the Truss:
- (e) All anchorage designs required to resist uplift, gravity and lateral loads.
- (f) Truss-to-Structural Element connections, but not Truss-to-Truss connections.
- (g) Permanent Building Stability Bracing; including Truss anchorage connections to the Permanent Building Stability Bracing.
- (h) Criteria related to serviceability issues including:
  - (1) Allowable vertical, horizontal or other required deflection criteria.
  - (2) Any dead load, live load, and in-service creep deflection criteria for flat roofs subject to ponding loads.
  - (3) Any Truss camber requirements.
  - (4) Any differential deflection criteria from Truss-to-Truss or Truss-to-adjacent Structural element.
  - (5) Any deflection and vibration for floor Trusses including:
    - (a) Any strongback bridging requirements.
    - (b) Any dead load, live load, and in-service creep deflection criteria for floor Trusses supporting stone or ceramic tile finishes.
  - (6) Moisture, temperature, corrosive chemicals and gasses expected to result in:
    - (a) Wood moisture content exceeding 19 percent.
    - (b) Sustained temperatures exceeding 150 degreed F. and/or

(c) Corrosion potential from wood preservatives or other sources that may be detrimental to Trusses."

As we have just read, Sections 2.3.2.4 (d), (e) & (f) provide us with the answer we are searching for regarding plated truss applications:
Paragraph (d) says that the Registered Design Professional for the Building [hereafter called the Building Designer], is responsible for and shall provide the location, direction and magnitude of all loads to be applied to the trusses.
Paragraph (e) states that the Building Designer is responsible for and shall provide all anchorage designs required to resist uplift, gravity and lateral loads.
Paragraph (f) states specifically that the Building Designer is responsible for, and shall provide, truss-to-structural element connections, but not truss-to-truss connections, which are the responsibility of the Truss Design Engineer.

Section 2.3.2.5 reaffirms the responsibilities of the Building Designer and specifically states that he/she is not responsible for the requirements of other parties outside of Section 2.3.2.

"**2.3.2.5 Responsibility Exemptions.**
The Registered Design Professional for the Building is responsible for items listed in Section 2.3.2, and is not responsible for the requirements of other parties specified outside of Section 2.3.2."

We can clearly see that the specification of the joist, rafter or truss-to-wall connection is the responsibility of the Building Designer. The Truss Manufacturer, via their Truss Design Drawings prepared by the Truss Design Engineer, is required to provide the maximum reaction force and direction, including maximum uplift reactions [see Section 2.3.5.5], but the Truss Design Engineer is not responsible for providing the additional lateral loads contributed to the connection from the building's response to its environment. Those loads, in addition to assuring a continuous (and predictable) load path, are clearly the responsibility of the Building Designer.

With all of this being said, and all of the loads and load combinations for a given connection being provided, and taking into consideration the bi-axial or tri-axial nature of simultaneous load combinations (a unity equation), reasonable suggestions for the connections can be provided to the Building Designer for review and approval using published catalog loads and/or proprietary software.

Designing joist, rafter or truss-to-wall connections based solely on an uplift reaction, without regard for other forces acting on the connection, poses a possible life safety issue. If you are going to specify a connection based solely on uplift, it should be clearly noted [disclaimed] that the connector specified is preliminary and has been designed only for the uplift component of the connection, and that in-plane and out-of-plane loads, as well as simultaneous loading, has not been considered. The Building Designer is responsible for the final connection specification.