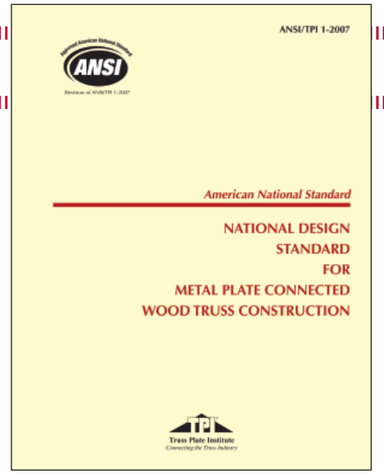

The National Design Standard for Metal Plate Connected Wood Trusses gets an update.

New & Improved: ANSI/TPI 1-2007

by Ryan Dexter, P.E., TPI staff
Reviewed by Mike Cassidy, R.A., TPI Executive Director &
Dave Brakeman, P.E., S.E., ITW Building Components Group

at a glance

- *TPI 1-2007* will be referenced in the 2009 *International Building Code* and *International Residential Code*.
- The *TPI 1* Project Committee consisted of about 50 individuals representing the industry.
- The changes that have been made to *TPI 1* will make for a more user-friendly document.
- The mandatory net section lumber limit on tension introduced into a wood member was replaced by a non-mandatory user note recommending a limit of 2300 pounds/inch.

ANSI/TPI 1-2007 "National Design Standard for Metal Plate Connected Wood Truss Construction" was approved as a revised American National Standard to *ANSI/TPI 1-2002*. This approval was undertaken by the American National Standards Institute (ANSI) Board of Standards Review and was made effective February 1, 2008. Referred to as *TPI 1-2007,* this standard will be referenced in the 2009 *International Building Code* (IBC) and *International Residential Code* (IRC). It is important to know what is contained within the standard. The purpose of this article is to introduce the industry to the key changes that have been made to the 2002 edition. Minor editorial changes made to the standard are not discussed in this article.

The TPI 1 Project Committee that worked on the revisions consisted of nearly 50 individuals representing a balanced cross section of the industry. A balanced committee was essential in order to help ensure all points of view were represented and shared within the committee and that a consensus was reached on the final language. A list of all *TPI 1-2007* Project Committee members is shown in Table 1.

One of the changes you will notice with *TPI 1-2007* is that it will be easier to locate the information you need. There are still eight chapters covering the same topics as in the *TPI 1-2002* edition. All section numbers within the chapters however now include a title summarizing the information included in it. These section titles and the corresponding page numbers have also been incorporated into a detailed table of contents. These organizational enhancements coupled with the changes mentioned below make for a more user-friendly document and also allow the standard to keep up with the evolution of the metal plate connected wood truss industry.

The revisions to the 2007 edition of *TPI 1* primarily impact standard design responsibilities (Chapter 2), in-plant quality control (Chapter 3), evaluating connector plates (Chapter 5), materials and general design considerations (Chapter 6), designing truss members' procedures (Chapter 7), and designing connector plate joints (Chapter 8). Chapter 1 has been expanded to include definitions, symbols and notations to coordinate with the revisions to the other chapters of *TPI 1-2007*. Here is a summary of the major updates. The commentary to *ANSI/TPI 1-2007* (included with the purchase of *TPI 1*) includes a detailed list of all the changes.

Chapter 2: Responsibilities in the Design Process Involving Metal Plate Connected Wood Trusses

TPI 1-2007 now contains two distinct sections. One will cover responsibilities for buildings when a Registered Design Professional (RDP) is required to be the Building Designer and one for buildings when a RDP is not required to be involved in the project. Responsibilities under these two conditions have some key differences which was important for us to clarify.

As a result of having these two sections, the term Truss Design Engineer (one licensed to practice engineering) is now used to define the individual responsible for the design of the trusses when a RDP is required and the Truss Designer is the one responsible for the design of the trusses when a RDP is not required. Another change to Chapter 2 includes a clarification of the Owner's responsibilities regarding special on-site inspections of trusses with a clear span of 60' or greater. *TPI 1-2007* now indicates that the Owner will contract with a RDP to provide special inspections to assure that the temporary and permanent bracing are installed properly in the case of long-span trusses.

TPI 1-2007 now follows the language in BCSI. The term "continuous lateral bracing (CLB)" has been replaced with the term "continuous lateral restraint (CLR)" in the updated standard. This change coordinates with language used in the current BCSI document jointly produced by TPI and WTCA. *TPI 1-2007* also lists BCSI as one of the methods to provide permanent individual truss member restraint/bracing. This will allow Truss Designers and Truss Design Engineers to reference BCSI on the Truss Design Drawing when determined to be appropriate.

There are also additions to the information that must be contained on the Truss Design Drawing (TDD) such as the applicable building code(s), number of plies, creep factor, and the fabrication tolerance instead of the quality control factor (C_q). The fabrication tolerance is a new addition to the *TPI 1-2007* and directly relates to the quality control factor (C_q). It is expressed as a percentage and its value is determined by the following formula; 1 minus C_q. Reaction forces that are listed on the TDD must be the maximum forces generated by the various load cases reviewed. Additionally, *TPI 1-2007* now uses language that is consistent with the 2006 IBC.

Chapter 3: Quality Criteria for the Manufacture of Metal Plate Connected Wood Trusses

Per an article in the December 2006 issue of SBC magazine (*TPI 1-2007* Changes: Improving the In-Plant Quality Control Standard), revisions to *TPI 1-2007* provide "...manufacturers with more efficient quality checks, leading to greater confidence in their production lines and products."

TPI 1-2007 PROJECT COMMITTEE MEMBERS

- **Chairman:** David Brakeman, ITW Building Components Group, Inc.
- Colin Bailey, Bailey and Son Engineering
- Larry Beineke, PFS Corporation
- James R. Brown, Engineering Consultants, Inc.
- Steve Cabler, MiTek Industries, Inc.
- Thomas E. Caton, US CPSC
- Kevin Cheung, Western Wood Products Association
- Scott Coffman, Builders FirstSource
- Steven Cramer, University of Wisconsin-Madison
- Brad Crane, SCA Consulting Engineers
- Scott Douglas, NCSEA - National Council of Structural Engineers Association
- Johnny Drozdek, Keymark Engineering
- Patrick Edwards, Timber Products Inspection
- Rich Edwards, USP Structural Connectors
- John G. Ernst, Wade Trim, Inc.
- Charles Goehring, Truss Plate Institute
- Samuel A. Greenberg, Dansco Engineering, LLC
- John Gruber, Sheppard Engineering, PC
- Kirk Grundahl, Qualtim, Inc.
- Joe Heinsman, Stock Building Supply, Inc.
- Art Hernandez, Eagle Metal Products
- David Horne, Universal Forest Products
- Paul Johnson, Universal Forest Products
- David Johnston, CompuTrus, Inc.
- Michael Kelly, Letherer Truss, Inc.
- Steve A. Kennedy, Lumber Specialties Ltd.
- Ted Kolanko, 84 Lumber/84 Components
- Stuart Lewis, ITW Building Components Group, Inc.
- Michael Magid, Robbins Engineering, Inc.
- Joseph Michels, Brunsell Lumber & Millwork
- Tim Murphy, Simpson Strong-Tie Co.
- David Nelson, Weyerhaeuser Company
- Michael O'Reardon, ICC Evaluation Service
- Timothy W. Ott, Callahan Associates, Inc.
- Timothy Riegel, Rigidply Rafters, Inc.
- Christopher Rizer, Stock Building Supply
- Donald Scott, ITW Building Components Group, Inc.
- Stan Sias, LMC - Lumbermens Merchandising Corp.
- Marvin Strzyzewski, MiTek Industries, Inc.
- Jim Vogt, WTCA
- David Weaver, Nederveld Associates, Inc.
- David Wert, MiTek Industries, Inc.
- Larry Wilder, Cherokee Metal Products, Inc.
- Frank Woeste, Virginia Tech University

Table 1. ANSI/TPI 1-2007 Project Committee Members

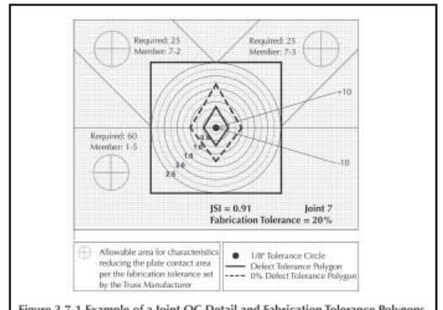

Figure 3.7-1 Example of a Joint QC Detail and Fabrication Tolerance Polygons.

Figure 3-7.1 from *TPI 1-2007*

Refer to the previous article for more detail on the changes in Chapter 3. Highlights of the Chapter 3 changes are as follows:

- **In-Plant QC manual:** More explicit requirements have been stated to help document and communicate that the particular QC requirements are known by all involved in the process.
- **Fabrication Tolerances:** As mentioned under Chapter 2 above, fabrication tolerances correlate to the quality control factor (C_q) as defined in Chapter 6 of the *TPI 1-2007*. This factor allows manufactures to dial in the fabrication tolerances they choose to operate their production under.
- **Plate Placement:** *TPI 1-2007* now has revised requirements for Joint QC details. Two fabrication tolerance polygons will now be shown. One depicting the mid-point placement of the plate incorporating the allowable defects and another polygon depicting the mid-point placement of the plate with 0% defects which will make the inspection process easier. Additionally, the new Joint QC details will list the required teeth if you need to count them (see Figure 3-7.1 from *TPI 1-2007* below).
- **Revised JSI:** The Joint Stress Index (JSI) has been revised to make it easier to understand and implement.
- **Alternate inspection methods** documented in an in-plant QC manual are also permitted to provide manufacturers with the flexibility to gear their quality control to the unique characteristics of their operations and to generate specific management information systems for benchmarking performance.

Chapter 5: Performance Evaluation of Metal Connector Plated Connections

As with former editions of *TPI 1, TPI 1-2007* still contains three test procedures:

- Testing for lateral restraint,
- Testing for shear strength, and
- Testing tensile strength.

Continued on page 30

Continued from page 29

Slight adjustments to language in this chapter have been made:

- When creating test joint specimens, the specific gravity, moisture content, and moisture adjustments of the wood members that are parallel to the load are no longer required in joints at the AE orientation (load perpendicular to grain, connector plate length parallel to load) and EE orientation (load perpendicular to grain, connector plate length perpendicular to load). This is because the wood members parallel to the load in these two tests are not the ones being tested.
- Alternatives to the given Net Area Method end distance of 1/2" and edge distance of 1/4" are now recognized in *TPI 1-2007*.
- The testing procedure for solid metal control specimens has also been modified. The specified (versus measured) coating thickness is now permitted to be used to determine the uncoated steel thickness from measurements of coated steel thickness. Also, the dimensional measurements of the solid metal control specimens' thickness are specified to 0.0001".

Ladder Frame: Short wall fabricated in the factory containing a top plate, a series of vertical members spaced 24 in. (61 cm) on center or less, and a sole plate, also known as knee wall or cripple wall.

Chapter 6: Materials & General Design Considerations

Installation tolerances have been removed from *TPI 1-2007* since they are not related to design and are addressed appropriately in BCSI. Loading conditions previously located in Chapter 2 have been relocated to Chapter 6 in this 2007 edition. The IBC now states attic live loads (other than floor live loads) that are applied to the entire length of the bottom chord are not required to be applied concurrently with other live loads. As a result, the attic live load section of *TPI 1-2007* now references the building code for specifics.

There are also some changes to the various adjustment factors used in sawn lumber.

- The repetitive member factor (C_r) increase of ten percent is now permitted to be applied to E_{min} in addition to F_c and F_t.
- The flat use factor (C_{fu}) is only applied to F_b of solid sawn lumber.
- A bending capacity modification factor (K_m) has been introduced in *TPI 1-2007* for solid sawn lumber to incorporate adjustments for lengths, load distribution, and joint location that could provide up to a 30 percent increase in F_b for some compression chords.
- The use of structural composite lumber in trusses now has specific limitations and provisions outlined in *TPI 1-2007.*

The quality control factor (C_q) is an adjustment factor pertaining to quality in the manufacture of metal plate connected wood trusses. The C_q basis changed from a maximum value of 1.25 in *TPI 1-2002* to a maximum value of 1.00 in *TPI 1-2007*. In other words, a 20 percent reduction in plate lateral resistance values with *TPI 1-2002* suggested C_q = 1.00 for 2x_ trusses is now obtained if C_q = 0.80. Recall that the fabrication tolerance that is listed on the TDD (see Chapter 2) relates to the quality control factor.

Another change in Chapter 6 is clarification with respect to ladder frames (see definition above). Building code officials have required certification for ladder frames because metal connector plates are used to fasten the vertical "stud" members to the chords. Additionally, repair drawings have been required in some instances for cutting and notching of ladder frames whereas standard building code language is accepted for conventional wall frame cutting and notching. Provisions have been added to *TPI 1-2007* to clarify ladder frame design and to indicate that "...cutting and notching of members shall be permitted within the requirements detailed in the building code for wall members."

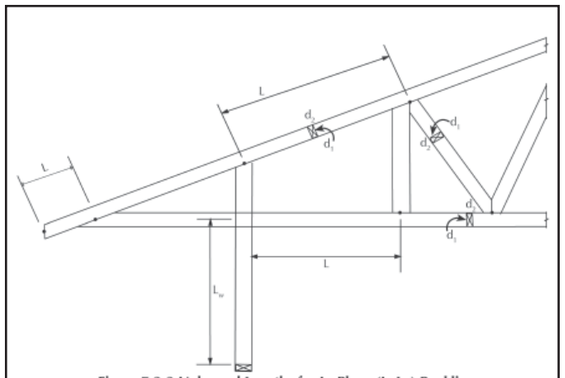

Figure 7.2-3 Unbraced Lengths for In-Plane (L, L_u) Buckling, Members Subject to Sidesway.

Figure 7.2-3 from *TPI 1-2007*

Chapter 7: Member Design Procedures

TPI 1-2007 now addresses chord member panels subject to sidesway. Sidesway is defined as a condition when the top of a column is relatively free to displace laterally with respect to the bottom of the column and its lateral displacement is resisted primarily by the flexural rigidity of the column. The opposite condition (without sidesway) occurs when the ends of the column are prevented from moving relative to each other by a much stiffer restraint, such as a trussed frame (where openings between members consist solely of triangles) connected to both ends of the compression member, or other structure. These requirements were added so that conditions such as framed down leg members are designed properly (see Figure 7.2-3 from *TPI 1-2007* above).

Truss designs that have compression webs are now restricted to a maximum of two continuous lateral restraints (CLR) and strongback attachment to trusses has also been modified from 16d common to 10d nails to reflect common and acceptable practice on the jobsite.

Continued on page 32

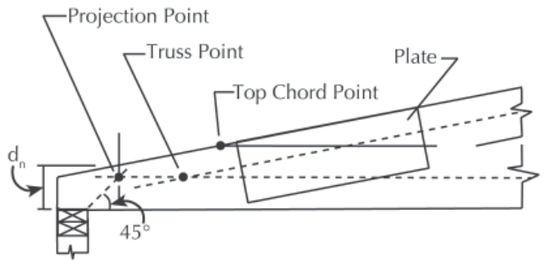

Figure 7.3-2 Depth for Shear Check of Tapered Bottom Chord Heel.

Figure 7.3-2 from *TPI 1-2007*

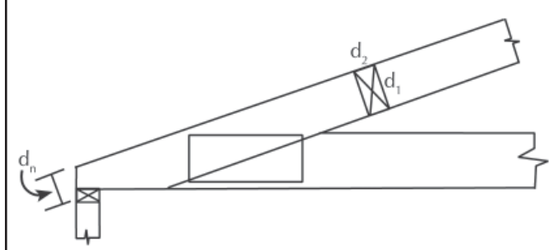

Figure 7.3-3 Depth for Shear Check of Scarf Cut Bearing.

Figure 7.3-3 from *TPI 1-2007*

New & Improved: ANSI/TPI 1-2007

Continued from page 30

Length over depth (L'/d) ratios have changed as well. An exception to the maximum L'/d ratios for compression and tension members was added to *TPI 1-2007* to permit exceeding the given ratios when design calculations are performed to account for the interaction of axial compression with initial deformation of compression members due to warp or other causes. The maximum L'/d ratio of 50 for compression members was modified to apply only to "long-term" compression members. This edition no longer explicitly assigns a maximum L'/d ratio limit for tension members not subject to reversal of stress, or tension members subject to reversal of stress from short-term gravity loads.

TPI 1-2007 has also added coordinated language with other design standards into the 2007 edition. Similar to what is currently required by the Truss Plate Institute of Canada in TPIC-2007, wood shear design provisions for tapered bottom chord heels have been added (see Figure 7.3-2 from *TPI 1-2007* above). Scarf-cut bearings supported at the outside end of the scarf cut must now be checked for tension perpendicular to grain fracture at the inside edge of the bearing using the National Design Standard (NDS®) for Wood Construction shear in joints provisions (see Figure 7.3-3 from *TPI 1-2007*). The bearing perpendicular to grain design requirements has been slightly modified in *TPI 1-2007* as well.

A new requirement for a rigid insert (e.g., 20 gauge metal insert) on parallel to grain bearing surfaces with high compression stresses must be illustrated and specified on the TDD. With an exception, bearings are also now specified to be at least 1.5" in length if on wood or metal supports and 3" in length if on concrete or masonry supports. Finally, Chapter 7 includes some modifications to ply-to-ply connections and total deflection calculations.

Chapter 8: Metal Connector Plate Joint Design

The equation to determine the minimum required metal connector plate contact area for lateral resistance has been modified to no longer require a 20 percent reduction which matches the changes to the quality control factor (C_q) in Chapter 6.

TPI 1-2007 has added a provision requiring connector plates to be designed for moments when the joints are modeled as pinned if the plate cross-section is eccentric to the chord centerline. How connector plates are designed for moments was changed as well. The moment capacity equation was updated per recent TPI Technical Advisory Committee (TAC) research. The equation now recognizes the effects of plate positioning, compression forces on the joint, and the interaction of axial compression and transverse deflection on the moment (P-delta effect) for mid-panel splices.

The mandatory net section lumber limit on tension introduced into a wood member that was set at 1600 pounds/inch in *TPI 1-2002* was removed and replaced in *TPI 1-2007* by a non-mandatory user note recommending a higher limit set at 2300 pounds/inch. Also, the new limit only applies at locations where the wood member ends under or within 1' of the truss plate edge.

Conclusion

The above information provides those working in the metal plate connected wood truss industry a summary of the new information contained in the upcoming *TPI 1-2007* design standard. The changes that have been made to *TPI 1* will make for a more user-friendly document and also allow the *TPI 1* standard to keep up with the evolution of the metal plate connected wood truss industry. The printed standard and its commentary will be available to order from TPI within the next month or two. SBC

Truss Plate Institute (TPI) was organized in 1961 to maintain the wood truss industry on a sound engineering basis. Its members are engaged in the production of metal connector plates for the wood truss industry, and individuals or firms engaged in related activities. To accomplish its purpose, TPI establishes methods of design and construction for wood trusses using metal connector plates through their ANSI accredited TPI 1 standard, supports and disseminates test and research data, assists in the development of proper building code regulations, recommends quality control standards, and distributes information on the use of metal plate connected wood trusses in the interest of public safety. Visit www.tpinst.org for more information.

STRUCTURAL BUILDING COMPONENTS™

THE FUTURE OF FRAMING

www.sbcmag.info

Dear Reader:

The mission of ***Structural Building Components Magazine (SBC)*** is to increase the knowledge of and to promote the common interests of those engaged in manufacturing and distributing of structural building components to ensure growth and continuity, and to be the information conduit by staying abreast of leading-edge issues. SBC will take a leadership role on behalf of the component industry in disseminating technical and marketplace information, and will maintain advisory committees consisting of the most knowledgeable professionals in the industry. The opinions expressed in SBC are those of the authors and those quoted solely, and are not necessarily the opinions of any affiliated association (WTCA) .

Truss Publications, Inc.

6300 Enterprise Lane • Suite 200 • Madison, WI 53719
608/310-6706 phone • 608/271-7006 fax
www.sbcmag.info • admgr@sbcmag.info