STRUCTURAL BUILDING™

COMPONENTS

THE FUTURE OF FRAMING

December 2014 www.sbcmag.info

Inside this Issue:

Truss Industry Standard of Care: Part 2 • Quality Control • and much more!

Implementing BCMC 2014

Framing the AMERICAN DREAM.

TRUSS INDUSTRY STANDARD OF CARE ISSUES

by Scott D. Coffman, P.E., SECB & Jim Vogt, P.E.

PART 2

Editor's Note:

The purpose of this article series is to identify truss-related structural issues sometimes missed due to the day-in and day-out demands of truss design/production and the fragmented building design review and approval process. This series will explore issues in the building market that are not normally focused upon, and provide recommended best-practice guidance. As with Kirk Grundahl's article addressing communication challenges created by the deferred submittal process (***SBC Magazine,*** November 2014), the objective is to raise awareness of these issues and, ultimately, improve overall quality of truss roof and floor system construction.

1 All references to *ANSI/TPI 1-2007.*

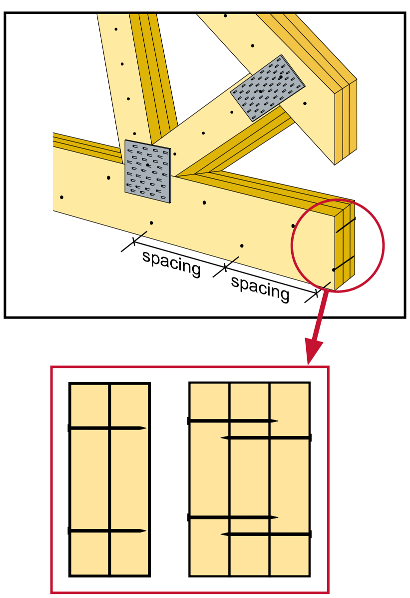


Figure 1. Built-up girder truss constructed by fastening multiple individual plies together.

A*NSI/TPI 1, National Design Standard for Metal Plate Connected Wood Truss Construction (TPI 1),* is referenced in the building codes and provides information and specifications on the design and manufacture of metal plate connected wood trusses.[1] Chapter 2 of *TPI 1* identifies and clarifies responsibilities between various parties with respect to truss use in building construction. Specifically, responsibility for preparing each truss design drawing, when required, is assigned to a truss designer, or truss design engineer, depending on engineering exemption laws for residential construction. The responsibility for preparing the truss placement diagram (TPD), when required by the contract or construction document, is assigned to the truss manufacturer. Additionally, a truss manufacturer is responsible for preparing a truss submittal package, when required, to meet requirements detailed within Chapter 2.

Truss design drawings (TDD) are a critical component of a truss submittal package. These documents are typically presented on 8½ x 11 sheets of paper and summarize critical design and installation information not readily apparent to individuals outside the truss industry. It can be a challenge for a code official, building designer and/or contractor to review these documents and glean critical truss information. As the truss industry becomes aware of these challenges, it can improve how critical information is communicated and ultimately improve the quality of truss construction.

Section R502.11.4 and R802.10.1 of the *2012 International Residential Code® (IRC®),* Section 2303.4.1.1 of the *2012 International Building Code® (IBC®)* and *TPI 1* Section 2.3.5.5 and 2.4.5.4 specify the minimum information each TDD must contain. The order this information is presented varies slightly between the three documents; however, the requirements are the same in each. The sidebar on page 27 includes the list of required information on truss design drawing as specified in Section 2.4.5.4 of *ANSI/TPI 1.*

The focus of this article is item (k) from Section 2.4.5.4 of *TPI 1,* Truss-to-Truss connections and Truss field assembly requirements. Unfortunately, these particular items are not always effectively communicated to the contractor or building designer and, in some instances, may even be disregarded or marginalized.

Truss-to-Truss Connection: Ply-to-Ply

TPI 1 permits girder trusses to be created by fastening multiple truss plies together (Section 7.5.5) (see Figure 1). Although *TPI 1* allows a maximum of five- (5) and six- (6) ply girders under specific, defined loading situations, many truss designers and truss design engineers limit girder truss design to four (4) plies or less. Fastener schedules for multi-ply girder trusses are generally displayed within the TDD and are separated for top chords, bottom chords, and webs. Occasionally, fasteners required to distribute loads equally between plies cannot be calculated by truss software, and in that event a caution or warning note is displayed on the TDD. An example of one such warning note reads:

"Special connection required to distribute bottom chord loads equally between all plies."

Based on *TPI 1* Section 2.3.5.5(k) and 2.4.5.4(k), the required truss ply-to-ply connection must be included on the TDD. Left unresolved, a truss manufacturer has not complied with all the requirements of the TDD notes included in *TPI 1* and the building code.

Truss-to-Truss Connection: Truss-to-Girder

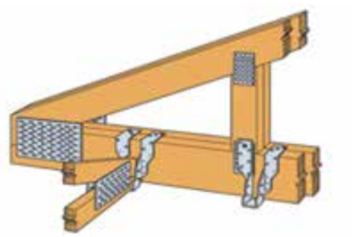


Figure 2. Girder truss supporting other trusses.

A common framing practice is to design and integrate a girder truss (carrying member) to support another truss or trusses (carried member) (see Figure 2). Per *TPI 1* Section 2.3.5.5(k) and 2.4.5.4(k), this connection must be included on the TDD. Most metal plate connected wood truss design software has the capability to analyze and identify a hanger or other connection device sufficient to transfer calculated gravity and uplift reaction loads from a supported truss. When this feature is active, the required hanger or connection device is specified on either the TDD for the supported truss or the girder truss. Some truss manufacturers may choose to deactivate this software feature because: 1) they may inventory and sell hangers and/or connection devices from a company different than supported by the software database, or 2) the truss manufacturer has been requested not to provide hanger/connection devices. When the hanger selection feature is deactivated, truss design software typically generates a note indicating this occurrence. An example of one such note reads:

"Hanger(s) or other connection device(s) shall be provided sufficient to support concentrated load(s) [value] lb. down and [value] lb. up at [location] on bottom chord. The design/selection of such connection device(s) is the responsibility of others."

When a truss manufacturer provides hangers and connection devices for truss-to-girder connections, the hanger type(s), fasteners and their locations must be effectively communicated to the contractor. This is typically accomplished by including truss-to-girder connection information on the TPD. When a truss manufacturer does not provide hangers and connection devices, many building designers prefer the software feature remain active to display a connector capable of load transfer. There are two primary reasons. First, *TPI 1* clearly assigns truss-to-truss ***connection*** design to the truss industry (truss designer and/or truss design engineer). *TPI 1* makes no provisions to limit this critical item to a summary of truss reactions or a connector supplier. Second, it helps ensure a connector device exists for calculated reactions, hanger and truss geometry, and *TPI 1* cross grain tension analysis; items not easily checked by parties outside the truss industry.

A dependence on TDD notes to communicate ply-to-ply and truss-to-girder connection requirements contributes to review oversights and/or insufficient installation information, as this critical information can easily be overlooked or misunderstood, given the large number of TDDs for a project.

Truss Field Assembly: Truss Field Splices

Manufacturing or shipping limitations sometimes require a truss profile to be fabricated in multiple pieces for field assembly. Additionally, a desired building appearance may be created using truss components as "fill" members. Specific applications include, but are not limited to: 1) "piggyback" or cap trusses; 2) field splice truss segments; and 3) valley framing. According to Section 2.3.5.5(k) and 2.4.5.4(k), these members shall be field assembled and connected together according to instructions provided on the TDD. There are times these instructions or diagrams fail to get into the field. The following are common examples:

Example 1:

The top chords of metal plate connected wood trusses installed at 24" o.c. or less are typically restrained and braced by a direct applied wood structural sheathing diaphragm such as plywood or OSB. "Piggyback" truss profiles, comprised of multiple truss components oriented parallel and stacked on top of each other,

Continued on page 28

2.4.5.4 Information on Truss Design Drawings

Truss design drawings shall include, at a minimum, the information specified below:

(a) Building Code used for Design, unless specified on Cover/Truss Index Sheet.

(b) Slope or depth, span and spacing.

(c) Location of all joints and support locations.

(d) Number of plies if greater than one.

(e) Required bearing widths.

(f) Design loads as applicable, including:

- (1) Top Chord live load (for roof Trusses, this shall be the controlling case of live load or snow load);
- (2) Top Chord dead load;
- (3) Bottom Chord live load;
- (4) Bottom Chord dead load;
- (5) Additional loads and locations;
- (6) Environmental load design criteria (wind speed, snow, seismic, and all applicable factors as required to calculate the Truss loads); and
- (7) Other lateral loads, including drag strut loads.

(g) Adjustments to Wood Member and Metal Connector Plate design values for conditions of use.

(h) Maximum reaction force and direction, including maximum uplift reaction forces where applicable.

(i) Metal Connector Plate type, manufacturer, size, and thickness or gauge, and the dimensioned location of each Metal Connector Plate except where symmetrically located relative to the joint interface.

(j) Size, species and grade for each Wood Member.

(k) Truss-to-Truss connection and Truss field assembly requirements.

(l) Calculated span to deflection ratio and/or maximum vertical and horizontal deflection for live and total load and KCR as applicable.

(m) Maximum axial tension and compression forces in the Truss members.

(n) Fabrication tolerance per Section 6.4.10.

(o) Required Permanent Individual Truss Member Restraint location and the method of Restraint/Bracing to be used per Section 2.4.3.

...Standard of Care Issues • Continued from page 27

often result in the absence of direct applied sheathing along a portion of the supporting truss top chord. *TPI 1* Section 2.3.5.5(o) and 2.4.5.4(o) require TDDs to indicate permanent individual truss member restraint location and method of restraint bracing to be installed. One company's top chord (TC) purlin brace note for a piggyback supporting truss reads:

"Design assumes 4x2 (flat orientation) purlins at o.c. spacing indicated, fastened to truss TC w/ 2-10d nails."

This note clearly identifies purlin spacing (i.e., lateral restraint) and a general required connection. However, it fails to indicate or reference diagonal bracing, required to resist purlin and truss chord buckling or racking. Nail diameter and length, critical to nail capacity, is missing. Additionally, piggyback truss connections to the base truss are absent.

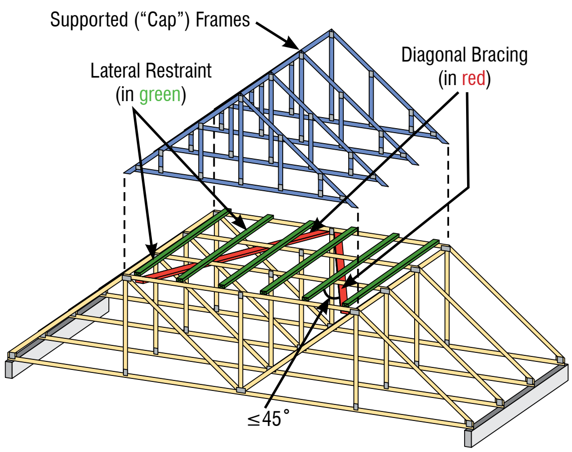


Figure 3. Typical "piggyback" assembly consisting of cap trusses, supporting trusses, top chord lateral restraint and diagonal bracing.

TPI 1 and the building code allow the use of standard industry details. This was intended to convey that each individual lateral restraint and diagonal bracing situation did not need a specific design, but rather the general prescriptive concepts included in *BCSI* could be used. Nevertheless, permanent individual truss member restraint/diagonal bracing must be installed.

Chapter B3 in the *Building Component Safety Information book (BCSI) – Guide to Good Practice for Handling, Installing, Restraining and Bracing of Metal Plate Connected Wood Trusses* and the *B3 Summary Sheet* provide the general prescriptive permanent restraint/diagonal bracing and reinforcement concepts for metal plate connected wood truss chord and web members, including piggyback truss installations (see Figure 3). Standard piggyback connection details are also typically available from truss design software providers.

The *B3 Summary Sheet* and/or the standard piggyback connection details should be part of the truss submittal package, and a note referencing these documents included on appropriate TDDs and the TPD(s), if provided, to help direct the contractor to properly brace truss elements and connect piggyback trusses.

Example 2:

Trusses too long or tall for manufacture and/or transport as a single component are often designed in two (2) or more parts and field spliced at the jobsite. For example, a scissor struss may be fabricated in two (2) halves symmetrical about the ridge (see Figure 4). Building designers and contractors should receive a TDD depicting the final in-service truss profile and associated splice connection details. A note should be placed on the TPD(s), if provided, to help direct the contractor to this important information. Where required by the registered design professional, the building official or the statutes of the jurisdiction in which the project is to be constructed, all field splice truss documents should bear the seal and signature of the truss design engineer.

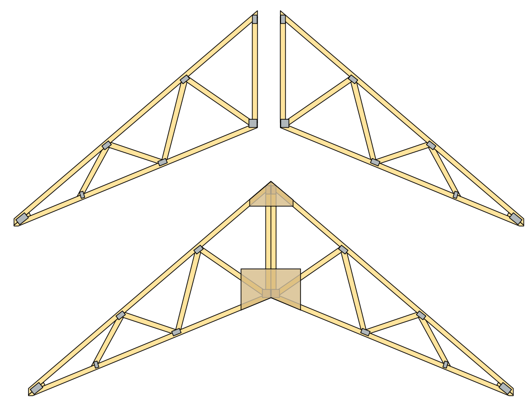


Figure 4. Example of a steeply pitched Scissors Truss requiring a specially designed field splice at the top and bottom peak. See TDD for splice details.

Example 3:

Final building appearance is sometimes created using a "valley set" comprised of truss members framed perpendicular to each other. Often, valley truss gravity and uplift loads are displayed on the output without identifying the appropriate connector. An example of a typical note provided on a TDD for a valley member is:

"Provide mechanical connection (by others) of truss to bearing plate capable of withstanding [value] lb. uplift at joint [location(s)]"

TPI 1 Section 2.3.5.5(k) and 2.4.5.4(k) require the connection information to be included on the TDD. Standard industry details for this application are typically available and should be referenced on appropriate TDD(s) and the TPD(s), if provided, to help direct the contractor to this important information. Standard industry details should be included within the truss submittal package to satisfy *TPI 1* and building code requirements. (See Figure 5 on page 30.)

Conclusion

TPI 1 defines a truss submittal package and identifies specific relevant truss items that should be provided within the package. Each package typically contains numerous 8½ x 11 sheets that encompass each truss design drawing for a

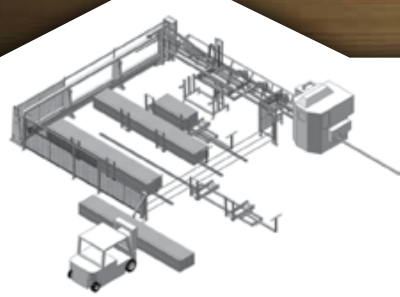
Continued on page 30

FOR SOME GUYS, IT'S FAST CARS.

FOR OTHERS, IT'S BEAUTIFUL WOMEN.

FOR US, IT'S LASER-GUIDED

LUMBER RETRIEVAL.



Our WoodRunner™ lumber retrieval system not only reduces labor by a half over manual saw feeding, it increases productivity by 30%. And, it's compatible with any new or existing linear saw. Now, who wouldn't be a little passionate about all that? Visit www.apexmw.com or call 507-322-3700 to learn more today.

WoodRunner

SBCA MEMBER

APEX MACHINE WORKS

Classified Ads

parting shots

Share your stories and photos with us! Send submissions to partingshots@sbcmag.info.

At 3,426 square feet, the 2014 BCMC Build project was the most ambitious house built over the weekend prior to the BCMC show. With the help of several volunteers, including a professional framing crew supplied by US Framing, the house went from a bare slab to a fully framed and sheathed building in just four days! Almost two weeks later, the house's exterior almost looked complete (see photo). Currently, the homebuilder (Niblock Homes) is planning on finishing the home and handing over the keys to Anthony Feaster and his family by Christmas. Watch for more information about the home dedication as we approach the end of the year. For more information on BCMC Build and to see additional photos and video, visit bcmcbuild.com. **SBC**

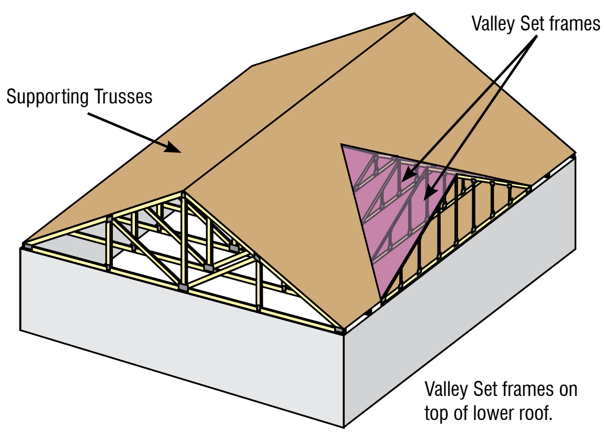


Figure 5. Example of roof system with dormer created with valley set frames.

...Standard of Care Issues • Continued from page 28

project. The truss industry expects building designers and contractors to read each drawing, grasp the method and information communicated, and effectively integrate or reconcile small font notes to ensure truss structural or performance integrity. This expectation must be met while coordinating trades, maintaining a project schedule, interacting with product suppliers, and complying with code-related issues. Accomplishing all tasks successfully is difficult at best. In light of the fragmented aspects of a construction project that are generally created through the deferred submittal process, the truss industry can take the lead to improve the quality of truss construction through better communication.

This may require a paradigm shift in the method that critical items are presented to code officials, building designers, and contractors. This article begins the process—featuring truss-to-truss connections and truss field assembly requirements that are sometimes incomplete or missing in the building design and construction process. Each truss-to-truss connection must be designed and each warning and/or caution note highlighted for a truss submittal package to be truly complete. Providing this information and making sure it is effectively communicated to the contractor and building designer can only help to improve the quality of truss construction and minimize downstream construction defects. It is in everyone's interest to implement communication best practices because, if done well, it is guaranteed to lessen downstream issues. **SBC**

Scott Coffman has over 30 years in the wood truss and component industry and is a past committee member of TPI 1. He is currently employed by Construction Science and Engineering as a forensic engineer specializing in construction defects.

Jim Vogt is SBCA's Director of Technical Services and has over 25 years of experience in the industry.